**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Parts 400, 401, 404, 405, 406, 413, 415, 431, 433, and 435**

**[Docket No. FAA–1999–5535; Notice No. 99–04]**

**RIN 2120–AG71**

# Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Notice of proposed rulemaking (NPRM).

**SUMMARY:** The FAA proposes to amend the commercial space transportation licensing regulations by establishing operational requirements for launches of reusable launch vehicles (RLVs) and the authorized conduct of commercial space reentry activities. The proposed rule would respond to advancements in the development of commercial RLV and reentry capability and enactment of legislation extending the FAA's licensing authority to reentry activities. The agency is proposing requirements that limit risk to the public from RLV and reentry operations and seeks public comment on appropriate measures to carry out its licensing and safety responsibilities.

**DATES:** Comments must be received on or before July 20, 1999.

**ADDRESSES:** Comments on this document should be mailed or delivered, in duplicate, to: U.S. Department of Transportation Dockets, Docket No. FAA–1999–5535, 400 Seventh Street SW., Room Plaza 401, Washington, DC 20590. Comments also may be sent electronically to the following Internet address: 9–NPRM–CMTS@faa.gov. Comments may be filed and examined in Room Plaza 401 between 10 a.m. and 5 p.m. weekdays, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Mr. Stewart W. Jackson, AST–100, Space Systems Development Division, Office of the Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, U.S. Department of Transportation, 800 Independence Avenue SW., Washington, DC 20591, (202) 267–7903; or Ms. Esta M. Rosenberg, Attorney-Advisor, Regulations Division, Office of the Chief Counsel, Federal Aviation Administration, U.S. Department of Transportation, (202) 366–9320.

## Comments Invited

Interested persons are invited to participate in the making of the proposed action by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this document also are invited. Substantive comments should be accompanied by cost estimates. Comments must identify the regulatory docket or notice number and be submitted in duplicate to the DOT Rules Docket address specified above.

All comments received, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking, will be filed in the docket. The docket is available for public inspection before and after the comment closing date.

All comments received on or before the closing date will be considered by the Administrator before taking action on this proposed rulemaking. Comments filed late will be considered to the extent possible without incurring expense or delay. The proposals in this document may be changed in light of the comments received.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this document must include a pre-addressed, stamped postcard with those comments on which the following statement is made: ''Comments to Docket No. FAA–1999–5535.'' The postcard will be date stamped and mailed to the commenter.

## Availability of NPRMs

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the FedWorld electronic bulletin board service (telephone (703) 321–3339) or the Government Printing Office's electronic bulletin board service (telephone (202) 512–1661).

Internet users may reach the FAA's web page at http://www.faa.gov/avr/arm/nprm/nprm.htm or the Government Printing Office's web page at http://www.access.gpo.gov/nara for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680. Communications must identify the notice number or docket number of this NPRM.

Persons interested in being placed on the mailing list for future NPRMs should request from the above office a copy of Advisory Circular No. 11–2A, Notice of Proposed Rulemaking Distribution System, that describes the application procedure.

**SUPPLEMENTARY INFORMATION:**

## Background

*General*

The Commercial Space Act of 1998 (CSA), Public Law 105–303, extends the licensing authority of the Secretary of Transportation under 49 U.S.C. Subtitle IX, chapter 701 (known as the Commercial Space Launch Act or CSLA), to reentry vehicle operators and the operation of reentry sites by a commercial or non-Federal entity. Under the CSA, the Secretary is authorized to license reentry of a reentry vehicle, including reusable launch vehicles, and the operation of reentry sites when those activities are conducted within the United States or by U.S. citizens abroad. The Secretary is charged with exercising licensing authority protection of public health and safety and the safety of property as well as consistency with U.S. national security and foreign policy interests, and treaty obligations entered into by the United States. By delegation of authority, the Administrator of the Federal Aviation Administration is responsible for carrying out the Secretary's licensing and safety mandate with respect to commercial space transportation and the Administrator has, in turn, delegated regulatory and related authority to the Associate Administrator for Commercial Space Transportation (AST).

Amendment of the CSLA responds to development of reentry capability and reusable launch vehicle technology by the commercial space industry. Market forecasts of launch demand and international launch competition are driving industry to invest in means of accomplishing lower cost and more efficient access to space and specifically to low earth orbit. Reusable, or partially reusable vehicles that are capable of payload delivery and return to Earth for reflight are considered by many in industry as integral to reducing launch costs. For years, expendable launch vehicles (ELVs) have successfully provided commercial payload delivery services; however, the ability to survive the rigors of launch and the prospect of multiple missions per vehicle may dramatically lower price-per-pound-to-orbit launch costs. Growing interest in the ability to provide reliable round-trip space-route services, such as satellite

retrieval, package delivery, and ultimately space tourism, is attracting investment in a new class of space launch vehicle that can provide orbital launch and reentry services.

A reusable launch vehicle, or RLV, differs from an expendable launch vehicle in that the vehicle, or a significant portion of it, would be designed to survive launch and reentry from space and maintain functional integrity. Proponents of reusable launch technology envision rapid reconditioning and turn-around time to maximize efficiency and profitability.

Reusable launch vehicles are one form of reentry capability that would be subject to FAA licensing and safety requirements under the Commercial Space Act of 1998. Any vehicle, reusable or not, that is designed and operated such that it would intentionally return to Earth from Earth orbit or outer space, substantially intact, would require an FAA license. A person who offers use of a designated site for purposes of containing landing impacts would also be subject to FAA licensing to assure public safety is maintained if that person is a citizen of the United States or if the reentry site is in the United States.

Launch vehicle survivability poses unique issues for the FAA in carrying out its safety mandate. Except for the U.S. Space Transportation System (STS) which transports the space shuttle, only ELVs are launched from the United States and the vast majority of ELV launches have been from federally owned and operated launch sites, such as Cape Canaveral Air Station (CCAS) or Vandenberg Air Force Base (VAFB). ELVs having an orbital delivery capability are generally launched over unpopulated ocean areas so that debris generated from a vehicle failure would impact the Earth away from population. Risk to public safety is assessed by Federal ranges and launches proceed from Federal sites only if public risk is contained at an acceptable level. ELVs rely upon flight termination systems (FTS) that assure safe flight by destroying a vehicle if it is traveling beyond pre-approved boundaries so as to endanger the public. The boundaries, or impact limit lines, are drawn in advance of a launch and ensure that vehicle debris is confined within an unpopulated area in the event of vehicle failure or FTS activation.

In contrast, RLVs would be designed for recovery and reuse. Therefore, launch safety, for the most part, may be assured through non-destructive means of terminating flight. In the event of a malfunction, an RLV may be able to return to its launch site or fly to an alternative landing site where the problem can be corrected and flight attempted again. Or, in another scenario, thrust termination combined with a soft or slowed landing may allow a vehicle operator to recover its vehicle for reconditioning and reuse. If a landing can be accomplished safely in terms of public risk, the operator would prefer it to total loss of the vehicle, and may purposely select an in-land site for the conduct of an RLV launch rather than risk launching over water where recovery would be difficult and costly.

Return to Earth of a substantially intact vehicle also presents safety issues for the FAA. Although spent vehicle stages return to Earth periodically, as does other space debris, 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. Reentry vehicles would be designed and controlled to the extent necessary to avoid burning up upon entry into the Earth's atmosphere and the FAA's safety program must ensure that they impact Earth in a manner that does not jeopardize public health and safety or the safety of property. Until accuracy and reliability of a vehicle's performance can be demonstrated through rigorous testing and numerous flights, other risk mitigation measures may be necessary to limit risks to the public from an off-site landing, explosion or release of toxic substances.

The proposed rules would establish general performance-based standards for the launch of an RLV from any launch site and requirements applicable to commercial reentry activities. The approach proposed by the FAA in this notice is intended to provide the emerging commercial space transportation industry with the requisite flexibility to develop commercially feasible reentry and reusable launch vehicle systems whose operation would not jeopardize public safety.

*Reentry Vehicles and Reusable Launch Vehicle Proposals*

Extension of the FAA's licensing authority to cover reentry operations responds to the development of RLV technology by a number of commercial entities that have begun to develop and test RLV concepts. Not all test operations require FAA launch and reentry licensing and may be covered by other agency authority. A number of RLV technology developers have begun preliminary consultations with the FAA to ascertain the nature and extent of FAA safety requirements and authorization needed for flight of their vehicles and the FAA encourages early discussion between the agency and aerospace companies to avoid regulatory obstacles down the road that may delay operations.

The proposed rules would apply to both commercial reentry vehicle and RLV activities. Not all RLVs are reentry vehicles, and all reentry vehicles are not RLVs. A reentry vehicle is defined by the Commercial Space Act of 1998 to mean ''a vehicle designed to return from Earth orbit or outer space to Earth, or a reusable launch vehicle designed to return from outer space to Earth, substantially intact.'' Pub. L. 105–303, Section 102(a)(3). Therefore, an RLV is a reentry vehicle under specific conditions of design and operation. Similarly, ''reentry'' is defined to mean ''to return or attempt to return, purposefully, a reentry vehicle and its payload, if any, from Earth orbit or from outer space to Earth.'' Pub. L. 105–303, Section 102(a)(3).

An RLV is a launch vehicle designed to be launched more than once; however its return to Earth would be licensable as a reentry only if the vehicle achieves Earth orbit or outer space. Some RLVs are designed to operate in a suborbital fashion in that they do not enter Earth orbit. Others achieve Earth orbit and remain on orbit anywhere from one orbital revolution to several days prior to initiating reentry, depending on the nature of the mission. Some vehicle concepts employ a fully reusable vehicle that carries the payload to orbit and returns to Earth with the entire vehicle intact. This category of RLV includes single-stage-to-orbit (SSTO) vehicles, such as the VentureStar vehicle planned by Lockheed Martin Corporation (Lockheed Martin) and Rotary Rocket's Roton vehicle. For some, only certain stages, or portions, of the vehicle are designed to reenter . For example, Kistler Aerospace Corporation's (Kistler) K–1 vehicle relies upon a two-stage-to-orbit concept in which both the orbital vehicle and booster vehicle return to Earth for reuse; however only the orbital vehicle would qualify as a reentry vehicle under the statutory definition. An RLV also may be designed with one or more stages that are fully reusable and with other stages that are either partially reusable or even expendable. There are also airborne launch systems under development, such as that proposed by Kelly Aerospace, involving RLV and reentry operations.

Further complicating the development of regulations for commercial space transportation activities is the variety of take-off and landing concepts that have been proposed. These concepts include

vertical launch from conventional launch pads, horizontal take-off from conventional runways, and airborne release using tow or air-drop configurations. Also included are vertical landing, horizontal landing, and a variety of ''soft'' landing concepts, such as parachutes, airbags, parafoils, rotors, water landings, or aerial recovery.

The FAA does not want to constrain the development of emerging technology as operators seek effective and efficient methods of operation. Therefore, the regulatory requirements proposed by the FAA are not, generally speaking, based on type or design of a reentry vehicle or RLV, nor is the FAA proposing to certificate vehicle design. Rather, the FAA is proposing to examine closely those critical systems whose performance or reliability can affect public safety. Except for certain restrictions deemed critical to assuring public safety, the FAA proposes to employ a system safety engineering approach that effectively allows an operator to design its own operational restrictions and performance envelope within permissible risk thresholds established by the agency consistent with safety mandate. Limits and conditions on a licensee's RLV launch and reentry vehicle operations would be determined through the system safety process and risk assessments performed by a license applicant. The FAA envisions that future use of RLV operations may include passenger transport, in addition to cargo transport, to and from space. This notice is not intended to address these issues. Future rulemakings will address crew and passenger safety and other issues.

**History of U.S. Commercial Reentry Capability**

*COMET/METEOR Program*

A number of the safety principles reflected in this proposal originate with the experience gained by the Department's Office of Commercial Space Transportation (OCST), the predecessor organization to AST, in evaluating the COMET (Commercial Experiment Transporter) Program and, later, the METEOR (Multiple Experiment to Earth Orbit and Return) Program.

The COMET Program began as a commercial program administered through National Aeronautics and Space Administration (NASA)'s Centers for the Commercial Development of Space (CCDS). COMET was intended to provide the services of a reentry vehicle system to carry and return to Earth experimental payloads. Three reentry missions were originally planned, with an option for two additional missions. The reentry vehicle system was comprised of a service module, manufactured by Westinghouse Electric Corporation, and a capsule-shaped reentry vehicle, manufactured by Space Industries, Inc. Both companies were under contract with NASA's CCDS. The program was intended to demonstrate the capability of a low cost, medium-term (30-day) platform in space for the conduct and return to Earth of microgravity experiments. The COMET Program and the agency's approach to authorizing its activity is fully described in several **Federal Register** Notices . (*See* 57 FR 10213, March 24, 1992; 57 FR 55021, November 23, 1992; and 60 FR 39476, August 2, 1995.) EER Systems Corporation (EER), also under contract to the CCDS, was responsible for launching the COMET reentry vehicle system into space using a Conestoga expendable launch vehicle.

Upon command from Earth, the COMET would separate into two components and the reentry vehicle portion (Freeflyer), designed and operated by Space Industries, Inc., would reenter the Earth's atmosphere targeting a designated landing site on earth where experiments could be recovered. Because of funding problems the COMET Program was terminated and subsequently resurrected under a contract between NASA and Systems, Inc., which became responsible for both launch and reentry operations. Flight capability of the reentry vehicle system, renamed METEOR, was never demonstrated, however, because of the Conestoga launch failure which destroyed the METEOR system shortly after lift-off.

The agency's initial approach to the COMET Program was to license the reentry event separately from the launch event under existing launch licensing authority. The determination to issue a separate license for return to Earth of the reentry vehicle was based, in large measure, on the fact that the reentry vehicle operator was a different entity than the launch operator, and that responsibility over the subsequent reentry (30 days following completion of the launch) ought not be imposed regulatorily on the launch operator, whose responsibility for launch safety would terminate after delivery of COMET to orbit and upon safing of the Conestoga expendable launch vehicle upper stage. Also, under typical circumstances, the launch provider's obligations to its customer would end upon successful deployment of the payload or cargo, in this case the COMET reentry vehicle system. By letter from the Chairman of the House Subcommittee on Space to the Director of OCST, the Department was advised that it did not have explicit licensing authority over payloads but that it should continue its safety review of reentry vehicle operations associated with the Launch. In the letter, dated September 2, 1992, the House Subcommittee Chairman indicated that the Committee would seek legislation to address commercial reentry vehicle licensing issues, including indemnification and liability. OCST continued its evaluation of the COMET reentry vehicle system, and then METEOR, under its authority to evaluate missions and payloads not otherwise licensed by the Federal government, for purposes of assuring whether the launch of the COMET payload would jeopardize public health and safety or safety of property.

The Commercial Space Act of 1998, Pub. L. 105–303, provides reentry licensing authority to the Department and imposes the financial responsibility and risk allocation provisions of 49 U.S.C. 70112 and 70113 on licensed reentries. (Financial responsibility issues associated with licensed reentry activities are discussed in a separate rulemaking.)

COMET/METEOR Safety Approval

The COMET Program safety review evaluated safety aspects of the reentry vehicle system when operated in accordance with certain operating limits. The review encompassed vehicle design, engineering analyses, testing, manufacturing, and integration. A vehicle safety evaluation determined the performance capabilities and limitations of the integrated reentry vehicle system. OCST did not dictate the methodology to be used by the applicant in performing the hazard and risk assessment required for vehicle safety approval; however, the applicant had to address engineering and safety analyses, component and system tests and checkouts, quality assurance procedures, manufacturing processes, and test plans and results. A separate operations review evaluated the operator's ability to carry out the reentry operation in a safe manner consistent with the capability and limitations of the reentry vehicle system. Vehicle safety and operations approvals issued by OCST were limited to the design and operating limits presented in the respective applications. Any subsequent changes would require an amendment of the application and further review and approval by the agency.

For further assurance of public safety, OCST determined it prudent to conduct

independent evaluations of the reliability, design performance, and operation of the COMET reentry vehicle system in addition to assessing the data submitted by Space Industries, Inc., and later by EER, to support the application for vehicle safety approval. These independent evaluations were designed to serve as a means of ensuring all hazards had been identified and the applicant had adequately addressed all potential risks. The evaluation also provided technical verification of the applicant's analysis of the reliability of the reentry vehicle system.

COMET/METEOR Safety Approval Criteria

The COMET Program was the first commercial reentry operation that proposed to land a reentry vehicle in the United States. The designated landing site for the reentry vehicle was the Utah Test and Training Range, a Federal facility located in a sparsely populated area.

In fulfilling its statutory mandate to protect public safety, OCST selected three criteria against which the reentry vehicle system would be evaluated. The evaluation criteria were performance-based rather than design standards to afford the COMET Program participants maximum flexibility in developing a safe and cost-effective product. As a general matter, performance-based standards also further the public interest by encouraging innovation and technology development. The three criteria developed by OCST to evaluate the COMET Program reentry vehicle system were as follows:

1. The probability of the Reentry Vehicle (RV) landing outside the designated landing site shall not be greater than 3 in 1,000 missions.

2. The additional risks to the public in the immediate vicinity of the landing site (that is, the area within 100 miles of the designated landing site) shall not exceed the normal background risks to which those individuals ordinarily would be exposed but for the reentry missions. Normal background risk is characterized as: the probability of any casualty occurring within the 100-mile zone shall not exceed one in a million on an annual basis. In addition, the probability of any casualty occurring within the zone shall not exceed one in a million for a single mission.

3. The additional risks to the general public beyond the 100-mile zone around the designed landing site, and to property on orbit, shall not exceed normal background risks to which the public ordinarily would be exposed but for the reentry missions. This normal background risk is characterized as: the probability of any casualty occurring shall not exceed one in a million on an annual basis. In addition, the probability of any casualty occurring in the area that is both outside the designated landing site and the 100-mile zone around the site shall not exceed one in a million for a single mission.

The three criteria, established an acceptable level of risk that conservatively, did not exceed the normal background risk of individuals affected by the activity. The criteria were published in the **Federal Register** on March 24, 1992 (57 FR 10213).

As explained in the March 24, 1992 Notice, the first criterion was directed at ensuring vehicle reliability and accuracy within a controlled area. The second criterion was intended to ensure that as a result of nominal operations, or in the event of a system error or deviation from planned trajectory of the vehicle, persons living within the vicinity of the landing site were not exposed to greater than the normal background risk that is accepted by the public in daily activities. The third criterion would limit public risk to normal background risk even if a major system failure resulted in an essentially random reentry; however, flight path, design, and limited cross-range capability of the vehicle made it possible to define the potential ''footprint'' in which a random reentry could occur.

Believing that it could not satisfy the first criterion in the absence of flight performance history, Space Industries, Inc. petitioned for relief from the accuracy and reliability criterion. The program was discontinued in May 1994, before official action could be taken on the waiver request. Approximately one year later, NASA restarted the program, renamed METEOR by EER, which took over responsibility for development and operation of the reentry vehicle system in addition to launch of the METEOR, on its Conestoga launch vehicle. However, unlike the COMET Program, NASA contracted for reentry services and designated an area in the Atlantic Ocean, off the coast of Virginia, for the program's initial reentry attempt. Changing the landing site from Utah to the Atlantic Ocean significantly reduced the public's exposure to risk if the vehicle were to land off-site as a result of a system failure. While analysis showed that the properly operating reentry vehicle would land within the designated landing area in 997 out of 1,000 nominal cases, Systems Corporation argued that it could not demonstrate that the vehicle met the criterion in non-nominal cases. Non-nominal cases were those that considered the probability of failure of certain safety critical systems and the resultant errors in the landing location. Therefore, EER pursued the requested relief from the accuracy and reliability criterion.

OCST granted the requested waiver for the following reasons: OCST determined that the three criteria were designed to collectively ensure public safety, meaning that satisfaction of the second and third criteria would compensate if the ability of the reentry vehicle system to meet the accuracy and reliability criterion was marginal. OCST analyzed failure scenarios and determined that there were circumstances in which intentional reentry of the METEOR reentry vehicle could occur and public safety would be assured without the demonstrated level of accuracy required under the first criterion. Those circumstances were as follows: (i) if there were well-defined areas within which the vehicle was most likely to land if it missed the designated landing site, and the risk to the population within those areas fell within acceptable limits; (ii) if the condition of the vehicle following an errant reentry presented little risk to exposed populations because it would not survive reentry or because of its small size and mass and the absence of hazardous materials on the vehicle; and (iii) if risk mitigation measures could be implemented to limit public safety risk to acceptable levels. Because all of these circumstances were found to exist, and because criteria two and three were satisfied, OCST concluded that public safety and U.S. national interests would not be jeopardized if criterion one were not satisfied for non-nominal cases. A waiver of the accuracy and reliability criterion was therefore granted for the METEOR Program's first reentry. However, as a condition of the waiver, OCST required that the operator implement a public information communications plan under which the affected public would be informed of the reentry activity, including its estimated time and location. The operator also was required to have an emergency response plan whereby local officials would be notified in the event of an off-site landing.

The launch vehicle failed shortly after lift-off during first stage powered ascent and the vehicle and payload were destroyed. No subsequent application for a launch license or payload determination has been made under the COMET/METEOR Program and, as yet, no formal application has been submitted to the FAA to reenter a reentry vehicle.

*Lessons Learned From COMET/METEOR Safety Approval Criteria*

The FAA concludes that a collective approach of using a number of safety standards, in combination, to limit risk is in the public interest. Accordingly, the FAA is proposing a three-prong interrelated approach to achieving safe reentry operations, in addition to requiring certain organizational safeguards derived from the government's experience in managing safe launch operations. First, the performance hazards and risks to public safety presented by a reentry vehicle proposal would be identified through a system safety process that defines the safe operating envelope for a particular reentry vehicle, much like the vehicle safety approval process utilized for evaluating the COMET reentry vehicle system. Second, an applicant for a reentry license would be required to satisfy a collective risk criteria, referred to as $E_c$. Third, as in COMET, the FAA is proposing certain risk mitigation measures that must be followed even if other standards are satisfied. These measures take the form of operational restrictions and are described below.

The FAA proposes that the reentry site must be sufficiently large so as to encompass the three-sigma footprint of the vehicle, as explained in greater detail in a subsequent section elsewhere in this notice under supplementary information. This articulation of the landing site accuracy standard effectively limits the risk of an off-site landing but does so in a way that is more readily demonstrable by an applicant, as it relates only to nominal performance of the vehicle and its systems.

**General Approach to Reusable Launch Vehicle and Reentry Licensing**

*Purposeful Reentry From Earth Orbit or Outer Space*

Prior to enactment of the Commercial Space Act of 1998 (CSA), FAA licensing authority over launch vehicle flight was limited to launches of launch vehicles, defined to mean to place or try to place a launch vehicle and any payload in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space. 49 U.S.C. 70102(3). A ''launch vehicle'' is defined in 49 U.S.C. 70102 to mean a vehicle built to operate in, or place a payload in, outer space, and a suborbital rocket. 49 U.S.C. 70102(7).

Recent amendment of 49 U.S.C. Subtitle IX, chapter 701, grants to the agency explicit licensing authority over reentry operations. ''Reentry,'' an event that must be authorized by the FAA, means the ''return or attempt to return, purposefully, [of] a reentry vehicle and its payload, if any, from Earth orbit or from outer space to Earth.'' 49 U.S.C. 70102(10). Two elements must be satisfied for an event to qualify as a ''reentry'' subject to FAA licensing jurisdiction. First, the vehicle (an undefined term) that is being returned to Earth must qualify as a ''reentry vehicle'' under the statutory definition. That is, not only must its reentry originate from Earth orbit or outer space, but the vehicle must be designed to reenter and land on Earth in substantially intact condition. Second, deliberate intent to reenter, or the element of purposefulness, must exist. Absent these two elements, the unintended, though foreseeable, return to Earth of an object capable of surviving reentry is not an event that requires licensing by the FAA.

For example, the return to Earth in 1997 of a major part of a Delta II launch vehicle, a second stage tank, in substantially intact condition in a Texas field was foreseeable inasmuch as any object in orbit, and most immediately in low Earth orbit, will experience the effects of orbital decay over time and eventually reenter Earth atmosphere. Most such objects will burn up upon reentry into Earth atmosphere due to aerodynamic heating caused by atmospheric drag. The Delta II second stage tank is notorious because it failed to do so, however it would not require FAA licensing. The event illustrates that an object that is not intended to survive reentry substantially intact may in fact do so. The Delta II second stage is not a reentry vehicle under the statutory definition because it was not designed to survive reentry. However, even if it were a reentry vehicle, the event would not be subject to FAA licensing jurisdiction because there was never any deliberate intent by an operator to return the Delta II second stage to Earth, even though it was understood that the Delta stage, just like any other space object, would eventually reenter Earth atmosphere as a function of orbital decay.

Certain RLV launch concepts operate in a suborbital [1] fashion in that they do not achieve orbital velocity. However, until passage of the CSA, it remained doubtful (or at best unclear) as to whether Congress intended for the FAA to impose regulatory controls over the intact landing of such vehicles returning from outer space and whether financial responsibility and risk allocation requirements, specifically the so-called indemnification provisions of 49 U.S.C. 70113, would apply to their landing on Earth. The matter is now resolved by legislation and, to ensure consistency in its regulatory approach to assessing and limiting risk to public safety, the FAA considers a suborbitally operated RLV the same as other reentry vehicles that return from Earth orbit or outer space. From a safety and risk standpoint, the difference between a suborbital reentry and an orbital one is a distinction without a difference, in the agency's opinion, because both pose comparable risks to public safety as a result of launch or ascent of the vehicle and intact descent or reentry of the vehicle. To ensure consistent application of standards in evaluating ascent and descent risks presented by RLV proposals, the FAA has determined that the better approach is to regard a suborbitally operated RLV as the launch and reentry of a reentry vehicle, rather than as a suborbital launch of a launch vehicle. As explained in the next section of this supplementary information, because the FAA would evaluate the safety of the entire mission, regardless of whether one authorization (launch) or two (launch and reentry) are combined in a single instrument known as a license, consistency in the agency's approach to risk assessment is assured.

The FAA concludes that a suborbitally operated RLV that achieves outer space would satisfy the requisite element of purposefulness and would thus be subject to FAA reentry licensing authority, even though an intervening event of human control over vehicle operations is not required to return that vehicle to Earth. The term ''purposefully'' that appears in the definition of ''reenter'' and ''reentry'' is intended to include within the FAA's reentry licensing authority those vehicles whose return to Earth must be deliberately initiated by human or pre-programmed intervention, as well as those vehicles for which intentional reentry has been designed into the vehicle's capability without initiation of a reentry sequence, as is the case in a ballistic launch and reentry where there is no need to activate a reentry propulsion system. The term ''purposeful'' is, however, intended to eliminate from the scope of FAA licensing jurisdiction those spacecraft that are not designed to, but may, survive reentry into Earth atmosphere through application of natural deorbiting forces, such as orbital decay.

[1] The dictionary definition of the term ''suborbital'' means of or less than one orbit of the earth. A suborbital trajectory is a flight path that is not closed, whereas an orbit is a closed path. A suborbital trajectory may be ballistic, that is, acted on only by atmospheric drag and gravity, or it can be controlled by external forces and therefore maneuverable.

Where the operator's intent, as evidenced through vehicle design and operation, is to launch and deliberately return to Earth the RLV, and the vehicle is designed to return from outer space to Earth substantially intact, the return to Earth is licensable as a ''reentry.'' Thus, suborbitally operated RLVs that reach outer space are reentry vehicles whose reentry would be subject to FAA reentry licensing authority.

As previously indicated, not all RLVs will satisfy the statutory definition of the term ''reenter'' because they do not achieve Earth orbit or outer space. However, RLVs and reentry vehicles share the common operational characteristic of intact, targeted reentry and it is this operational characteristic that presents risks to public safety warranting regulatory oversight. It is also this operational characteristic that heightens the risk of U.S. Government international liability under the Outer Space Treaties and therefore warrants regulatory supervision by the United States to ensure that reentry activities are conducted in a manner consistent with international obligations of the United States.

Therefore, whether or not an RLV is also a reentry vehicle specifically subject to reentry licensing jurisdiction of the agency, the FAA is proposing a consistent measure of safety for ascent and descent flight phases of an RLV. The measure of safety would not vary on the basis of whether an RLV's flight and return to Earth meet the statutory definition of a ''reentry.'' In other words, the public should not be exposed to greater risk because a vehicle achieves Earth orbit or outer space, or is maneuvered in its return to Earth rather than returning through ballistic flight. However, where reentry must be deliberately initiated for de-orbit to occur, certain affirmative controls or safety standards, as described under a separate heading elsewhere in this supplementary information, would be imposed on the operator to ensure conditions for safe reentry are satisfied.

*Mission Risk Assessment*

For all RLVs and most reentry vehicles, the FAA proposes to approach safety on an overall mission basis. The FAA would evaluate the safety of the ascent and descent phases of an RLV mission and would not allow it to proceed unless the combined risk of the ascent and descent phases of the mission satisfies the agency's safety criteria. That criteria is: $E_c \leq 30 \times 10^{-6}$. For risk assessment purposes, the FAA proposes no distinction among space launch vehicles that combine expendable and reusable vehicle concepts, or that reenter in multiple stages (some or all of which may also be reentry vehicles). A single safety criteria, measured in terms of expected casualty for the mission, would apply to all public risk exposure from vehicle operations during both ascent and descent. Thus, a launch vehicle that utilizes an expendable first stage booster to achieve altitude and a second reusable stage for delivery on orbit followed by reentry would be required to satisfy the single $E_c$ criterion cited above for the FAA to authorize the mission (launch and reentry).

The FAA believes a caveat may be appropriate with respect to the appropriate public safety risk threshold to apply to a reentry vehicle that is designed to remain on orbit for an extended period of time and for which planned reentry is so remote from the launch event that there is no objective means or rational basis for combining reentry risk with launch or ascent risk. The FAA requests public comment on the circumstances, if any, under which it may be appropriate to separately assess the reentry risks of a reentry vehicle from those presented by the entire mission of launching a reentry vehicle into space and its subsequent reentry.

That said, the FAA envisions combining launch and reentry authorizations under a single license whereby a single operator is responsible for launch and reentry phases of the mission.[2] The FAA would not use a ''wait and see'' approach to authorize a reentry. Reentry authorization would have to be issued in advance of launch, signifying the FAA's conclusion that both ascent and descent flight phases could be performed in a manner that does not expose the public to unreasonable risk.

*Scope of License*

The report of the House Committee on Science, Report 105–347, addresses the intended scope of licensing authority over reentry operations granted to the FAA by H.R. 1702, the Commercial Space Act of 1997. (The Commercial Space Act of 1998 was enacted into law during the second session of the 105th Congress as Public Law 105–303. No substantive changes to FAA reentry licensing authority from that reported on by the House Science Committee in Report 105–347 appear in the public law.) It provides that the legislation is not intended to extend FAA launch licensing authority, as far as the payload is concerned, beyond placement of the payload in orbit or its planned trajectory. According to the Committee Report, only the launch of a launch vehicle and reentry of a reentry vehicle requires FAA licensing and regulatory oversight. While non-reentry vehicle operations on-orbit, maneuvers between orbits, and activities following launch that also precede reentry are not intended to be covered by an FAA license, the Committee Report recognized that the FAA may need to examine pre-reentry procedures and activities to evaluate safe reentry capability.

A discussion of launch duration and the commencement point of a reentry license appears in a separate rulemaking that addresses financial responsibility and risk allocation for licensed reentry activities so that space vehicle operators can manage risks appropriately. Unlicensed events would only be eligible for government payment of excess claims protection, known as indemnification, to the extent losses result from and are causally related to a licensed activity. Therefore, for purposes of insurance and indemnification under 49 U.S.C. 70112 and 70113, it is critical that the FAA define those activities to which statutory-based insurance and risk allocation would be applicable. For purposes of licensing, it is also important that the agency define the extent of activity that is covered by a license and is therefore subject to FAA safety standards.

In determining the appropriate scope of a reentry license, the FAA considered the Committee Report language cited above, the scope of launch licenses for ELV launches, and reentry risks for which statutorily mandated financial responsibility and risk allocation are necessary.

In its report accompanying H.R. 1702, the House Committee on Science stated that ''[b]y way of definition, the Committee intends that [''reentry''] begins when the vehicle is prepared specifically for reentry. By way of definition, the Committee intends the term to apply to that phase of the overall space mission during which the reentry is intentionally initiated. Although this may vary slightly from system to system, as a general matter the Committee expects reentry to begin when the vehicle's attitude is oriented for propulsion firing to place the vehicle on its reentry trajectory.'' (Report 105–347 at p. 21, 105th Cong., 1st Sess.)

The Report acknowledges that to evaluate capability of a reentry operator to conduct a safe reentry, the agency

[2] Separate licenses would be appropriate in circumstances where different operators are each responsible for a particular phase of flight, as originally planned in the COMET Program.

may need to examine certain proposed procedures and activities that would precede initiation of reentry; however, these procedures and activities are not events requiring a license or otherwise subject to regulations. ''Rather, they would represent aspects of an application that the Department would have to measure against standards and criteria that the Department has established are necessary to evaluate capability to conduct the reentry.'' The Committee further allows for both general and particular (case-by-case) applicability of such standards and criteria to a reentry proposal.

The FAA proposes regulations adopting the analytical approach to assessing reentry capability envisioned by the House Science Committee. The FAA is not proposing design-based or prescriptive requirements applicable to RLV or reentry vehicle activities while on orbit. As described below, the agency's system safety approach to reentry risk requires that a reentry operator establish operating procedures and specifications that ensure reentry risks are confined within acceptable limits. Reentry authorization would be granted based on a demonstration by an applicant that its vehicle and reentry operations satisfy the agency's safety criteria when operated in accordance with operator-designed procedures and criteria.

For purposes of measuring reentry safety against FAA criteria ($E_c$), however, it remains necessary to define the extent of activities that enter into the $E_c$ analysis. Most of the RLV and reentry activities currently contemplated by the aerospace industry involve very limited time on orbit. RLVs that operate suborbitally, as discussed above, would spend no time on orbit and would be subject to continuous FAA licensing. Unlike the COMET situation, RLVs that are reentry vehicles are not payloads for purposes of launch. Rather, they are both a launch and reentry vehicle.

Except for extended microgravity experimentation, such as that contemplated by the COMET Program, regulation of on orbit activity of orbital reentry vehicles would be limited to that necessary to ensure reentry readiness, capability and safe return to a designated destination. Because additional time on orbit would raise costs and otherwise interfere with RLV objectives of prompt delivery and return services, the FAA envisions that the only on orbit time spent by an orbital reentry vehicle would be that required to assure reentry-readiness through reentry safety-critical system check-out and attitude and orientation adjustment for return to the reentry site. Because a non-nominal reentry could occur as a result of or during reentry-readiness activity following a vehicle's ascent to orbit, the agency concludes that such activities must necessarily be covered by a license in order to assure public safety. As discussed in a separate rulemaking on reentry financial responsibility, licensing reentry-readiness activity is also critical to a meaningful risk management scheme under 49 U.S.C. 70112 and 70113.

Accordingly, the FAA proposes to define reentry and the scope of a reentry license in a manner similar to that utilized for launch licensing. The term ''launch'' is characterized in the House Science Committee Report as including activities that precede flight that entail critical preparatory steps to initiating flight, are unique to space launch and are so hazardous as to warrant agency regulatory oversight, as long as they are conducted at a launch site in the United States, even if that site is not ultimately the site of the actual launch. (Report 105–347 at p. 22, 105th Cong., 1st Sess.) The FAA finds in this report language helpful guidance in attempting to delimit ''that phase of the overall space mission during which the reentry is intentionally initiated.'' Just as pre-flight launch activities must be licensed because, among other things, they are critical and particular to the launch process, the reentry phase may be defined as encompassing those vehicle operations necessary to assure reentry readiness and safety that are uniquely associated with the purpose and performance of the reentry mission.

The FAA also considered the point in time when licensing authority over a launch is concluded in an effort to define the point after launch when an authorized reentry may commence for licensing purposes. In a separate rulemaking governing licensing requirements for launches from Federal ranges, the FAA defines the end of licensed activity, for purposes of the launch vehicle, as the point after payload separation when the last action occurs over which a licensee has direct or indirect control over the launch vehicle. Typically, this point occurs when the vehicle's upper stage is rendered inert or safe from explosive risk. Currently, licensed launches from Federal ranges are exclusively launches of expendable launch vehicles (ELVs), and the licensing rule definition of the end of licensed launch activity is directed, quite properly, to ELV launches. If applied to RLV technology, however, a launch might not be concluded under the terms of this definition until reentry is complete because the RLV operator would retain (or design in) certain control over the vehicle in order to ready it for reentry. Because separate licensing authority over launch and reentry is granted to the agency by the amended statute, the FAA believes that the defined end of licensed launch activity for an ELV may not be appropriate in defining the end of licensed launch activity for an RLV. However, that portion of the definition that addresses payload delivery is instructive in defining the end of the launch phase of an RLV mission that involves both a launch and reentry. In fact, the Committee focuses on payload delivery in defining the end of launch under the original intent of the CSLA. ''The original Act intended that a launch ends, as far as the payload is concerned, once the launch vehicle places the payload in Earth orbit or in the planned trajectory in outer space.'' (House Science Committee Report 105–347, at p. 22.)

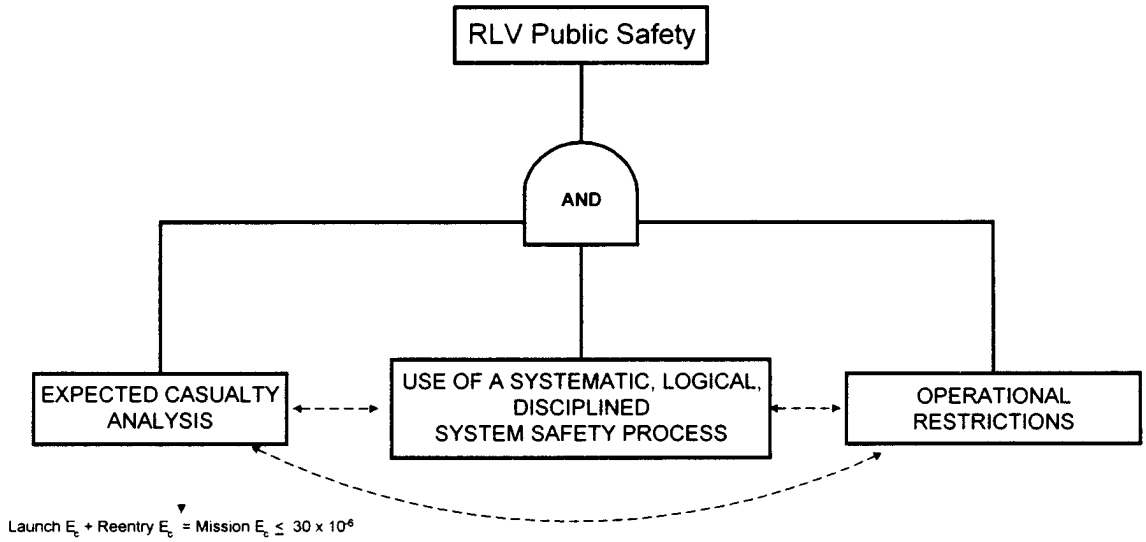
The Committee report language employs terms that describe the appropriate end of a licensed launch of a reentry vehicle when the reentry vehicle itself is a payload, as was the case in the COMET/METEOR experience, in an effort to ensure the FAA does not bootstrap licensing authority over payloads. If the COMET or METEOR vehicle were presented today for licensing, the end of launch would properly be defined as placement of the payload, the COMET or METEOR reentry vehicle, in Earth orbit or its planned trajectory, and safing of the ELV upper stage used to launch the reentry vehicle (payload) to orbit, consistent with FAA licensing rules and Committee report language. During the 30-day period following launch and preceding planned reentry, the COMET/METEOR payload would not be subject to FAA licensing, just as any other payload operating on orbit is not subject to FAA licensing. However, the intentional reentry to Earth of the COMET/METEOR reentry vehicle from Earth orbit would require FAA licensing because it was designed to return to Earth substantially intact.

Reusable launch vehicles that are also reentry vehicles present a different situation from COMET/METEOR in that RLV operations on orbit are not payload operations. Based on pre-application consultations with RLV developers, the FAA understands that RLV operations on orbit following payload deployment would be those conducted generally for the purpose of assuring reentry readiness, such as safety system checkouts, vehicle orientation for the targeted landing site, and attitude control and adjustment prior to initiating a deorbit burn or other reentry

sequence necessary for the intended return to Earth. Accordingly, the FAA defines the end of licensed launch activity for an RLV launch at deployment of a payload. The licensed reentry phase of a mission begins immediately thereafter for vehicles that are intended to reenter when reentry-readiness is verified. In other circumstances, such as a planned or designed-in delay of reentry for an extended duration the FAA requests comments on the appropriate point for commencing reentry licensing authority.

*Public Safety Strategy for Assessing Reusable Launch Vehicle and Reentry Safety*

This proposal reflects a three-pronged approach to assuring that risks to public safety are maintained at or below acceptable levels during an RLV mission and any licensed reentry. The three prongs, which are interrelated, are: (1) utilization by an applicant of a systematic, logical and disciplined system safety process; (2) an analysis that determines the expected casualty rate per mission; and (3) mandatory operational restrictions imposed by regulation for risk mitigation purposes. No single one of these processes is sufficient by itself to ensure that a reentry operation would not jeopardize public safety. The FAA believes that the combination of these elements will be effective in limiting public risk. The following chart demonstrates the interrelationship of the three elements of the agency's public safety strategy:




The first two elements are applied on a case-by-case, or individual, basis because the factors that comprise the necessary analyses are uniquely dependent on vehicle capability, design and intended operation. Mandatory operational restrictions would be specified in rules of general applicability.

Assessment of expected casualties is a commonly used measure of launch risk within the aerospace community. The FAA proposes to measure collective risk, defined as the product of the probability (or frequency) of occurrence of all events and the severity of each events impact or consequences on public safety. A quantitative number is derived through analytic techniques in lieu of empirical launch data, because the actual number of launches of a particular type of launch vehicle is too small to be statistically significant. Presented below is the agency's proposed measure of acceptable casualty risk.

Applicants will be required to utilize a system safety process. In some respects, this is similar to the FAA systems approach to examining aviation systems such as that contained in 14 CFR 25.1309. This process lays the foundation for the system safety engineering effort used in designing a vehicle and therefore the FAA believes the requirement would impose no additional burden on an applicant. A system safety process employs methods and techniques that may be utilized for identifying: (i) the hazards that result from a particular launch or reentry vehicle operation, (ii) the effects on or consequences to public safety of those hazards including vehicle failure, (iii) means of controlling or mitigating those consequences, and (iv) verification processes of the effectiveness of risk mitigation measures. Part of a system safety process is the application of techniques and tools to determine failure probabilities and to estimate the consequences of such failures, which in turn informs calculation of the expected casualty rate. Thus, the two analyses are interrelated. Through a system safety process, an applicant develops operational constraints and defines the operating envelope that will ensure its mission does not exceed acceptable risk thresholds .

The FAA does not propose to define acceptable system safety processes as a regulatory matter; however, the process selected must be adequate to accomplish its intended purpose. The FAA will issue guidance material describing an acceptable system safety process and its elements as a means of compliance with regulations. The FAA will also issue guidance on acceptable methodology for calculating expected casualty risk. The FAA believes applying a flexible approach of this nature to assessing risk to public safety is particularly critical at this early stage of RLV and reentry technology development to accommodate, and encourage, the varied operational and design concepts envisioned within the industry.

Calculation of casualty expectancy and system safety process analyses are analytical tools. Absent operational proof of vehicle reliability, the FAA believes that additional constraints on operations are also necessary to assure public safety until sufficient flight data is available to validate analytical demonstrations. The FAA is proposing to impose certain operational

restrictions on all RLV missions and reentries, and additional restrictions for unproven vehicles. The FAA will relieve or waive restrictions once sufficient performance data is available to support an agency determination that public safety is assured without their imposition.

1. Calculation of $E_c$ (Acceptable public risk)

Although risk is inherent in the operation of an RLV or reentry vehicle, this proposal would establish limits on the risk to public safety that may result from licensed flight of an RLV or reentry vehicle. Risk analysis has been widely used to support regulatory and industrial decision-making and to allocate limited resources. The Nuclear Regulatory Commission and the Department of Energy, for example, have made extensive use of risk analysis in analyzing, licensing, and regulating the operation of nuclear power plants; prioritizing nuclear waste disposal safety issues; and performing environmental impact analyses. The Department of Defense (DOD) also has used risk analysis to develop and test nuclear weapons systems.

In the space launch arena, risk analysis is used to evaluate the hazards and consequences associated with a launch. One measure of acceptable flight risk used to determine whether a launch can proceed at a Federal launch range is calculation of the expected number of casualties ($E_c$) to the collective members of the public exposed to debris hazards from a particular launch. A casualty includes serious injury as well as death. $E_c$ provides the advantage of a mathematically defined criterion on which to evaluate an event, such as a launch or reentry, without the necessity of completing detailed vehicle design analyses. The term ''public'' for purposes of $E_c$ calculation means all persons who do not participate in the operation of the vehicle, hence, the term ''public'' would not include the crew on a manned vehicle.

Federal range safety requirements developed over the last 40 years safeguard the public by limiting the public's exposure to the risks associated with launch activities. Because of operator adherence to Federal range safety requirements and practices, the public has not suffered any casualty from launches of ELVs. Therefore, it has not been necessary for the FAA to independently evaluate the design or manufacture of vehicles and duplicate the evaluation process undertaken when a vehicle is launched from a Federal range. The FAA has adopted the Federal range $E_c$ standard of 0.00003 casualties per launch or $E_c \leq 30 \times 10^{-6}$ in its licensing regulations and will license launches from non-Federal launch sites if equivalent safety is demonstrated. The FAA proposes to apply the same approach to evaluate RLV and reentry risks on a per mission basis.

There are two fundamental components of $E_c$ analysis: (1) determination of the probability of a failure event ($p_i$), and (2) evaluation of the consequence of the failure event ($C_i$). The complete equation for $E_c$ is the sum, over all possible failure events, of the product of the $p_i$ and $C_i$ as follows:

$$E_c = \sum_{i=1}^{n} (p_i \times c_i)$$

where ''i'' is a failure event and where there are ''n'' failure events that could result in a non-zero consequence.

The probability of a failure event is always a fraction between 0 and 1, while the measure of the consequence of the failure event could be any number. The larger the number, the greater the risk. Reducing the probability of the failure event could lower the risk. Because the probability of a failure event is related directly to the reliability of a vehicle's safety critical systems and subsystems, having a very reliable vehicle could lower the risk. (Whether a system is safety critical such that a failure of the system might affect public safety would depend on a number of factors, including vehicle flight path and its capability to reach populated areas.)

Lowering the consequence of the failure event also could reduce the risk. The consequence of the failure event is calculated by multiplying the surface area population density by the casualty area of the vehicle. This calculation would have to be made using the casualty area produced by an intact vehicle or the casualty area created by the debris fragments produced by a vehicle that has broken up in midair. The worst-case scenario should be used. The casualty area of the vehicle would consider the potential for casualties related to secondary explosions, hazardous material exposure, collateral damage, and the lateral movement of debris after impact. From the equation it can be deduced that $E_c$ could be lowered by operating the vehicle so that a failure event causes few or fewer casualties. (ELVs generally have a small $E_c$ because planned flight paths are over unpopulated areas, such as the ocean, and a destructive flight termination system (FTS) would be used to destroy the vehicle if it deviates from its planned flight path.)

The basic elements for determining mission risk are discussed above; however, the real-world process for determining mission risk is a bit more complicated. The process must account for a large number of possible events, and there are likely to be many different failure modes that could affect the characteristics (e.g., size, location) of the debris and lethal area. Fortunately, the goal in conducting a risk analysis to determine $E_c$ for a particular mission is not to determine the actual risk but to determine that the risk is below a certain threshold $E_c$ of $30 \times 10^{-6}$. The FAA believes that $E_c$ calculations are best made using conservative estimates and worst-case assumptions to identify and limit the public's risk exposure for improbable hazardous events with high consequences.

Recognizing that Congress has chosen to accept the risk of RLV operations and reentry to derive the benefits from evolving commercial technology, the FAA considered whether to separately assess launch risk from reentry risk and, if so, whether a different risk threshold should be used for launch as opposed to reentry. This proposal reflects the FAA's opinion that a single consistent standard for measuring acceptable public risk should be applied, and that it should apply on a per mission basis.

The FAA has met with representatives of the space transportation industry in pre-application consultation on RLV proposals and to provide licensing guidance. On May 13, 1998, the FAA met with representatives of each RLV developer then known to the agency to discuss RLV and reentry safety assessment issues and to gather information from industry members who have begun to develop commercial RLVs and reentry vehicles. A summary of the meeting has been added to the docket for this proposal. Information obtained by the FAA indicates that a reentry accident may be comparatively less hazardous than a launch accident, a risk generally accepted by the public. A reentry accident could pose less of a risk than a launch accident because a reentry vehicle could carry substantially less propellant, if any, than a launch vehicle and could therefore pose less of an explosive or fire hazard under some circumstances. If this is so, it also could be expected that the $E_c$ for the reentry of a vehicle of a particular design would be significantly less than the $E_c$ for the launch of that same vehicle over any area of the same population density.

On February 11, 1999, the FAA held a public meeting to discuss draft interim safety guidance concerning RLV operations and to gather information from industry representatives who are

developing commercial RLVs. The draft interim safety guidance, issued in advance of rulemaking proceedings, was prepared to assist prospective reentry license applicants in understanding the nature of the agency's public safety concerns when evaluating proposed RLV operations. A transcript of comments made at the public meeting have been added to the docket inasmuch as they may also address aspects of the agency's proposed regulatory approach to regulating safety of RLV and reentry operations. Written comments are also placed in the docket.

In light of this information, the FAA considered whether a single $E_c$ risk threshold should be applied to the mission as a whole or separately to each segment of the mission (launch and reentry). If it is assumed that a vehicle will operate at the absolute extreme allowed by the risk threshold, employing separate risk thresholds at the level currently tolerated for launch would make the total maximum risk exposure for an entire RLV mission nearly equal to $60 \times 10^{-6}$ ($30 \times 10^{-6}$ for launch plus $30 \times 10^{-6}$ for reentry, assuming independent events). The effect of using separate, independently applied standards would be to effectively nearly double the acceptable maximum risk exposure imposed on the public for an RLV mission in comparison to the public's risk from the launch of an expendable launch vehicle launching the same payload. (Note that applying separate risk thresholds for launch and reentry would result in an increased risk threshold for the mission if the aggregate risk allowed (launch $E_c$ + reentry $E_c$) were greater than $30 \times 10^{-6}$.)

Next, the FAA considered the appropriate risk threshold to use in assessing risk on a per-mission basis if a single $E_c$ value is applied to the mission, that is, whether the level of acceptable risk should be increased in the interest of technology advancement.

Currently, the FAA's practice in evaluating the collective risks associated with a launch is to ensure that $E_c$ is not greater than $30 \times 10^{-6}$. This value was derived from launch risk guidance employed by the U.S. Air Force at Cape Canaveral Air Station and Vandenberg Air Force Base to define acceptable risk. ''Eastern and Western Range 127–1 Range Safety Requirements,'' Section 1.4 (October 31, 1995). Since the beginning of the U.S. space program, the public has not suffered any serious injuries or fatalities as a result of a Government or commercial launch under this standard. Expected risks from eventual reentry of ELV stages due to orbital decay is relatively small because most are believed to burn up on reentry. While some components of the stages have been found to have survived, empirical data seems to support this conclusion.

In fostering the nation's space launch capability, the government understands that some risk to public safety shall be endured for the national interest and economic well-being of the United States. And, the public accepts the very limited risks to which it is exposed, as evidenced by population growth in the vicinity of Federal launch sites. However, the FAA is reticent to impose greater risk on the public than that currently accepted for ELV launches in order to accomplish the comparable launch mission of placing payloads on orbit, but at reduced costs. Accordingly, the FAA proposes to continue use of the Federal range risk standard of $E_c \leq 30 \times 10^{-6}$ on a per mission basis for RLV and other launch and reentry missions. Nevertheless, the FAA acknowledges that there may be circumstances under which it would be appropriate to separate launch from reentry risk, such as where different operators are involved and may be apportioned allowable risk thresholds, or where intervening events or time make reentry risks sufficiently independent of launch risks as to warrant separate consideration.

2. System Safety Process and Risk Analysis

As part of the system safety process and risk analysis, an applicant would be required to determine the probability and consequences of events that may affect public safety. Doing so requires population data, vehicle casualty areas, and vehicle failure modes and rates. Accurate population data generally are available and casualty areas could be estimated using accepted industry practices. However, development of vehicle failure rate is more complicated.

Failure modes and rates for a vehicle are related to the failure modes and rates of its major systems, which in turn correlate to the failure modes and rates of major subsystems of a vehicle. To obtain a conservative risk assessment of a vehicle lacking an adequate flight history, an applicant could conduct a risk analysis and assume the probability of a catastrophic failure of 1.0. In the alternative, an applicant would have to complete a detailed risk analysis. This risk analysis would be similar to a traditional systems safety analysis used by DOD and NASA; however, it would not focus on mission success *per se.* However, while experience shows that such analyses are helpful, they are subject to error because of ''unknowns'' for unproven vehicles. Instead, it would focus solely on identifying and evaluating failure modes and rates affecting risks to public health and safety and the safety of property by conducting an evaluation of vehicle systems and proposed operations.

Because of the variety of RLV and reentry vehicle designs and operational concepts, the FAA has not enumerated a specific evaluation methodology. Examples of acceptable techniques for determining failure conditions include, but are not limited to, the following: Preliminary Hazards Analysis, Failure Mode and Effect Analysis, Failure Mode Effect and Criticality Analysis, Fault Hazard Analysis, Event Tree Analysis, Double Failure Matrix, Hazard and Operability Analysis or Operability Hazard Analysis, and Fault Tree Analysis Methodology for Hazard Assessment. An applicant would use the evaluation methodology most appropriate for the system being evaluated. A separate analysis needn't be performed for each flight of a launch vehicle. If a previously approved mission utilized a risk assessment for a similar mission with a substantially similar vehicle, the earlier risk assessment may serve as the basis of a comparative analysis for the proposed mission.

Potential risks identified in the analysis must be mitigated to protect public health and safety and the safety of property. The process of evaluating and mitigating the potential risk of a vehicle or operation would continue until all risks are mitigated to an acceptable level. In the aviation industry, typical hazard control and risk mitigation includes the following:

- Design integrity and quality, including life limits, to ensure intended function and prevent failures;
- Proven reliability of systems so that multiple, independent failures are unlikely to occur during the same flight;
- Capability to check a component's condition;
- Failure warning or indication to provide failure detection;
- Isolation of systems, components, and elements so the failure of one does not cause the failure of another;
- Redundancy or backup systems to enable continued function after any failure;
- Design failure effect limits, including the capability to sustain damage and to limit the safety impact or effects of a failure;
- Design failure path to control and direct the effects of a failure in a way that limits its safety impact;

- Margins or factors of safety to allow for any undefined or unforeseeable adverse conditions;
- Error tolerance that considers adverse effects of foreseeable errors during the vehicle's design, test, manufacture, operation, and maintenance;
- Computer software verification, validation, documentation, configuration management, and quality assurance;
- Personnel qualification and training;
- Contingency planning, including operator procedures after failure detection to enable continued safe flight, evacuating personnel from high risk areas, and modifying vehicle trajectory to avoid high risk areas; and
- Process approval, including an evaluation of risk reduction, mitigation strategies, and configuration management.

The system safety process and associated risk analysis that the FAA proposes to require is substantially similar to the engineering analysis a vehicle developer would complete to assess the viability and the probability of success of an intended operation. Developers would also need this information to convince and assure investors of the soundness of their investment.

The FAA is developing guidance material to assist the industry in complying with the proposed system safety approach. In discussions, industry representatives recommended that the FAA develop an approach built around engineering documentation during specific program phases, such as design and development, manufacturing, and vehicle operations. Others have stated that [an applicant's submission] [the documents] should outline the applicant's ''philosophy'' but that the FAA should require evidence supporting the documentation. The FAA invites further comments and recommendations that would assist in developing an acceptable analysis to ensure all factors affecting public health and safety and the safety of property are considered and addressed specifically.

3. Operational Restrictions on Reusable Launch Vehicle Launch and Reentry

The system safety process, in combination with quantitative risk criteria, yields a performance envelope within which an applicant demonstrates its ability to operate without excessive risk to public safety. But these are analytical processes only and may not reflect real world performance even under the best of circumstances.

As noted above, the risk a vehicle poses to public health and safety and the safety of property is a product of two factors: the probability of a failure event and the consequences of that failure event. If the probability of a failure event is related directly to vehicle reliability and that reliability cannot be determined accurately, public health and safety and the safety of property can be protected only by limiting the consequences of a failure event. Therefore, based on the uncertainties involved in the operation of an unproven RLV or reentry vehicle and the projected benefits resulting from the imposition of operational restrictions on such vehicles (based on a current assessment of probable system failures), the FAA proposes to impose operational restrictions on a vehicle that has not proven system performance and reliability through a flight test program or operational use.

In support of proposed restrictions, the FAA notes that industry representatives have stated that, historically, predictions of vehicle performance and failure modes have often overlooked key events or circumstances. None of the significant failures in the Apollo program or other ELV programs were predicted. Also, failure rates for the first launch of new launch vehicles are significant. While a quantitative risk analysis is an important and necessary tool in the development of a vehicle concept, the FAA considers it inappropriate in this proposal to allow the flight of an unproven and untested RLV or reentry vehicle over populated areas in a manner that can affect public safety based solely on the favorable results of a quantitative risk analysis.

The FAA does not believe an adequate determination of system performance and reliability for new flight concepts can be demonstrated solely through hazard analyses and ground tests. Accidents or other failures often are the result of an unforeseen combination of hardware and software failures in combination with external influences, such as human error. System design validation and functional performance verification could possibly be accomplished in 10 to 20 flights, depending on the design unique to each vehicle. However, a relatively large number of flights may be needed to demonstrate reliability and to understand unanticipated failure modes. Some industry representatives have expressed the opinion that one would need to complete 1,000 flights to accurately determine reliability of a vehicle. At the May 1998 FAA meeting with RLV industry representatives, industry noted that the STS (Space Shuttle) is still in the midst of its test program.

Moreover, because of the costs and disadvantages of flight testing, the FAA expects that many RLV and reentry vehicle operators will propose to validate vehicle design through the use of sophisticated computer simulations, ground testing, or other detailed analyses. The FAA does not object to this anticipated approach but does believe it necessary to impose operational restrictions in the interest of public safety until vehicle performance is proven.

Finally, the FAA is not proposing rules applicable to reuse or reflight of a particular vehicle. Each flight of a reusable launch vehicle would be required to satisfy the safety criteria promulgated by the agency in licensing rules, and an applicant's demonstration that it has satisfied the criteria would have to account for effects of prior flight on vehicle performance.

For these reasons, the FAA proposes to impose operational restrictions that would apply to *all* RLV launches and reentries, with an additional restriction on the flights of unproven vehicles at least until sufficient data is obtained about vehicle performance to warrant relief from that restriction.

A. *Restricting flight over populated areas.* The FAA defines flight restrictions applicable to flight of an RLV or reentry of a reentry vehicle in terms of its ''dwell time,'' which refers to the measured period of time during which an area is exposed to hazards from a vehicle's operation, and its instantaneous impact point, or IIP. The IIP reflects a projected impact point on the surface of the Earth where the vehicle or vehicle debris in the event of failure and break-up would land. A vehicle's IIP is not generally the area immediately under the vehicle's flight path because the vehicle's momentum and atmospheric conditions will cause the vehicle to impact in some other location. The projected IIP of a vehicle can be calculated with some degree of accuracy if the vehicle's aerodynamic characteristics are known. The projected IIP of an RLV during ascent to orbit moves across the surface of the Earth until the vehicle attains orbital velocity. Once on orbit, a vehicle no longer has an IIP.

The FAA does not believe it would be appropriate to allow the IIP of an unproven RLV or reentry vehicle to pass over populated areas unless the risk is very low, even if failure occurs. In other words, if the vehicle were to fail and the vehicle or debris from vehicle break-up were dispersed in the course of vehicle

flight, the flight path and trajectory must be designed to minimize the risk of debris impacting a populated area. The proposed regulation therefore limits public risk exposure to an $E_c$ of not greater than $30 \times 10^{-6}$ assuming a failure while the IIP is over each populated area.

Thus, for unproven vehicles, the FAA proposes that during *any* segment of flight, the projected IIP of the vehicle shall not have substantial dwell time over a populated area. The applicant may either avoid any passage of the vehicle's IIP over populated areas or may demonstrate that the $E_c$ criteria of $\leq 30 \times 10^{-6}$ would be satisfied *even if the vehicle were certain to fail* while its IIP is over a populated area.[3] An applicant can select the approach to limiting public risk that best suits its proposed operations.

For a proven vehicle, the FAA proposes that a vehicle may not have substantial dwell time over densely populated areas but for the time being proposes to determine what is ''substantial'' and ''densely'' on a case-by-case basis to afford the agency flexibility in evaluating an RLV or reentry flight proposal. Substantial dwell time over a populated area could result from a stationary or slowly moving IIP that remains over a populated area or a rapidly moving IIP that traverses numerous populated areas. Typical dwell time for ELV operations ranges from four to six seconds of flight but varies depending upon the point in vehicle flight during which it occurs. For example, dwell time in the first seconds of a launch would not be tolerated because of the risk of vehicle failure. Later in flight when a vehicle is nearing orbital velocity, some dwell time over populated areas has historically been tolerated because the probability of failure and its consequences are much reduced. Thus, for any particular RLV flight or reentry proposal, the agency would evaluate on an individual basis the public safety risks associated with proposed dwell time over populated areas. However, in any event, vehicle operations would be assessed against $E_c$ criteria, which may not be exceeded.

The FAA is not prepared to state in a rule of general applicability the point at which an RLV transitions from an ''unproven'' state to a proven one. The number of flights necessary to determine the point of transition will depend on the unique design characteristics of the vehicle. The FAA believes that, at a minimum, an operator must validate its risk analysis with flight data in order to ''prove'' the performance of a vehicle. In this context, the term ''validate'' means that the vehicle's flight data show that the vehicle operated in a manner substantially similar to that predicted by the operator's risk analysis.

As stated earlier, the number of flights necessary to validate a vehicle's risk analysis also would depend on the nature of the operations the vehicle would be expected to perform. For example, if an operator proposes to operate its vehicle over populated areas and to rely on an abort capability to achieve required levels of safety, the operator would be required to demonstrate that the vehicle can perform the critical abort and recovery maneuvers necessary to fly safely.

The agency also believes it prudent to gain practical experience in observing the stresses of flight on reentry vehicles, particularly those intended for reuse, before issuing a pronouncement of the point at which a vehicle is ''proven'' for purposes of safety regulation. In adopting this stance, the FAA is mindful that the nation's STS, commonly referred to as the Space Shuttle, is still undergoing a test program under NASA's purview, despite its many flights. Therefore, before the FAA would allow an RLV or reentry vehicle to fly over densely populated areas, an applicant would need to prove that its vehicle maintains structural and aerodynamic integrity throughout its proposed flight regime (i.e., flight lifetime), and that the operator can maintain command and control of the vehicle during flight.

That said, the FAA is not specifically mandating adherence to a flight test regime to demonstrate vehicle capability. Traditionally, flight testing has not been required of ELVs. Because ELVs are generally launched over ocean areas and the flight safety systems are subject to rigorous design and testing standards such that little public risk exposure is involved, there is little to be gained in terms of public safety risk mitigation from a requirement to conduct test flights of ELVs for the purpose of design validation. Moreover, because each flight of an ELV is its first flight, and its only flight, little would be learned about the effects of flight stress on reusability of the vehicle.

RLV industry representatives have noted that for vehicles currently under development it would be impractical to require thousands of flight test hours, and the FAA concurs that a thorough flight test program similar to that required of commercial aircraft would stifle the emerging industry and pose a number of difficulties. Furthermore, by the nature of their operational envelopes, differences between an RLV or reentry vehicle test flight and operational flight are less distinct than those of an aircraft test flight and operational flight. While an aircraft may conduct tests of its full-flight envelope within a remote site, conducting full-flight tests of an RLV or reentry vehicle would require suborbital and/or orbital flights over substantially large areas. Because of the physical range of such flights, there would be little distinction between a test and an operational flight with its inherent risks. Imposition of a flight test requirement also would impose on the industry direct costs to conduct the tests and indirect costs through lost revenue, reduced life cycles, and vehicle test flight damage that would have to be repaired to ensure the vehicle meets regulatory standards for reentry operations. For these reasons, the FAA is not proposing requirements for the conduct of a flight test program but rather has proposed a regulatory structure that would require an applicant to demonstrate that its proposed operations meet an acceptable level of risk and conform to certain operational requirements. However, an operator may choose to conduct flight-testing to ensure its proposed operations meet proposed risk mitigation criteria.

The FAA requests views on appropriate measures of validating new vehicle performance and criteria for determining the point at which a vehicle may be considered ''proven.''

B. *Monitoring critical systems.* The operator of an RLV or reentry vehicle must be able to monitor and verify the status of launch and reentry safety-critical systems before launch, during launch flight, and before reentry flight. The status of a reentry safety-critical system before reentry would affect any decision to conduct reentry operations. To ensure an operator is aware of the status of the vehicle, the FAA proposes to require procedures for monitoring performance of on-board, safety critical systems just prior to enabling reentry. Monitoring would provide an operator with the status of key systems before conducting public safety critical operations and would ensure that reentry flight would be initiated only under nominal or non-nominal conditions that have been assessed through the system safety process and satisfy the risk threshold. Critical information would have to be provided perhaps through telemetry to a control

[3] The proposed restrictions would apply only to those segments of flight where the IIP touches the surface of the Earth. Certain reentry-readiness operations performed on orbit during the ''reentry phase of flight'' do not involve an IIP that touches the surface of the Earth and therefore would not be affected by the criteria.

center or individual with command capacity and decision making responsibility. Other information used for system validation, system reuse, performance characterization, or post-flight anomaly investigation could be recorded for review after flight. This type of data may facilitate transition from an unproven to proven vehicle; however, the FAA is not mandating real-time monitoring of non-safety critical systems.

C. *Positive enabling of fail-safe reentry.* To further enhance safety, the FAA proposes a fail-safe operational procedure whereby an operator must issue a command that enables vehicle reentry unless the vehicle is designed to operate suborbitally. In the event reentry cannot be enabled, the vehicle would remain in orbit. Totally autonomous initiation of reentry would not be allowed to ensure that certain clearances and system verifications are completed to assure that a reentering vehicle will not pose safety risks to the public. These may include clearance of airspace in the reentry corridor, securing reentry sites, verifying the configuration and status of reentry safety critical systems, and verifying reentry corridor weather is within vehicle operational constraints. Such activities would be external to the vehicle's systems and autonomous control systems would not verify them.

D. *Reentry sites.* To minimize public safety risk due to an off-site landing, the site selected for reentry of a reentry vehicle or as the landing area for an RLV must be sufficiently large such that the vehicle will land within it with a certain degree of predictability. The agency assesses size suitability of a proposed reentry or landing site by using the three-sigma footprint measure commonly applied to launch operations. The three-sigma footprint describes the area where the vehicle will land with a .997 probability rate, assuming no major system failure.

The statistical term ''three-sigma'' refers to three standard deviations from the mean, or average point, assuming a standard normal distribution. The area that is within three standard deviations from the mean point encompasses the area surrounding it with the mean at its center. An area within two or even one standard deviation of the mean point is a smaller, more precise measure; however, statistically there is less chance of an event falling within that range. The larger the area, the higher degree of confidence one has of an event falling within its boundary limits, assuming a normal distribution of events.

For example, if the reentry site were an area on a target, the mid-point or center point is the mean and the small area around it is the bulls-eye. The bulls-eye represents one standard deviation from the mean or center point. The first contour area is two standard deviations from the mean point and the second contour area is three standard deviations from that point. Assuming a normal distribution, the three-sigma area, or the area within two contours of the bulls-eye, represents the area in which an archer's arrow would strike with a three-sigma probability.

However, the size of the area must be adjusted for different conditions or variables, such as distance from the target, wind, or aerodynamic qualities of different kinds of arrows. If one's ability to meet the three-sigma probability distribution depends on the existence of certain conditions, then those conditions become requirements.

From a regulatory standpoint, an applicant would be required to demonstrate that a proposed reentry or controlled landing site is large enough to contain the landing impacts of its vehicle with a three-sigma probability, assuming a nominal reentry, and the conditions or assumptions on which the demonstration is predicated would become conditions of the license.

The size of the area must be large enough to accommodate potential trajectory deviations that may occur. Therefore, in determining the necessary size of the three-sigma area, an applicant should calculate the errors associated with physical forces that act on the vehicle to cause its flight path to deviate from the planned trajectory, if reentry is intended to occur despite those errors.

Maneuverability of a vehicle is likely to affect the three-sigma area. For example, the three-sigma area for an airplane may be a narrow ellipse because the pilot can stand otherwise control the vehicle's descent such that it touches down within a narrow band. An uncontrolled or ballistic vehicle, such as the COMET/METEOR reentry vehicle, required a large three-sigma area because of imprecise orientation of the vehicle at the point at which reentry was initiated and the varying effects of atmospheric forces on the vehicle.

In any case, a designated reentry site, including any designated contingency abort location, would have to be large enough to ensure the probability of landing outside the designated area is not greater than .997 for nominal vehicle operations.

**Reusable Launch Vehicle Mission and Other Reentry Licenses**

For the near term, the FAA envisions that the majority of reentry activities subject to FAA licensing jurisdiction would involve reusable launch vehicle technology, as opposed to the COMET/METEOR type of reentry vehicle. The latter was intended for launch as a payload by an expendable launch vehicle, would enter its designated orbit and ultimately perform an unguided ballistic reentry to a designated reentry site about 30 days later. In the case of such reentries, the same risk criteria would apply to launch and reentry of the reentry vehicle as would apply to any other RLV mission, under the FAA's proposal. However, other regulatory requirements to assure public safety, such as operational restrictions, would be directed exclusively to RLV missions. Other safety requirements may only be appropriate for reentry vehicles resembling the COMET/METEOR vehicle system. Therefore, to make the requirements ''user friendly,'' the FAA proposes to address RLV mission licensing requirements in a separate part of the licensing regulations so that RLV operators can see, at a glance, the commercial space transportation regulations applicable to their operations. A separate part is proposed to address unique safety requirements applicable to licensing other types of reentries, that is, those that don't involve RLVs, even though policy, payload reentry, and environmental review requirements would be comparable to those applied to RLV missions.

*1. Reusable Launch Vehicle Mission Licensing Overview*

Before granting an applicant a safety approval, the FAA would review the appropriateness for a particular launch activity of the following items: the location, size, and design configuration of the proposed launch site; launch operational procedures; personnel qualifications; range safety equipment and instrumentation; vehicle safety systems; and the applicant's flight safety analysis.

An RLV launch operator would be required to possess the ability to monitor the status of launch and reentry safety critical systems during countdown to launch. The FAA also proposes that an operator have the ability to activate the vehicle's flight safety system (FSS), if any, or to invoke contingency plans if the vehicle is not operating within approved mission parameters and poses an unreasonable risk to public health and safety. This

requirement does not mean that an FSS cannot also function automatically or autonomously. Such systems are desirable where, for example, a human monitor may not be able to react in sufficient time to achieve a safe condition.

The term FSS encompasses a variety of devices designed to place a vehicle in a mode less hazardous to public health and safety and safety of property. A type of FSS commonly used on ELVs is a destructive-type FTS, which is used to terminate flight and destroy the vehicle. However, many reentry vehicles and RLVs do not propose to rely on a destructive-type FTS as a primary mechanism for protecting public safety because the vehicle may be capable of attempting a nondestructive abort. The proposal would not mandate any particular type of FSS. An applicant for a launch license would be permitted to use any type of FSS necessary to ensure public safety during the applicant's proposed operation of the vehicle. Mission rules derived from the applicant's risk analysis, among other things, would dictate whether and when to activate the FSS.

Members of the RLV industry have agreed generally that some type of FSS would be necessary to meet the risk limitations imposed on launch vehicles by Federal ranges. Many believe that a reentry vehicle or RLV operator that proposed to operate without an FSS would have to improve overall vehicle reliability and performance to meet those risk limitations. Others have also asserted that some type of human intervention capability would be necessary before a vehicle could be allowed to operate within controlled airspace.

An RLV may have the capability to abort launch flight to a pre-planned and approved location. Other vehicles would require emergency planning so that in the event of a failure or anomaly, they can be directed to an unpopulated area or attempt a safe landing. Therefore, an operator without abort capability would be required to plan a flight path that allows for safe flight abort on an emergency basis before the vehicle reaches orbit.

Once an RLV achieves orbit, the FAA was concerned that if the vehicle could not reenter or must abort during reentry, an operator would have to be able to incapacitate the vehicle so it would not substantially survive reentry. Agency concern was based on the view that, unlike an expendable launch vehicle, a reentry vehicle is designed to survive reentry intact. However, industry representatives have noted that reentry vehicles are designed to survive reentry under very specific reentry parameters. An operator must undertake significant effort to achieve a successful reentry. Industry has compared successful reentry to ''flying the vehicle through a key hole.'' Because an uncontrolled RLV or reentry vehicle may be unlikely to survive reentry, the FAA does not propose a requirement that an operator would have to be able to incapacitate the vehicle so that it would not survive a random return to Earth. However, the applicant must demonstrate that a random reentry will not exceed acceptable risk for the mission.

The FAA is proposing a quantitative risk measure in evaluating RLV mission safety because it forces a vehicle designer to consider failure rates, consequences, and mitigation of unacceptable risks. Acceptable flight risk would be limited to the standard applied for launches from Federal launch ranges, that is, that the $E_c$ is not greater than $30 \times 10^{-6}$, a collective measure of risk, on a per-mission basis. Issues related to risk limitation and risk analysis are discussed above in relation to RLV launch and reentry. An applicant proposing to conduct an RLV mission would also be subject to operational requirements and restrictions because the FAA believes them necessary to limit risk to public safety as the industry conducts operational flights of innovative vehicle concepts.

The proposal would identify the two types of RLV mission licenses issued—a mission-specific license and an operator license. The mission-specific license would authorize an operator to conduct one or more RLV missions from a designated launch site to a designated reentry site, using essentially the same type or model of RLV such that it has substantially similar design, performance, and operational characteristics. Because more than one flight may be authorized, the license would be sufficiently broad to allow an operator to conduct a series of RLV test flights within identified parameters. The license would terminate automatically with the completion of all authorized activity or the expiration date of the license, whichever first occurs.

The proposed operator license would authorize an operator to conduct RLV missions using any of a designated family of vehicles from any launch site specified in the license to any reentry site specified in the license. A family of RLVs has similar design and operational characteristics, but each member of the family may be capable of different performance characteristics. The term of the operator license would be set at a 2-year renewable period.

The FAA expects it will first issue a new operator a mission-specific license to conduct RLV missions. Mission-specific licenses can be structured so as to accommodate a proposed test program that may consist of a series of test flights within an envelope of approved parameters. After the operator has demonstrated several successful reentries, it may apply to the FAA for an operator license. The FAA has used a similar licensing approach successfully for new launch operators and operation of new vehicles.

To receive an RLV license, an applicant would be required to obtain policy and safety approvals and complete a payload reentry determination and environmental review, if applicable. Procedural regulations governing the policy approval, payload reentry determination, and environmental review generally would be consistent with the corresponding regulations under part 415, Launch License.

To complete a safety review and receive approval for an RLV mission, an applicant would need an acceptable safety organization; mission rules, procedures, and contingency plans; a communications plan; and a mishap investigation and emergency response plan. In addition, the proposed operation could not pose an unacceptable risk to public safety as demonstrated through a risk analysis designed to ensure compliance with regulations to mitigate risk and protect public health and safety and the safety of property.

*2. Reentry Licensing Overview*

A separate part would prescribe reentry licensing and post-licensing requirements and would be modeled after the RLV mission license regulations. Unique attributes of reentry vehicles that are not RLVs would be assessed by the FAA on an individual basis as part of the safety approval process. The same risk criteria covering launch and reentry and the system safety process approach would apply to an applicant for a license to reenter a reentry vehicle. Operational requirements and restrictions would result from the applicant's system safety program plan, which would define the safe operating limits and procedures for reentry vehicle operations. Requirements applicable to launch of a reentry vehicle would depend on the type of vehicle used to place the reentry vehicle in orbit or otherwise in outer space. For example, an expendable launch vehicle (ELV) launched from a Federal range would be subject to the

licensing requirements contained in part 415 of this subchapter.

The FAA is proposing a mission approach to reentry licensing by assessing the combined risk of launch of a reentry vehicle with its reentry to determine that a reentry may be licensed. The agency considers that no less stringent safety criteria should be imposed upon a reentry because it occurs as a separate event, either by time or function, from the launch that placed it in Earth orbit or outer space. However, the FAA understands that reentry vehicles resembling the COMET/METEOR vehicle may remain in space for extended periods and may be operated under the responsibility of an operator different from that which launched the vehicle initially. To address these considerations, the FAA considered whether to apply a COMET/METEOR type of risk criteria to reentry, leaving launch risk as it currently is stated. The COMET risk criteria that there shall be no greater than one in a million probability of a casualty, when combined with acceptable launch risk, actually imposes a more stringent criteria on reentry than a combined collective risk measure of $E_c \leq 30 \times 10^{-6}$. The FAA wishes to utilize an appropriate measure of risk for reentry capability and requests comments on its proposed approach of applying mission risk.

**Section-By-Section Analysis**

FAA regulatory and licensing responsibilities have been extended by statute to include reentry, as well as launch. It is therefore necessary to add the term ''reentry'' or ''operation of a reentry site'' to agency procedures and enforcement provisions, as follows.

*Section 400.2 Scope*

Section 400.2 sets forth the scope of regulations presented in 14 CFR Chapter III. The scope would be revised to refer generally to commercial space transportation activities subject to 49 U.S.C. Subtitle IX, chapter 701. The FAA proposes to generalize the scope of the regulations rather than to add specific reference to reentry licensing and other authority under the statute.

*Section 401.5 Definitions*

New terms are added to the list of definitions. They are: ''contingency abort,'' ''emergency abort,'' ''flight safety system,'' ''operation of a reentry site,'' ''reenter,'' ''reentry accident,'' ''reentry incident,'' ''reentry operator,'' ''reentry site,'' ''reentry vehicle,'' ''reusable launch vehicle,'' ''safety-critical,'' and ''vehicle safety operations personnel.'' A reusable launch vehicle would be a reentry vehicle when it is designed to return from Earth orbit or outer space to Earth substantially intact.

The term ''reentry accident'' refers to unplanned events resulting in certain consequences listed in the definition. Accordingly, reentry to a pre-planned abort location would not qualify as a reentry accident unless it resulted in a casualty to an uninvolved person or damage to unassociated, off-site property.

The term ''mishap'' would be revised to include reentry events.

*Section 404.1 Scope*

Section 404.1 sets forth the scope of the agency's procedures for issuing implementing regulations. Rather than referring to specific licensing authority of the agency under 49 U.S.C. Subtitle IX, chapter 701, § 404.1 would be revised to refer to commercial space transportation activities falling within the agency's statutory authority.

*Section 404.3 Filing of Petitions to the Associate Administrator*

Section 404.3 would be revised to include rulemaking petitions regarding reentry and operation of a reentry site.

*Section 405.1 Monitoring of Licensed and Other Activities*

Reentry sites and reentry vehicle manufacturing, testing, assembly, and production facilities would be subject to FAA monitoring and observation and § 405.1 would be revised accordingly.

*Section 405.5 Emergency Orders*

The agency's authority to terminate, prohibit or suspend a licensed activity extend to reentry and operation of a reentry site. Section 405.5 would be revised accordingly.

*Section 406.1 Hearings*

Rights to a hearing extend to an owner or operator of a reentry payload, as well as a licensee, and section 406.1 is revised accordingly.

*Section 413.1 Scope*

The procedures contained in part 413 of 14 CFR Chapter III would apply to an application for a license to reenter a reentry vehicle or to operate a reentry site. Reference to reentry licensing requirements is added to section 413.1 in this proposal.

*Section 413.3 Who Must Obtain a License*

The proposal would revise paragraph (a) to require any person to obtain a reentry license to reenter a reentry vehicle in the United States or to operate a reentry site within the United States.

Under the proposal, paragraph (b) would be revised to require an individual who is a U.S. citizen or an entity organized under the laws of the United States or any State to obtain a reentry license to reenter a reentry vehicle outside the United States or to operate a reentry site outside the United States.

Proposed paragraph (d) would be added. That paragraph would require a foreign entity in which a U.S. citizen has a controlling interest to obtain a reentry license or, if the activity is occurring in certain locations and subject to certain conditions. The geographic constraints and conditions in the proposal would be identical to those imposed on licensed launch activities and launch site operators in current paragraph (c) of this section.

*Section 415.1 Scope*

Part 415 contains the approvals necessary to obtain a license to launch a launch vehicle from a Federal or non-Federal launch site. The FAA proposes to limit the scope of part 415 to vehicles other than reusable launch vehicles (RLV) and to place licensing requirements for the conduct of RLV missions in a separate part of the regulations. Launch and reentry flight phases of a proposed RLV mission would be evaluated under a single set of risk criteria applicable to the mission. Placing RLV mission requirements in a separate part, part 431, should facilitate understanding of the licensing requirements applicable to RLV operations.

*Part 431 Launch and Reentry of a Reusable Launch Vehicle (RLV)*

The proposal would create a new part 431 that prescribes licensing requirements for the conduct of missions involving reusable launch vehicles. Part 431 would include subpart A (General), subpart B (Policy Review and Approval), subpart C (Safety Review and Approval for RLV Missions), subpart D (Payload Reentry Review and Determination), subpart E (Post-Licensing Requirements—RLV Mission License Terms and Conditions), and subpart F (Environmental Review). Part 431 is organized in the same manner as part 415 ''Launch License'' and has been modified to address regulatory concerns applicable to RLV operations. Because safety aspects of an RLV mission would be evaluated on a per mission basis, commencing upon initiation of vehicle flight, proceeding through orbital insertion and concluding with the vehicle's landing on Earth, comprehensive requirements applicable to all licensed flight phases

of an RLV mission are included in this part. Specific mention is made in part 431 where requirements of other parts of the commercial space transportation regulations are applicable.

*Section 431.1 Scope*

Proposed § 431.1 would establish the applicability of part 431. The proposed part would prescribe the requirements for obtaining an RLV mission license and any continuing requirements to remain licensed.

*Section 431.3 Types of Reusable Launch Vehicle Mission Licenses*

The proposed section would identify the two types of RLV mission licenses that would be issued and set forth the privileges and limitations of the licenses. Under the proposal the FAA would issue either a mission-specific license or operator license, on bases comparable to that used for issuing launch licenses. A licensed RLV mission includes launch or ascent, and reentry or descent, authorization. Both authorizations are necessary to conduct an RLV mission; however, they would be embodied in a single license. The term ''mission'' is used to characterize both ascent and descent flight phases of an RLV operation but should not be confused with mission-specific authorization.

A mission-specific license need not be limited to a single RLV mission. The license would identify the specific RLV missions to which it applies and may authorize a proposed flight test program within an envelope of approved parameters. An expiration date would be stated in the license so that it is not unlimited as to time.

An operator license would provide broader authority to the licensee and, as with launch licenses, would be issued to operators that have demonstrated capability to conduct safe operations on an ongoing basis. The FAA is proposing an initial two-year license term so that it can routinely reevaluate licensee qualifications. Operator licenses issued under part 415 were initially authorized for a two-year term and have recently been extended to a five-year term. The FAA considers two years a reasonable duration at the outset of RLV operations.

*Section 431.5 Policy and Safety Approvals*

Under the proposal, a license applicant would be required to obtain policy and safety approvals from the FAA. Requirements for obtaining these approvals are contained in subparts B and C of this part.

*Section 431.7 Payload and Payload Reentry Determinations*

For purposes of launching a payload into earth orbit or outer space there should be no unique issues presented by the fact that an RLV is the transportation vehicle that places the payload in space. Accordingly, proposed paragraph (a) of this section states that the FAA would require an applicant to obtain a payload determination in accordance with part 415 requirements unless the proposed payload were exempt from payload review. Payload reentry issues may be different, however, and the FAA would require a separate payload reentry determination, as indicated in paragraph (b), for purposes of returning a payload to Earth unless it is exempt from FAA review. Payloads exempt from FAA review include U.S. Government payloads. Payloads subject to reentry review by another Government agency would not be subject to duplicative review by the FAA. For a payload that would be substantially similar to a previously approved payload, the previously issued payload reentry determination could serve as the basis for a comparative analysis. Proposed paragraph (c) would allow a previous payload reentry determination to be used to meet the requirements of proposed paragraph (b). Proposed paragraph (d) identifies the payload review procedures applicable to reentering a payload. A payload review determination may be requested of the agency in advance of or separately from an RLV mission (or other reentry) license.

*Section 431.9 Issuance of a Reusable Launch Vehicle Mission License*

The proposal states that the FAA would issue a license to an applicant who has obtained all approvals and determinations required under this chapter for an RLV mission license, including a policy and safety approval and payload reentry determination, if necessary. Although the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*) requires the FAA to perform an environmental review of major Federal actions, such as issuing an RLV mission license, specific environmental requirements would not be set forth in this section, but rather in proposed subpart F of this part.

The proposed section also would require a licensee to conduct its operations in accordance with the representations in its application and terms and conditions in license orders accompanying the RLV mission license, including financial responsibility requirements for launch and reentry activities.

*Section 431.11 Additional License Terms and Conditions*

Under the proposal, the FAA could amend an RLV mission license by modifying or adding license terms and conditions to ensure compliance with 49 U.S.C. Subtitle IX, chapter 701, and applicable regulations. Although standard terms and conditions that apply to most RLV mission licenses are proposed in subpart E, the unique circumstances of a particular licensee may require the FAA to impose additional requirements to protect public health and safety, safety of property, or U.S. national security and foreign policy interests, or to ensure compliance with international obligations of the United States.

*Section 431.13 Transfer of a Reusable Launch Vehicle Mission License*

Under proposed § 431.13, only the FAA would be able to transfer an RLV mission license. The prospective transferee would need to satisfy all requirements for obtaining a license as specified in this chapter. The FAA would amend the license to reflect any changes necessary as a result of license transfer.

*Section 431.15 Rights Not Conferred by a Reusable Launch Vehicle Mission License*

Proposed § 431.15 would state that an RLV mission license would not relieve a licensee of its obligation to comply with applicable laws.

*Subpart B—Policy Review and Approval for Launch and Reentry of a Reusable Launch Vehicle*

This subpart would describe the proposed requirements for a policy review. An applicant could choose to submit an application for a policy review with a comprehensive license application or separately in advance of submitting the complete application.

*Section 431.21 General*

Under the proposal, the FAA would issue a policy approval to an RLV mission license applicant upon completion of a favorable policy review; it would be part of the licensing record.

*Section 431.23 Policy Review*

Proposed § 431.23 states that the FAA would coordinate the policy review with other Government agencies, including the Department of Defense (DOD), Department of State (DOS), Department of Commerce (DOC), NASA, and Federal Communications

Commission (FCC). Under the policy review, the FAA would determine whether conduct of an RLV mission, inclusive of launch and reentry flight, would adversely affect U.S. national security or foreign policy interests, jeopardize public health and safety or the safety of property, or be inconsistent with international obligations of the United States. In determining whether the mission would jeopardize public health and safety or the safety of property under the policy review, the FAA would consider safety issues from a policy perspective rather than an engineering perspective.

*Section 431.25 Application Requirements for Policy Review*

The proposed section would describe the information an applicant would be required to provide to obtain a policy review. The FAA would require this information to effectively begin consultation with other Government agencies regarding resolution of any potential policy issues. Proposed paragraphs (a) and (b) would require a basic identification of the vehicle and its systems. Foreign ownership information would be required to be identified in proposed paragraph (c).

Under proposed § 431.25(d), an applicant would be required to provide the range of proposed launch and reentry profiles, including reentry sites and any planned contingency abort locations. An applicant must also provide the sequence of planned events or maneuvers during an RLV mission. Although these vary by vehicle and mission, the FAA would expect to be informed of events such as engine burn time; stage separation events; pitch, yaw, and roll maneuvers; and engine cutoff. This information could be provided in the form of text, diagrams, or charts.

For orbital RLVs, proposed § 431.25(e) would require information concerning intermediate and final orbits intended for the vehicle and its upper stages, if any, and their estimated orbital lifetimes.

*Section 431.27 Denial of Policy Approval*

Under the proposal, the FAA would notify an applicant in writing if a policy approval is denied. The notice would state the reasons for denial and allow an applicant to respond and request reconsideration. An applicant could correct the deficiencies identified in the denial and request reconsideration of the denial. Alternatively, an applicant could request a hearing upon denial of a license.

*Subpart C—Safety Review and Approval for Launch and Reentry of a Reusable Launch Vehicle*

Subpart C would describe the FAA's safety evaluation process for reentry license applicants.

*Section 431.31 General*

The proposal states that the FAA would conduct a safety review to determine whether an applicant is capable of launching and reentering, or otherwise landing, a reentry vehicle and payload, if any, from and to a designated site without jeopardizing public health and safety and the safety of property. The launch site may be different from the reentry landing site, but both must be approved by the FAA in the context of evaluating safety issues presented by a particular RLV mission. The safety review would be conducted from an engineering perspective to ensure that all aspects of the proposed RLV mission would be sufficient to support safe operations. The safety review is necessarily tailored to the unique attributes and capabilities of a vehicle and is conducted on an individual basis.

Under the proposal, the FAA would notify an applicant in writing of any issues that might prevent issuance of a safety approval. The notice would state the reasons for lack of safety approval and allow an applicant to respond and correct the deficiencies identified.

*Section 431.33 Safety Organization*

The FAA concurs with National Transportation Safety Board (NTSB) reports and the Rodgers Commission report that indicate an independent safety organization is key to ensuring safe transportation operations. The proposal, therefore, would require an RLV mission license applicant to possess a safety organization. The FAA would evaluate an applicant's safety organization to determine whether the structure, lines of communication, and approval authority an applicant establishes would enable the applicant to identify and address safety issues and to ensure an applicant conducts operations in accordance with its license and the proposed regulations.

The experience gained by the FAA in regulating aviation and launch operations has shown that an independent safety official with direct access to the person responsible for an applicant's licensed activities can positively influence safety. Therefore, the FAA also proposes that the safety official report directly to the person responsible for the conduct of licensed activity to ensure that management adequately considers public safety concerns before initiating either flight phase of the mission. The safety official may be dual-hatted in that he or she may perform functions other than safety-related or mission-driven operations for the applicant as long as there is no ''conflict of interest'' with safety responsibilities.

The safety official would evaluate an applicant's readiness to safely conduct an RLV mission by conducting operational dress rehearsals and completing a readiness determination. Rehearsals would allow an operator to verify that vehicle safety operations personnel are ready for launch and reentry and can manage non-nominal events, especially if a considerable period of time has elapsed since the operator's most recent conduct of a mission. A review typically would be conducted before launch and, for orbital RLVs, would address reentry readiness as well. However, before initiating reentry, an operator would be required to conform with mission rules designed to ensure safe reentry and verify the status of safety critical systems. The reviews would ensure all system and personnel readiness problems are identified and resolved, all systems needed for safe conduct of the mission are checked and ready, and each participant is cognizant of his or her role in the operation. While a rehearsal may not be necessary in every case, it is critical in certain situations, such as operations with a new vehicle, reentering to a new site, or after significant personnel changes.

This proposal also would impose an affirmative obligation on the person responsible for licensed activity to address any hazards and risks to public safety identified by the safety official. Such action would help ensure that RLV mission operations satisfy the proposed expected casualty criteria. The FAA believes that management attitude influences an organization's safety compliance; therefore, the proposed regulations would impose a safety obligation on the person responsible for licensed activity to address identified hazards.

Proposed § 431.33(a) would require an applicant to maintain and define its safety organization by identifying lines of communication and approval authority. A number of different individuals typically have input and decision authority with respect to the readiness of various vehicle and safety systems. FAA and NTSB investigations have shown that mishaps could result if the role of each critical individual in the organization is not defined clearly and understood by all parties. Therefore, the

applicant would have to identify these relationships by clearly establishing and identifying the lines of communication and approval authority for all mission decisions. An applicant would have to clearly identify persons with authority to make ''hold'' and ''go/no-go'' decisions and to authorize the resumption of the countdown or a recycle procedure, for both launch and reentry flight phases. The FAA recommends using organizational charts as an efficient method of depicting an applicant's organization, lines of communication, and other required information.

Proposed § 431.33(b) would require an applicant to designate a person responsible for the conduct of all licensed RLV mission activities.

Proposed § 431.33(c) would require an applicant to identify a qualified safety official to ensure compliance with the applicant's safety policies and procedures. The person assigned to the position of safety official would have the management and technical education, training, and experience to ensure the highest degree of safety in the applicant's operations. The safety official must be identified by title or position and by name and qualifications. Before mission operations begin, and before initiation of RLV reentry or descent, the person responsible for an applicant's licensed activities must address all hazards and risks to public safety identified by the safety official.

The safety official would be responsible for evaluating an applicant's readiness to safely conduct an RLV mission by monitoring compliance with the applicant's safety policies and procedures, completing a readiness determination, and conducting operational dress rehearsals. Rehearsals would have to simulate both nominal and non-nominal conditions, under the mission readiness requirements listed in proposed § 431.37, including vehicle and range safety system failures.

*Section 431.35 Acceptable Reusable Launch Vehicle Mission Risk*

Under the proposal, paragraph (a) would establish the limits on the risk the FAA would allow for an RLV mission. The FAA proposes to assess risk on a per mission basis, commencing with initiation of vehicle flight through authorized landing on Earth. Application of risk criteria on a per mission basis means that risks presented by launch of a reentry vehicle and its subsequent reentry or other return to Earth are assessed in a cumulative manner. The expected average number of casualties from a proposed RLV mission could not exceed .00003 ($30x10^{-6}$) and casualties for any launch and reentry mission and .000001 ($1x(10^{-6})$ casualties for persons in the areas adjacent to the reentry site. Risk criteria are presented in proposed § 431.35(b). The term ''public'' would include all members of the general public but would not include the launch operator, reentry operator, and site personnel. Satisfaction of acceptable risk criteria under this part includes consideration of the size and configuration of planned landing sites, including contingency abort locations, and the surrounding area.

The FAA would establish these risk limitations as a standard for all licensed RLV mission activities. An applicant proposing a mission that does not meet the FAA's risk criteria could request a waiver from requirements (or any requirement) under 14 CFR § 404.3, by demonstrating that granting the waiver would be in the public interest.

Proposed paragraph (c) would require an applicant to submit an analysis that assesses public safety risk for the proposed activity under nominal and non-nominal conditions. The analysis would need to demonstrate that the applicant's proposed activity would not expose the general public to an unreasonable level of risk at any time during vehicle flight, as defined in proposed § 431.35(b), and would not expose the general public within a 100-mile area surrounding the reentry site to unreasonable risk, as defined in proposed paragraph (b). Based on the agency's experience in evaluating the COMET/METEOR vehicle system, the FAA believes that it is prudent to ensure that population located within a reasonable area of the intended landing site is not exposed to greater than normal background risk as a result of a licensed reentry. The one hundred mile area surrounding the proposed reentry site was utilized in COMET/METEOR because it limits public risk exposure in the event of a minor system failure during reentry causing a somewhat off-site, but not random, landing.

If an applicant previously has submitted a risk assessment for a similar reentry, the applicant may not need to submit an additional analysis. An analysis that compares the parameters and assumptions of previously approved and proposed activities, after review by the FAA, may be deemed sufficient.

Proposed paragraph (c) would require an applicant to employ a system safety process that identifies and assesses risks to public health, safety and property associated with a nominal and non-nominal mission. The FAA will issue advisory guidance on acceptability of a system safety process under this requirement. At a minimum, it must identify and assess the probability and consequences of reasonably foreseeable hazardous events and safety critical system failures during a mission including consequences of a random reentry that could jeopardize public safety.

Proposed paragraph (d) would specify the data that must be provided by an applicant as part of the demonstration of acceptable risk under this subpart. Included are drawings and schematics for each safety critical system, a timeline identifying all safety critical events and empirical data to substantiate the risk analysis required by this section.

*Section 431.37 Mission Readiness*

Under proposed § 431.37, an applicant must include procedures for verifying mission readiness for both launch and reentry operations as part of its application. The procedures must enable the person designated and responsible for the conduct of licensed operations to make a judgment of mission readiness before initiating the mission, including launch and reentry site, equipment, vehicle, payload, personnel, and safety-critical system readiness. Mission rules, constraints and contingency or abort plans and procedures must be in a state of readiness as well by ensuring that they are contained in an approved form and coordinated with launch and reentry site operators. Launch and reentry readiness procedures must include dress rehearsal procedures covering nominal and non-nominal situations and provide bases for doing away with dress rehearsals under certain circumstances. Launch and reentry readiness procedures must also cover crew rest requirements and verification.

*Section 431.39 Mission Rules, Procedures, Contingency Plans, and Checklists*

To ensure a licensee's procedures would be conducted as planned, the FAA proposes that an applicant submit as part of its application written mission rules, procedures, emergency plans, and contingency abort plans, if applicable, and that vehicle safety operations personnel have current and consistent mission checklists. Inconsistencies in critical countdown checklists and procedures can jeopardize public safety. While all mission participants may not have identical checklists, an applicant would need some means, such as a master checklist manual, to ensure participants have current and consistent

procedures. This process would ensure that flight safety critical procedures are completed successfully.

Proposed paragraph (a) would require that an applicant possess adequate mission rules, procedures, contingency plans, and checklists to execute safe nominal and non-nominal operations throughout the mission. Proposed paragraph (b) would require that mission rules, procedures, contingency plans, and checklists be contained in a safety directive, notebook, or other compilation approved by the safety official designated under § 431.33(c) of this part and concurred in by the reentry site operator, if applicable. Under proposed paragraph (c), operations personnel would need current and consistent reentry checklists.

*Section 431.41 Communications Plan*

An applicant also would be required to submit a communications plan that describes personnel communications procedures during the mission. This requirement would be substantially similar to the current requirement for a launch license applicant to submit a communications plan describing communications procedures during launch, but the procedures would be required to apply throughout the mission. The NTSB has concluded that effective communications are critical to the conduct of a safe launch, and the FAA believes the same rationale applies to RLV and reentry operations.

Personnel would be required to follow communication procedures and proper protocol to help eliminate confusion and cross talk that could cause a miscommunication leading to an unsafe condition. Personnel with decision-making authority over launch and reentry would be available on the same predetermined channel during launch countdown and reentry countdown, if any. Safety-critical communications would have to be recorded and would include hold/resume, go/no go, and emergency and contingency abort commands, and any other irrevocable decisions that could affect public safety or the safety of property.

*Section 431.43 Reusable Launch Vehicle Mission Operational Requirements and Restrictions*

Under proposed § 431.43, the FAA would establish operational requirements and impose restrictions on RLV missions. Operational requirements would be implemented through procedures developed by an applicant to ensure that RLV mission risks are contained within acceptable levels. In keeping with the preference for performance-based, rather than design, standards the FAA is not dictating the content of procedures. An applicant would be afforded flexibility in developing procedures specific to its vehicle and mission profile that accomplish certain objectives. Procedures would need to cover such safety requirements as ensuring that mission risks do not exceed stated risk criteria for nominal and non-nominal operations, ensuring RLV operations conform with operator procedures derived through the system safety process described in proposed § 431.35(c), monitoring and verifying the status of safety critical systems during mission operations, and activating a flight safety system during the launch flight phase to safely terminate flight in the event the vehicle is not operating within approved limits. The FAA believes that sole reliance by an operator on an autonomous system to abort launch flight is not sufficient to ensure public safety and that, as is the case for nearly all expendable launch vehicles, human control capability is critical to safety.

A reentry site proposed for use in conducting an RLV mission would have to be of sufficient size to accommodate the three-sigma landing dispersion and other landing impacts associated with the reentry vehicle or vehicle stage. The three-sigma footprint requirement for determining site suitability would apply to any reentry site contemplated as part of the mission, that is, the nominal targeted site as well as any contingency abort location identified in order to satisfy acceptable risk criteria during launch of an RLV. A broad ocean area may be a contingency abort location because it would satisfy requirements for site suitability. An applicant for RLV mission safety approval would be required to identify such sites and show that they are attainable given the operational capability of a proposed RLV. Restrictions are also proposed to further mitigate public safety risks during flight of any RLV.

The space industry has been voicing a growing concern regarding the increasing number of objects being placed in orbit that increases the potential for collisions between objects in space. Collisions in space create additional objects that add to the orbital debris environment and increase the potential for damage to other objects. The requirements of this section serve to mitigate hazards associated with space debris. A collision avoidance analysis shall be performed prior to RLV launch to ensure that an RLV, its payload, and any jettisoned components do not pass closer than 200 kilometers to an inhabitable spacecraft. Window closures for launch and reentry activities should be adjusted to account for uncertainties in the predicted positions of inhabitable spacecraft. The 200 kilometer separation distance is currently practiced by Federal launch ranges.

To further assure public safety, the FAA is proposing a number of additional restrictions applicable to all RLVs. The FAA is proposing that the projected IIP of the vehicle shall not have substantial dwell time over densely populated areas during any segment of mission flight. The agency is not setting design-type requirements for determining what constitutes a densely populated area. This determination is consequence-driven, in the agency's view. For example, even though an applicant has satisfied the agency's risk criteria of $E_c$ no greater than 30 casualties in a million missions, if the consequence of a mission accident at a particular location would result in a significant number of actual casualties, then the FAA would view that area as densely populated for safety purposes. To mitigate debris risks that would interfere with the safety of other launch and reentry missions, the FAA proposes that RLV operators ensure no unplanned physical contact between its RLV and payload with other space objects and that explosive risks are minimized. The proposed requirement is intended to mitigate the hazards posed by orbital debris generation to the integrity of another vehicle and is in furtherance of the agency's safety responsibility for the conduct of licensed activities. This requirement is comparable to that imposed on licensed launch of an expendable launch vehicle involving an upper stage that remains on orbit.

The proposal contains crew rest requirements for vehicle safety operations personnel because their performance might affect public safety. Experience has shown that crew rest criteria for those involved in supporting space operations are extremely important and would have a significant impact on organizational safety. Crew rest is of particular concern when the same crew is involved in pre-launch preparation, launch, on orbit operations, monitoring reentry-readiness, and reentry flight of the vehicle. The proposed crew rest rules are based on an NTSB investigation of an anomaly that occurred during a commercial launch from a Federal launch range and are intended to ensure RLV mission personnel readiness. The specific work and rest standards are similar to those currently used at Federal launch ranges ''Eastern and Western Range 127–1 Range Safety Requirements,'' Section 6.5.1.4 (March 31, 1995). The FAA has

not reviewed the impact the proposed crew rest standards might have on an operator intending to launch and reenter a vehicle in a short time period. The FAA invites comments from the public on the practicality and potential burden to industry of the proposed crew rest standards and also requests information regarding analogous crew rest requirements in other industries or regulated areas.

Proposed paragraph (d) establishes additional restrictions on an unproven vehicle. The projected IIP of an unproven reentry vehicle must not have substantial dwell time over a populated, as opposed to a densely populated, area during any segment of the mission unless the applicant can demonstrate that it satisfies stated risk criteria assuming the vehicle will fail while the IIP is over a populated area.

To further enhance public safety when an RLV reenters from Earth orbit, the FAA proposes under § 431.43(e) that the operator must be able to monitor the status of safety critical systems before enabling reentry and verify that the condition of the vehicle is such that it can reenter safely. The operator would also be required to issue a positive command to enable the vehicle's reentry. The FAA is aware that some RLV operators are contemplating totally autonomous reentry capability. The agency is concerned that authorizing reentry of such vehicles would not fulfill adequately its public safety responsibility. In the absence of active control, those systems and conditions determined necessary for safe reentry would not be verified before reentry is initiated and safety could be compromised. Accordingly, because of the possibility of system anomalies or other non-compliant conditions, the proposed rules require that an operator enable reentry.

*Section 431.45 Mishap Investigation Plan and Emergency Response Plan*

The proposal also would require that an applicant prepare a mishap investigation plan (MIP) and emergency response plan (ERP) to respond to a launch or reentry accident or incident, or unplanned event during the mission. In addition to accident investigation plan requirements applicable to launches under part 415 of the regulations, the MIP would include procedures covering the reentry phase of a mission, including immediate notification to the FAA of a mishap and procedures for minimizing damage, preserving evidence, investigating or cooperating with an investigation conducted by the FAA or NTSB, reporting investigation results, and identifying and adopting preventive measures for avoiding recurrence of the event. This requirement would be substantially similar to the requirement for a launch license applicant to submit a plan describing accident and mishap investigation and emergency response procedures for a launch accident or incident.

Also required would be emergency response plan whereby an RLV operator would be responsible for contacting local officials in the event a non-nominal reentry occurs and can be projected to impact at an identified location.

*Section 431.47 Denial of Safety Approval*

Under the proposal, the FAA would notify an applicant in writing if a safety approval application is denied. The notice would state the reasons for denial and allow an applicant to respond and request reconsideration. An applicant could correct the deficiencies identified in the denial and request reconsideration of the denial or, upon denial of a license, an applicant may request reconsideration.

*Subpart D—Payload Reentry Review and Determination*

Subpart D would explain when a payload reentry review and determination would be required and the factors considered in that review. Either an RLV mission license applicant or a payload owner or operator may apply for a payload reentry determination separately from an RLV mission license application. A license applicant could request a summary determination, if the risks to public safety posed by the payload proposed for reentry are substantially similar to a previously approved payload reentry determination issued earlier to the applicant, the payload owner or operator, or another RLV mission license applicant. For purposes of launching the payload, payload review procedures and requirements of part 415 would apply.

*Section 431.51 General*

The proposed section would describe the scope of an FAA payload reentry review. Payloads owned and operated by the U.S. Government or subject to the reentry authority of another Government agency, such as the Department of Commerce, would be exempt from this subpart. A payload reentry review and determination is required to address the unique safety and policy issues presented by the return to Earth of a payload that has been launched or otherwise operated in outer space. A hazardous substance may be approved for launch over water or other unpopulated area, but disapproved for reentry if the consequences of dispersion cannot be adequately contained for a planned reentry to a site on land.

*Section 431.53 Classes of Payloads*

The proposal would permit an applicant to request a payload determination for a type or class of payload. The applicant would describe the type or class of payload proposed for reentry under the license and general characteristics of the payload. If a payload reentry determination is issued for a class of payloads under this section, the RLV mission license applicant would have to later provide additional information regarding the specific payload before reentering it.

*Section 431.55 Payload Reentry Review*

Proposed § 431.55 describes how the FAA would coordinate a payload reentry review with other Government agencies, such as the Department of Defense, the Department of State, and NASA. Other agencies may include the Department of Commerce and the Federal Communications Commission. It also would describe those issues that would be addressed by the FAA in a payload reentry review. The FAA would notify an applicant of any issue raised during the payload reentry review that would impede a favorable payload reentry determination, and the applicant could respond or revise its application.

*Section 431.57 Information Requirements for Payload Reentry Review*

The proposal would describe the specific information that an applicant would be required to provide to the FAA to perform a payload reentry review and conduct any necessary interagency review. In cases that present potential unique safety concerns, the FAA would require considerable detail regarding the physical characteristics, functional description, and operation of the payload, and its ownership.

*Section 431.59 Issuance of Payload Reentry Determination*

Proposed § 431.59 would explain that the FAA issues a payload reentry determination unless policy or safety considerations prevent reentry of the payload. If an applicant were to fail to obtain a favorable payload reentry determination, the applicant could attempt to correct the deficiencies that necessitated the denial and request reconsideration of the denial or, upon

denial of an RLV mission license, the applicant could request reconsideration.

*Section 431.61 Incorporation of Payload Reentry Determination in License Application*

The proposal states that a favorable payload reentry determination may be included in the RLV mission license application. If, prior to a licensed mission, there is a change in the information submitted for a payload reentry determination, it is the licensee's responsibility to report the change to the FAA which may revisit its determination. The licensee must ensure that the payload owner or operator reports any such changes to the licensee so that the licensee is in compliance with the requirement.

*Subpart E—Post-Licensing Requirements—Reusable Launch Vehicle Mission License Terms and Conditions*

Subpart E would describe post-licensing requirements for an RLV mission licensee, including license terms and conditions.

*Section 431.71 Public Safety Responsibility*

Proposed paragraph (a) would state that an RLV mission licensee is responsible for ensuring a safe mission and protecting public health and safety and the safety of property at all times during the conduct of the mission.

Proposed paragraph (b) would require the licensee to conduct its operations in accordance with representations made in its license application. Failure to conduct a licensed activity in accordance with the application would be cause for the FAA to revoke the license or take other appropriate enforcement action.

*Section 431.73 Continuing Accuracy of License Application; Application for Modification of License*

The proposal would require a reentry licensee to ensure the continuing accuracy of representations contained in its application for the term of its license and to conduct procedures and operations in accordance with its application. An RLV mission licensee would be required to apply to the FAA for modification of the license if any representation material to public health and safety and the safety of property made in the application is no longer accurate. A license modification application would have to conform with part 413 of this chapter and indicate the part of the license or license application affected. The proposal also would state that the FAA would review its previous determinations and approvals to determine their continued validity.

*Section 431.75 Agreements*

The proposed rules specify a number of agreements that an RLV mission licensee must have in place before conducting licensed activities. Just as launches of expendable launch vehicles from Federal launch ranges must be conducted under an agreement between a licensed launch operator and the Federal range for the provision of U.S. Government launch property and services, so must the conduct of an RLV mission or reentry using Federal range facilities. The FAA also envisions that licensed launch site operators will, through agreements with users of its facilities, require adherence to its safety rules and requirements and such agreements must be finalized before licensed launch or reentry activity occurs at the licensed site. In either case, the terms of an agreement between the RLV mission (or reentry) licensee and the site operator (whether Federal or non-Federal) would be expected to cover, as appropriate to the flight phase being conducted at the site, preparation for licensed flight, securing the vehicle before launch and after reentry, and transporting the vehicle from the site following its reentry, because these operations must be done in a manner that does not jeopardize public health and safety. A licensee would be required to comply with any portions of an agreement that would affect public health and safety and the safety of property during the conduct of a licensed RLV mission or reentry.

Federal launch ranges coordinate Notices to Airmen and Notices to Mariners with the FAA and the U.S. Coast Guard, respectively. Consequently, there need be no additional responsibility imposed on an RLV mission or reentry licensee to issue such notices when utilizing a Federal range facility as the site of a licensed launch or reentry. In a separate rulemaking, the FAA intends to propose that a licensed launch site operator undertake responsibility for completing an agreement with the FAA and Coast Guard, respectively, for the issuance of such notices when launches are conducted at its launch site in order to assure a single point of contact. However, in the absence of such agreements, responsibility for safety coordination with regional FAA and Coast Guard offices would remain with the vehicle operator. An RLV mission (or reentry) licensee that utilizes a licensed site would be relieved of these responsibilities if issuance of notices is covered by an agreement between the licensed site operator and other modal administrations of the U.S. Department of Transportation. An RLV mission or reentry licensee authorized to conduct licensed activities at a private site, or one that is reserved for its exclusive use, would be obligated to complete such agreements. An example of an exclusive, although not private, launch and reentry site would be the lot at the Nevada Test Site authorized for use by Kistler Aerospace Corporation (Kistler) under a subpermit from the Nevada Test Site Development Corporation. Although the launch and reentry site to be utilized by Kistler are located on U.S. Government property and therefore not privately owned, the Nevada Test Site is not a Federal launch range as defined in the Commercial Space Transportation Licensing Regulations. Therefore Kistler would be responsible for completing an agreement with the appropriate FAA regional office for issuance of Notices to Airmen and compliance with other public safety measures involving air routes. Because the Nevada Test Site is an inland location, it is highly unlikely that a comparable agreement with the U.S. Coast Guard would be necessary.

*Section 431.77 Records*

Proposed § 431.77 would require a licensee to maintain for a period of 3 years all records, data, and other material related to a licensed RLV mission activity. In the event of a launch or reentry accident, or launch or reentry incident, the proposal would require a licensee to preserve all records related to the event until the FAA advises the licensee that the records need not be retained.

*Section 431.79 Reusable Launch Vehicle Mission Reporting Requirements*

Under the proposal, a licensee would be required to report certain information to the Associate Administrator at least 60 days before each RLV mission. Not later than fifteen days before a mission, a licensee would be required to report the time and date of the planned RLV mission to the Associate Administrator. The proposal also would require the immediate submission of accident, incident, and mishap information to the FAA in accordance with proposed § 431.45. The FAA invites public comment on the timeframes proposed for reporting requirements in light of operator plans for rapid RLV launch and reentry services.

*Section 431.81 Financial Responsibility Requirements*

Proposed § 431.81 would require a licensee to comply with financial

responsibility requirements specified in its license.

*Section 431.83 Compliance Monitoring*

Proposed § 431.83 explains that a licensee is required to cooperate with the FAA's compliance monitoring policy.

*Section 431.85 Registration of Space Objects*

Consistent with the recently issued Commercial Space Transportation Licensing Regulations, certain information must be reported to the FAA regarding placement of objects in space. Information requirements applicable to RLV missions and the associated timeframe for reporting information are consistent with those for ELV launches.

*Subpart F—Environmental Review*

Subpart F would set forth the FAA's environmental review requirements. Regulations contained in this subpart would be substantially similar to the environmental review regulations applicable to launch licenses under part 415, subpart G.

*Section 431.91 General*

Under the proposal, an applicant would be required to provide the FAA with the information necessary for the FAA to comply with applicable environmental laws and regulations, including 42 U.S.C. 4321 *et seq.*, the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA; 40 CFR parts 1500–1508; and the FAA's Procedures for Considering Environmental Impacts, FAA Order 1050.1D. The proposal also would indicate how copies of these documents could be obtained.

*Section 431.93 Environmental Information*

Proposed § 431.93 would require an applicant to provide the FAA with required environmental information for a reentry site and contingency abort locations, if any, and activities that may have new effects on established reentry sites. Use of a new vehicle, or reentry of a payload with characteristics falling measurably outside the parameters of existing environmental documentation, would also be subject to FAA environmental review requirements.

*Part 433—License To Operate a Reentry Site*

The proposal would create a new part 433 that prescribes licensing requirements and procedures applicable to operation of a reentry site. Reentry sites may offer an array of reentry services or may simply provide a secured area within which reentry may occur. Given the breadth of possibilities, and the agency's desire to allow prospective reentry site operators to develop unique proposals for operation, the FAA intends to evaluate the safety of a particular site on an individual basis. This principle appears in proposed § 433.1.

*Section 433.1 General*

Proposed section 433.1 reflects the principle that the FAA will evaluate on an individual basis whether an applicant is capable of safe operation of a reentry site and whether a proposed site is suitable to support reentry operations.

*Section 433.3 Issuance of a License To Operate a Reentry Site*

Under § 433.3, the FAA would license an operator to offer use of a reentry site if its operation does not jeopardize public health and safety, safety of property and U.S. national security and foreign policy interests. As with other licenses, the authorization granted by an FAA license would be limited to the representations contained in the licensee's application and subject to terms and conditions stated in the license.

*Section 433.5 Operational Restrictions on a Reentry Site*

A reentry vehicle may be authorized to reenter to a site that, among other things, satisfies within three standard deviations the probable dispersion of the vehicle upon landing. This measure of landing dispersion is known as the three-sigma footprint of a vehicle. A reentry site may be offered to support reentry of a particular reentry vehicle if the vehicle's three-sigma footprint is contained entirely within the reentry site.

*Section 433.7 Environmental*

Issuance of a license to operate a reentry site is a major Federal action subject to agency review under the requirements of the National Environmental Policy Act. Section 433.7 provides that an applicant shall provide sufficient information to enable the FAA to fulfill its environmental review responsibilities under Federal law and FAA procedures.

*Section 433.9 Environmental Information*

Although a reentry site may be covered by existing environmental documentation, its use to support licensed reentry activities and other site operations may not be adequately addressed. Section 433.9 provides that a reentry site operator must submit information to support environmental review of reentry impacts at the site, if not already covered in existing documentation.

*Part 435—Reentry of a Reentry Vehicle Other Than a Reusable Launch Vehicle (RLV)*

The proposal would create a new part 435 that addresses FAA's anticipation that there may be some reentries that will not involve reusable launch vehicle (RLV) technology. A COMET/METEOR type of reentry vehicle or other reentry vehicle capability that is not also an RLV may be proposed for reentry, and regulations are required to address licensing requirements applicable to those vehicles. Under the proposal, the FAA would evaluate safety aspects of reentry vehicles of this nature on an individual basis using the same three-pronged approach proposed for RLVs. The three-pronged approach consists of a risk criteria assessed on a per mission basis so that it encompasses the risks to public safety presented by the launch of a reentry vehicle in addition to its reentry, operational requirements and restrictions, and utilization of a system safety process. Compliance with that portion of regulations and licensing procedures proposed for an RLV mission that pertain to its reentry would apply to a license to reenter a reentry vehicle. Any person seeking a license to reenter a reentry vehicle should refer to part 431 regulations governing RLV missions. Only those requirements and licensing considerations that are unique to reentry of a reentry vehicle that is not also an RLV would be expressly stated in part 435.

*Section 435.1 Scope*

Proposed § 435.1 would establish the applicability of part 435. The proposed part would prescribe the requirements for obtaining a license to conduct a reentry of a reentry vehicle other than an RLV and any continuing requirements to remain licensed.

*Section 435.3 Types of Reentry Licenses*

The proposed section would identify the two types of reentry licenses that would be issued and set forth the privileges and limitations of the licenses. Under the proposal the FAA would issue either a reentry-specific or operator license, on bases comparable to that used for issuing launch.

A reentry-specific license would identify the specific missions to which it applies. An expiration date would be

stated in the license so that it is not unlimited as to time.

An operator license would authorize reentry operations on an ongoing basis, as is currently done for launch. An initial two-year license term is proposed.

*Section 435.5 Policy and Safety Approvals*

Under the proposal, a license applicant would be required to obtain policy and safety approvals from the FAA. Requirements for obtaining these approvals are contained in subparts B and C of this part.

*Section 435.7 Payload Reentry Determinations*

A payload reentry determination would be required, consistent with proposed requirements for RLV missions, for purposes of returning a payload to Earth unless it is exempt from FAA review. As with other payload determinations, a payload substantially similar to a previously approved payload may be reviewed using a comparative analysis. Under paragraph (b), a previous payload reentry determination may be used to meet the requirements of proposed paragraph (a). Proposed paragraph (c) identifies the payload review procedures applicable to reentering a payload. A payload review determination may be requested of the agency in advance of or separately from a reentry license application.

*Section 435.9 Issuance of a Reentry License*

The FAA would issue a license to an applicant who has obtained all approvals and determinations required under this chapter for a reentry license, including a policy and safety approval and payload reentry determination, if necessary. The authorization would be limited to representations contained in an application and subject to licensee compliance with applicable requirements of the agency.

*Section 435.11 Additional License Terms and Conditions*

As proposed, the FAA may amend a reentry license by modifying or adding license terms and conditions to ensure compliance with 49 U.S.C. Subtitle IX, chapter 701, and applicable regulations.

*Section 435.13 Transfer of a Reentry License*

Consistent with other licensing authority of the agency, only the FAA would be able to transfer a reentry license. The prospective transferee would need to satisfy all requirements for obtaining a license as specified in this chapter.

*Section 435.15 Rights Not Conferred by Reentry License*

Proposed § 435.15 would state that the license would not relieve a licensee of its obligation to comply with applicable laws.

*Subpart B—Policy Review and Approval for Reentry of a Reentry Vehicle*

This subpart would impose requirements for a policy review consistent with those for an RLV mission license.

*Section 435.21 General*

Under the proposal, the FAA would issue a policy approval to a reentry license applicant upon completion of a favorable policy review; it would be part of the licensing record.

*Section 435.23 Policy Review Requirements and Procedures*

An applicant for reentry policy review and approval would be referred to requirements expressed in proposed part 431, subpart B concerning policy review for an RLV mission. The FAA reserves authority to impose additional requirements unique to reentry policy concerns, if any.

*Subpart C—Safety Review and Approval for Reentry of Reentry Vehicle*

Subpart C would describe the FAA's safety evaluation process for reentry license applicants. The safety review is conducted to ensure that all safety aspects of a proposed reentry have been adequately addressed. The safety review is necessarily based on the unique attributes and capabilities of a vehicle and is conducted on an individual basis, measured against a regulatory risk criteria.

*Section 435.31 General*

The proposal states that the FAA would conduct a safety review to determine whether an applicant is capable of reentering a reentry vehicle and payload, if any, to a designated site without jeopardizing public health and safety and the safety of property. The suitability of a proposed reentry site would be assessed by the FAA in the context of evaluating safety issues presented in a particular reentry proposal.

*Section 435.33 Safety Review Requirements and Procedures*

Safety review requirements proposed for the reentry or descent flight phase of an RLV mission would apply to the reentry safety review, unless otherwise stated in proposed subpart C of part 431.

*Section 435.35 Acceptable Reentry Risk for Reentry of a Reentry Vehicle*

The FAA is proposing a mission approach to assessment of reentry safety and risk. As proposed, the risk presented by a proposed reentry, in combination with the launch of the reentry vehicle into Earth orbit or outer space, must not exceed acceptable risk for an RLV mission. As indicated previously in the supplementary information of this proposed rule, the FAA requests comment on its proposed approach to combined risk.

*Subpart D—Payload Reentry Review and Determination*

*Subpart E—Post-Licensing Requirements—Reentry License Terms and Conditions*

*Subpart F—Environmental Review*

Consistent with the FAA's general approach to authorizing reentry, requirements governing payload reentry review, license terms and conditions, and environmental review for the reentry or descent phase of an RLV mission would apply to a reentry license application, unless otherwise stated in the regulations.

**Paperwork Reduction Act**

This proposal contains the following new information collection requirements subject to review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995 (44 U.S.C. § 3507(d)).

*Title:* Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations.

*Summary:* The FAA proposes to amend the commercial space transportation licensing regulations by establishing operational requirements for launches of reusable launch vehicles (RLVs) and the authorized conduct of commercial space reentry activities. The proposed rule would respond to advancements in the development of commercial reentry capability and enactment of legislation extending the FAA's licensing authority to reentry activities. The agency is proposing requirements that limit risk to the public from RLV and reentry operations.

*Description of Respondents:* Applicants seeking licenses to conduct licensed reentry operations and launches of RLVs.

The proposed rule outlined is in accordance with the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.* The required information will be used to determine whether applicants satisfy requirements for obtaining a launch license to protect the public

from risks associated with RLV missions and other reentries. The information to be collected includes data required for performing a safety review, which includes a technical assessment to determine if the applicant can safely reenter a reentry vehicle, including an RLV and payload, if any, to a designated reentry site without jeopardizing public health and safety and safety of property. The frequency of required submissions may depend upon the frequency of licensed launch activities; however, a license may authorize more than one launch. The estimated average burden hours per respondent are 4,384 hours.

The agency is soliciting comments to (1) evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) evaluate the accuracy of the agency's estimate of the burden; (3) enhance the quality, utility, and clarity of the information to be collected; and (4) minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology (for example, permitting electronic submission of responses). Individuals and organizations may submit comments on the information collection requirement by June 21, 1999, to the address listed in the **ADDRESSES** section of this document.

**International Compatibility**

The FAA has determined that a review of the Convention on International Civil Aviation Standards and Recommended Practices is not warranted because there is not a comparable rule under ICAO standards.

**Regulatory Evaluation Summary**

Proposed and final rule changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980, as amended in May 1996, requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effect of regulatory changes on international trade. In conducting these analyses, the FAA has determined that the proposed rule would generate benefits that justify its costs and is ''not a significant regulatory action'' as defined in the Executive Order and the Department of Transportation Regulatory Policies and Procedures. The proposed rule is not a significant action. The proposed rule would not have a significant impact on a substantial number of small entities and would not constitute a barrier to international trade. In addition, this proposed rule does not contain Federal intergovernmental or private sector mandates. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply. These analyses, available in the docket, are summarized below.

**Baseline for Economic Analysis**

The proposed rule implements certain policies developed by AST in 1992 with respect to public safety for the first commercial space reentry operation. However, the safety criteria proposed in this rulemaking uses different measures that better reflect current agency and range safety practices. The 1992 policy established safety criteria pertaining to a unique and specific request to conduct a first-of-a-kind payload reentry mission; that is, the COMET, later renamed METEOR, reentry vehicle. Accordingly, a comprehensive regulatory (benefit-cost) analysis was not required. Therefore, the baseline case used for this analysis views the proposed rule as a new requirement imposed on an emerging segment of the commercial space transportation industry that plans to operate reusable launch vehicles (RLVs) or conduct reentry operations with reentry vehicles (RVs). Doing so implies that, but for imposition of safety requirements by the agency, some compliance costs would not have been incurred by entities planning to conduct RLV missions (launch and reentry) and RV operations that are associated with launches from Federal ranges. (Regulatory costs and benefits associated with launches from Federal ranges are assessed as part of a separate rulemaking on launch licensing requirements for launches from Federal ranges.)

*Costs*

The proposed rule is expected to impose a total estimated cost of $113 million ($65 million, discounted), in 1997 dollars, on the commercial space transportation industry and the FAA over the 15-year period from 2000 to 2014. Commercial space transportation industry operators potentially impacted by the proposed rule would incur approximately 27 percent (or $30 million) of this total cost estimate in the form of compliance costs. The FAA would incur about 73 percent (or $83 million) of the total cost estimate in the form of administrative costs. All monetary values shown in this regulatory evaluation summary are expressed in 1997 dollars over the 15-year period. Due to some of the operational requirements of the proposed rule, costs may materialize that have not been specifically considered in this evaluation. For example, the proposed requirement for each commercial space operator to have an independent safety inspector could, under certain circumstances, result in costs not examined in this evaluation. The independent safety inspector could require the operator to abort a launch or reentry for safety reasons, which would result in higher operating costs. Due to this additional safety oversight, it is uncertain whether all cost and benefit considerations have been captured in this evaluation. Accordingly, the FAA solicits industry comments on the extent to which this evaluation has captured critical costs associated with the proposed rule.

Reentry of RLVs and RVs are subject to comparable safety requirements and therefore regulatory costs for reentry are assessed collectively. Costs are assessed on the basis that, over the next 15-year period, five commercial operators of RLVs or RVs would be impacted by the regulations. It is assumed that five operators would obtain all necessary approvals to conduct RLV missions or RV reentries and that market demand is sufficient to support that level of vehicle operation.

**Industry Compliance Costs**

*Section 431.25 Application Requirements for Policy Review and Section 435.23 Policy Review*

These sections of the proposed rule would impose an administrative paperwork burden on each of the five anticipated commercial space industry operators potentially impacted by requiring them to provide specific policy review information to the FAA with regard to their anticipated RLV missions (launch and reentry) or RV reentry operations. Compliance with this proposed section would result in an estimated cost of $400 per operator to assemble the data and submit each application or $2,000 (5 x $400), in 1997 dollars, for all five operators over the 15-year period. The cost estimate of $400 per operator assumes an employee with an annual loaded salary of approximately $103,000 (with fringe benefits) and a level of effort of eight hours.

*Section 431.33 Safety Organization and Section 435.33 Safety Review Requirements and Procedures*

Under the baseline, a safety organization with clearly defined roles, responsibilities, authorities, and lines of communication is consistent with the findings and recommendations of the Rodgers Commission and National Transportation Safety Board. However, the proposed requirement to ''* * * designate a qualified safety official * * * to monitor independently compliance * * * with * * * [all] safety policies and procedures'' is not necessarily customary and usual practice. Inclusion of this proposed requirement suggests that it is a refinement of industry baseline practices designed to mitigate safety risks to the public. For example, to be ''responsible for the conduct of all * * * mission activities * * *''implies a degree of comprehensiveness that may not be common practice in industry. Because the safety official must be independent, the function cannot be assigned as a collateral duty to an individual with line responsibility for launch and reentry operations though it could conceivably be assigned to an existing employee. Furthermore, the magnitude of responsibilities of the safety official suggests that the level of effort required to perform this function would exceed part-time employment. Assuming that the independent safety official function will not be performed as a collateral duty, this proposed requirement would result in a commercial space transportation entity hiring a person to fulfill the safety official role. An annual loaded salary for this position would be about $103,000. Therefore, the total incremental compliance cost to a commercial operator attributable to the proposed requirement would be about $1.6 million or $8 million (5 × $1.6 million) for all five operators over the 15-year period.

*Section 431.35 Acceptable Reusable Launch Vehicle Mission Risk, and Section 435.35 Acceptable Reentry Risk for Reentry of a Reentry Vehicle*

Commercial space transportation entities are expected to incur additional costs for performance of risk analyses of vehicle operations, including reentry, and would incur costs in assessing the probabilities and consequences of all reentry hazards, events, and system failures that potentially expose the public to risk. Additionally, commercial entities would expend effort preparing documentation and establishing an associated document control system for drawings and schematics. This compliance activity is expected to fulfill the level of rigor implied by the requirements contained in the proposed rule. The cost impact to a commercial entity attributable to this proposed requirement would be approximately $757,000 in the first year of operation, with recurring costs of $3,600 annually, in 1997 dollars. Over the 15-year period, from 2000 to 2014, the cost of compliance for each potentially impacted operator would be about $800,000. The total cost of compliance for all potentially impacted operators would be approximately $4 million (5 × $800,000), over the 15-year period.

*Section 431.37 Mission Readiness and Section 435.33 Safety Review Requirements and Procedures*

The proposed requirement to provide specific procedures to the FAA that verify mission readiness presents an administrative paperwork burden to a commercial entity. This proposed requirement would cause an operator to incur costs for preparing and submitting the requisite information to the FAA. A knowledgeable employee having an annual salary of about $103,000 over a period of 80 hours would perform the requirement. This exercise would result in a paperwork cost to a commercial entity of approximately $4,000 per application submittal over the 15-year period. For all entities, this proposed requirement would impose an estimated cost of compliance of $20,000 (5 × $4,000) over the 15-year period.

*Section 431.39 Mission Rules, Procedures, Contingency Plans, and Checklists, and Section 435.33 Safety Review Requirements and Procedures*

Commercial space transportation entities are generally expected to fulfill the proposed requirements as part of their standard operating procedures. However, the FAA anticipates that these entities would incur some additional costs conforming to FAA requirements. Additionally, commercial entities are expected to incur costs from submitting updated documents with the FAA periodically, and preparing for, accommodating and reacting to FAA inspection and compliance monitoring activities. The cost impact to a single commercial space transportation entity to comply with this proposed requirement would be approximately $90,000 or $450,000 (5 × $90,000) for five entities over the 15-year period.

*Section 431.41 Communications Plan and Section 435.33 Safety Review Requirements and Procedures*

Commercial space transportation entities are expected to have in place a communications plan that, for the most part, are consistent with proposed regulatory requirement as a matter of standard business practice. However, they are expected to incur incremental costs complying with the requirement, annual recurring costs from interfacing and exchanging documents with the FAA periodically and preparing for, accommodating, and reacting to FAA inspection and compliance monitoring activities. The cost impact to a single commercial space transportation entity to comply would be approximately $90,000 or $450,000 for all five entities over the 15-year period.

*Section 431.43 Reusable Launch Vehicle Mission Operational Requirements and Restrictions, and Section 435.33 Safety Review Requirements and Procedures*

(Mission Operational Requirements: Dwell Time)

Commercial space transportation entities are expected to expend additional levels of effort to comply with risk mitigation requirements that, to some extent, may limit vehicle flight path options during nominal and non-nominal operations, specifically limitations on dwell time over populated areas and requirements for performing a collision avoidance analysis during launch windows to maintain adequate separation from orbiting objects.

(Rest and Duty Restrictions)

This proposed rule would impose work restrictions and personnel rest requirements on commercial space transportation entities potentially impacted by this action. For example, an individual having direct control over reentry or involved in decisions affecting reentry operations is restricted to working 60 hours over the seven-day period preceding reentry. Further, the proposed rule would reduce the maximum permissible hours worked per shift to 12, limits the maximum number of consecutive workdays to 14, and specifies the minimum rest required (48 hours) between five consecutive days of 12-hour work shifts.

Currently, based on information received from industry, it is common practice among commercial space transportation entities to follow Air Force work and rest standards for launches. Those standards are similar to the proposed requirements. Ordinarily,

based on industry information, launch mission operations personnel work less than the maximum currently permissible, such as a 40-hour workweek comprised of five eight-hour shifts. Hence, the 72-hour workweek is generally an extreme condition that occurs infrequently.

The duration of a reentry operation is likely to determine the extent of the impact that the proposed work and rest requirements would have on commercial space transportation entities. However, this impact would occur under extreme or limiting conditions only (e.g., one reentry operations person).

Given the relatively small size of the entities comprising the emerging RLV segment of the commercial space transportation industry, staff augmentation of at least one person is not unlikely as a result of the proposed requirements. Additionally, the FAA anticipates that additional costs would be incurred for recordkeeping to ensure compliance with required work and rest standards, and preparing for, accommodating, and reacting to FAA inspection and monitoring activities.

The incremental cost to a single commercial entity to comply with this proposed work and rest requirement would be slightly more than $3 million over the 15-year period. Over this same period, for all five entities, the cost of compliance would be $16 million ($5 × $3.2 million).

*Section 431.45 Mishap Investigation Plan and Emergency Response Plan, and Section 435.33 Safety Review Requirements and Procedures*

As a matter of standard business practice, commercial entities are expected to have prepared emergency response plans that are consistent with much of the regulatory requirement. However, the FAA anticipates that these plans would require additional annual maintenance to comply with certain elements of the proposed rule. For example, entities are likely to incur additional costs to establish their ability to successfully respond to accidents occurring in remote areas having sparse populations. Furthermore, additional annual maintenance costs are expected to arise from preparing for, accommodating, and reacting to FAA inspection and monitoring activities. Accordingly, a commercial space transportation entity would incur incremental costs of $542,000 or $2.7 million (5 × $542,000) for all five entities over the 15-year period.

*Section 431.57 Information Requirements for Payload Reentry Review and Section 435.43 Payload Reentry Review Requirements and Procedures*

This proposed requirement to provide specific payload information to the FAA presents an administrative paperwork burden to a commercial entity. The submission of data to the FAA is estimated to impose costs of $400 per application or $2,000 for all five entities over the 15-year period.

*Section 431.73 Continuing Accuracy of License Application; Application for Modification of License*

The proposed requirement would impose minor costs on a licensee to advise the FAA of material changes to its application, and RLV and reentry missions that may impact public safety and property. Depending upon the types of changes reported, it is assumed based on input received from FAA and industry technical personnel that, on average, a licensee would incur incremental compliance costs of approximately $33,000 per modification application or $165,000 (5 × $33,000) for five entities over the 15-year period.

*Section 431.75 Agreements, and Section 435.51 Post Licensing Requirements—Reentry License Terms and Conditions (General)*

Entities that conduct commercial launches of ELVs from Federal ranges must enter into formal agreements with the Federal range authority prior to using such facilities. Entities planning to use these same facilities for reentry missions would also be required to enter into such agreements. The proposed requirement has no impact on commercial entities other than the negligible level of effort expended (e.g., less than one hour) to advise the FAA of compliance, and the incremental cost to industry to comply with this requirement would be negligible.

*Section 431.77 Records and Section 435.51 Post Licensing Requirements—Reentry License Terms and Conditions (General)*

It is generally accepted practice among all commercial concerns to maintain business operations records for some period of time, often more than three years. Furthermore, the availability and capability of electronic storage systems renders records retention a manageable task. Accordingly, the proposed three-year requirement to maintain records for FAA review, upon request, would not impact commercial space transportation entities. From a worst case perspective, this evaluation assumes the FAA would exercise its record request authority. As a result the cost of compliance is expected to be about $400 per entity per year. Over the 15-year period, the cost would be $6,000 (400 × 15) per entity or $30,000 (5 × $6,000) for five entities.

*Section 431.79 Reusable Launch Vehicle Mission Reporting Requirements, and Section 435.51 Post Licensing Requirements—Reentry License Terms and Conditions (General)*

The information to be supplied by a licensee under this proposed requirement is similar to that supplied previously to the FAA during the application process in accordance with Section 431.57. The burden placed on the licensee is to provide more specific mission data than that supplied previously but closer in time to the actual conduct of the mission. Because an operator must have this data to perform a scheduled mission, the incremental cost to industry to comply with this proposed requirement would be zero.

*Section 431.93 Environmental Information, and Section 435.61 Environmental Review (General)*

Because licensing is a major Federal action, a commercial space transportation entity would be required to provide information addressing the environmental effects of its operations so that the agency can fulfil its responsibility under NEPA and CEQ environmental regulations, even in the absence of the proposed rule. Commercial entities planning to conduct launch and reentry missions must submit environmental assessment data to the FAA regarding environmental impacts of its proposed activities. Additional information must be submitted to evaluate environmental effects not previously assessed by the agency. This proposed requirement would cause a commercial entity to incur incremental compliance costs of $271,000 per entity or $1.4 million (5 × $271,000) for five entities over the 15-year period.

*Section 433.7 Environmental*

An analysis of the environmental impacts of operating a reentry site is required under NEPA. The proposed requirement, as distinct from similar requirements for operation of a launch site, would cause a applicant to incur incremental compliance costs of $162,000 over the 15-year period as a result of the need to submit additional information to the agency to evaluate environmental effects not previously assessed by the agency. For all

operators, the cost of compliance would be about $800,000 over the same period.

**FAA Administrative Costs**

The proposed rule would result in the FAA expending great effort in evaluating RLV mission and reentry license applications and monitoring licensees for compliance.

This evaluation estimates that the FAA would incur costs of approximately $83 million ($45 million, discounted), 1997 dollars over the 15-year period, as the result of administering its review of license applications and monitoring of licensees compliance in accordance with the proposed requirements of certain sections of parts 431, 433, and 435.

The FAA's actual experience in evaluating an application to conduct a reentry mission is limited to the COMET and METEOR programs. Much of the proposed rule reflects safety policies for reentry developed by the agency in 1992 to ensure that the COMET/METEOR payload reentry missions would not jeopardize public health and safety and health and the safety of property. Consequently, this experience provides a partial basis for establishing the costs to the FAA for administering the proposed rule. Using this past experience, AST expects that the costs to be incurred in performing its RLV mission and reentry licensing pre-application consultation, application evaluation, and compliance monitoring duties in the near term to be higher than that incurred for COMET/METEOR for a single application, with or without a formal reentry licensing regulation. The extent to which such costs would be higher than that incurred for COMET/METEOR is unknown since there is no history of U.S. commercial reentry activity. The assessment of higher application costs, however, is largely due to the expectation that inherently more complex RLV programs would dominate reentry missions in the future and initially these would require greater evaluative effort on the part of FAA personnel until they have developed experience in this area. While AST budget estimates for fiscal year 2000 reflect additional funding needed to exercise its reentry mission approval function, this need cannot be attributed to the proposed rule, but rather to the complexity associated with the advancing technology that would be evaluated.

AST fiscal year 2000 budget estimates of the cost to perform its pre-application consultation and application evaluation licensing responsibilities may be correlated collectively to sections 431.23, 431.27, 431.31, 431.47, 431.55, 431.59, and 431.91; 433.3, 433.9; and 435.23, 435.31, 435.43, and 435.61 of the proposed regulation. The costs to be incurred by the FAA to implement its compliance monitoring responsibilities corresponding to sections 431.73, 431.83, and 435.51 can vary widely, as the spectrum of changes to reentry program operations can range from minor to major. Therefore, the FAA expects to spend $2.5 million—an amount equivalent to that expended for COMET/METEOR—to implement and administer these proposed requirements for a single application.

Based on projections of the level of application activity over the 15-year period from 2000 to 2014, the FAA is expected to spend approximately $83 million in administering the safety requirements of parts 431, 433, and 435. Approximately 94 percent (or $78 million) of the cost by the FAA to administer these parts would be incurred to approve the projected reentry license applications and modifications to be evaluated over the 15-year period. Approximately 6 percent (or $5 million) of the cost to administer parts 431, 433, and 435 would be expended on the review of application denials and the reconsideration process.

Unlike the estimates for potential benefits, the costs section of this evaluation uses a point (or single) estimate rather than a range. The point estimate approach was chosen in estimating FAA administrative costs because, due in large measure to the agency's experience with the COMET/METEOR Program, there is far less uncertainty associated with the estimation of costs for this proposed rule relative to benefits.

*Benefits*

The proposed rule is expected to generate safety benefits of $119 million ($66 million, discounted), in 1997 dollars, over the 15-year period. Benefits include enhanced safety by limiting reentry risk to a level that does not exceed an expected average number of 30 casualties per one million RLV missions or reentries for the general public, and an expected average number of no more than one casualty per million missions for the public in the vicinity of reentry sites.

The potential safety benefits that are expected to accrue as the result of this proposed rule stem from two types of safety criteria implemented and administered by the FAA on commercial space transportation industry operators who wish to engage in RLV missions or reentries. The two criteria are:

(1) $E_c \leq 30 \times 10^{-6}$. This criterion applies on a per mission basis and includes both launch and reentry phases of an RLV mission. It requires that the risk to the public associated with each mission incorporate a level of safety that is equivalent to a probabilistic outcome of no more than an expected average number of 30 public casualties per one million missions.

(2) $E_c \leq 1 \times 10^{-6}$. This criterion pertains to the public adjacent to reentry sites. It requires that the risk to the public associated with each reentry mission incorporate a level of safety that is equivalent to a probabilistic outcome of no more than an expected average number of one public casualty per one million missions.

Compliance by operators with these safety criteria, along with other restrictions addressed in the proposed rule are intended to limit risk to public safety. In estimating these potential safety benefits, the FAA employed the following steps: (First), the agency examined six accident types, grouped into two categories, related to airborne explosions and ground point-of-impact crashes. (For the purpose of this evaluation, the term accident is defined as any unplanned event with potential casualty losses). For each accident category—airborne or ground—the population density of the area surrounding the accident scene or accident zone can be either (1) none, (2) sparse (e.g. rural), or (3) dense (e.g., urban). An examination of the consequences of these types of accidents was conducted. To arrive at accident consequences, the accident scenes or zones for airborne and ground accidents are characterized in terms of fatalities, injuries, and property damage under the baseline and the proposed rule. The difference between the baseline scenario and proposed rule scenario represents the incremental safety benefits that would be generated by the proposed rule. This process was performed for each of the steps below: (Second), monetary values are assigned to each of the various types of accidents expected to occur during launch or reentry (including accidents at or near launch sites). (Third), probabilities are assigned to each of the six accident types based on the percentage of impacted landmass (e.g., no population, sparse population, and dense population) for the baseline and the proposed rule. That is, the probability of occurrence for each accident type over the next 15 years was determined by using the two types of risk criteria mentioned earlier.

And last, expected values were estimated for each of the accident types under the baseline and the proposed

rule. For this proposed rule, the expected benefit values represent the difference between these two scenarios. One of the more difficult areas to ascertain is the probability of a reusable launch vehicle (RLV) or RLV accident in the absence of government regulation in order to calculate the expected value of an accident under the baseline and estimate the incremental safety benefits of the proposed rule. This difficulty stems from the fact there is no empirical evidence or historical RLV accident history. Because of this difficulty, there is uncertainty associated with estimating the probability of an RLV or RLV accident. As a result of this uncertainty, the FAA estimated a range of accident probabilities, which are based on historical experience with ELV accidents and incidents, and sorted them into six categories or types of accidents. In estimating the expected casualty and property loss values, the probability of each of the six accident types is multiplied by the accident consequence values (e.g., the cost of an accident). This process was repeated for all six accident types and summed. This procedure was done for both scenarios (baseline and proposal). Thus, the difference in casualty and property losses for these two scenarios was used as the estimated benefits for this proposed rule. The results of these calculations generate the potential safety benefits as discussed below.

Safety benefits—accident costs avoided—are realized as RLV launch and reentry operations are performed, without incident. Therefore, the number of completed RLV missions and reentries projected over the 15-year period is multiplied by incremental safety benefits per mission to estimate total incremental safety benefits over the period 2000 to 2014. The total safety benefit resulting from the proposed rule is estimated to be $119 million for the period 2000 to 2014. This estimate of $119 million represents the midpoint of benefits ranging from $22 million to $217 million over the 15-year period. This midpoint estimate of benefits was chosen because of the high degree of uncertainty associated with the wide range of accident probabilities. Uncertainty stems from the extent to which industry has already adopted and implemented safety measures similar to those proposed as part of this rulemaking action. (Based on information obtained from commercial space industry technical personnel, nearly all of the potentially impacted operators would be in compliance with the proposed rule to some degree.) The low end of the range of benefits assumes that practically all of the potentially impacted operators would be in almost complete compliance in the absence of the proposed rule. The high end of the range of benefits assumes the opposite. There is insufficient information that would support adopting the benefits estimates at either end of the range. Thus, the median (or midpoint) was chosen as an appropriate benefits estimate. It suggests that the actual benefits to be generated by the proposed rule lies somewhere between the lower and upper end of this range. Since uncertainty is associated with using a midpoint benefits estimate and range of benefits, the FAA solicits public comment as to whether its assumptions are appropriate and the validity of this approach. The agency asks that comments be specific and supported by quantitative data wherever possible.

*Secondary Benefits*

The proposed rule would generate secondary benefits in the form of enhanced operational efficiency, due largely to regulatory and procedural clarifications that would be facilitated by the iterative pre-application consultation process, help ensure consistency in implementing the licensing process, and may result in cost-savings to the FAA as a result of repetitive operations. These cost-savings would also reduce the turnaround time between application submittal and licensing approval, help commercial space transportation entities gain familiarity with requirements, and facilitate government-industry interaction. Enhanced operational efficiency, in turn, would lead to industry cost-savings, possibly due to less rework or paperwork avoided.

**Summary of Total Costs and Benefits**

The total potential benefits and costs of this proposed rule are shown below in Table 1. This Table shows that the potential cost imposed by the proposed rule would be approximately $113 million over the 15-year period. Also shown in Table 1, about $30 million of this total cost would be incurred by industry. The cost estimate of $30 million is lower than the summation of those costs discussed in the above sections for industry because it takes into account the fact that certain operators would incur recurring costs for some of the 15-year period rather than for the entire period. Table 1 also shows that the proposed rule would generate potential safety benefits of $119 million over the 15-year period. Due to some of the operational requirements of the proposed rule, costs and benefits not considered in this evaluation may materialize. The FAA solicits comments from the commercial space industry as to what extent this evaluation has captured critical costs and benefits associated with the proposed rule.

TABLE 1.—SUMMARY OF TOTAL COSTS AND BENEFITS

[In millions of dollars]

| Category (in 1997 dollars, 15 yrs.) | Undiscounted | Discounted |
|---|---|---|
| Commercial Space Transportation Industry Compliance Costs | $30 | $20 |
| Federal Aviation Administration Implementation Costs | 83 | 45 |
| Total Costs | 113 | 65 |
| Accident Costs Avoided: Lower Bound (Safety Benefits) | 22 | 12 |
| Accident Costs Avoided: Upper Bound (Safety Benefits) | 217 | 121 |
| Total Accident Costs Avoided: Midpoint (Safety Benefits) | 119 | 66 |

**Initial Regulatory Flexibility Determination**

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities (e.g., small business and small not-for-profit government jurisdictions) are not unnecessarily and disproportionately burdened by Federal Government regulations. The RFA, which was amended in March 1996, requires that whenever an agency publishes a general notice of proposed rulemaking, an initial regulatory flexibility analysis be performed if the proposed rule would

have a significant economic impact on a substantial number of small entities. The regulatory flexibility analysis must (1) identify the economic impact on small entities and (2) consider alternatives that may lessen those impacts.

The Small Business Administration has defined small business entities relating to space vehicles (Standard Industrial Codes 3761, 3764, and 3769) as entities comprising fewer than 1,000 employees. The FAA has determined that the proposed rule would impact five small businesses, imposing on an entity average compliance costs of approximately $6 million over the 15-year period (in 1997 dollars).

The annualized compliance cost to each small business is approximately $700,000 (in 1997 dollars). Ordinarily, this section of the evaluation would be based on typical financial data (for example, annual net income or losses) as a means to determine any of the commercial space transportation small entities significantly impacted by the proposed rule. However, the traditional use of such financial data for these small entities cannot be employed since RLV operators (including a number of RV operators) represent relatively new companies and they have no revenue history. In fact, these small operators are in the process of raising funds to finance their new ventures. Due to the lack of data on the financial characteristics of these small RLV operators, this evaluation uses the 1998 average revenue received per launch for ELV operators. The revenue that RLV operators would obtain from their customers is expected to be similar to the revenue that established ELV operators currently receive from their customers. Revenue data based on ELV operators' experience would be used for the purpose of assessing the extent to which compliance with the proposed rule would impose significant economic impacts on each of the five potentially impacted small RLV operators. This assessment would be done by comparing the annualized cost of compliance to the annual average revenue expected to be received by each of the five small RLV operators over the next 15 years. While the long-term revenues of RLV operators are expected to exceed those of ELV operators, which would be due to inherent lower operating costs, for the purpose of this evaluation they are assumed to be nearly the same over the 15-year period. For this reason, the average revenue of about $50 million generated by each ELV launch in 1998 will be used as an indicator of what RLV operators would be expected to generate per RLV mission in future years. This assessment is based primarily on information received for orbital launch events for ELV operators from the FAA's Office of Commercial Space Transportation Report entitled, ''Commercial Space Transportation: 1998 Year In Review'', Table 1 and the Appendix (January 1999).

Each of the five potentially impacted small RLV entities is expected to average about seven missions per year over the next 15 years. Using $50 million as an average expected revenue per mission, each entity would be expected to receive about $350 million in revenue ($50m $\times$ 7 missions annually) for all missions annually. The FAA has determined that none of the five small entities would incur a significant economic impact, since the average annualized cost of compliance ($700,000) would be only 0.2 percent of the anticipated average annual revenues of $350 for missions conducted annually.

The FAA certifies that the proposed rule would not impose a significant economic impact on a substantial number of small businesses. Therefore, a regulatory flexibility analysis is not required. Furthermore, the proposed rule is not likely to cause small business failures or adversely impact their competitive position relative to larger businesses. However, the FAA requests comments on the validity of the assertions herein and additional information on the financial characteristics of these small businesses

**International Trade Impact Assessment**

The proposed rule contains revisions to commercial space transportation licensing regulations that would not constitute a barrier to international trade, including the export of domestic goods and services out of the United States. The proposed rule would equally affect domestic and foreign organizations conducting commercial space transportation operations within the United States. The proposed rule is not expected to place domestic firms at a disadvantage with respect to foreign interests competing for similar business in international markets. Therefore, based on this evaluation and impacts reported herein, the proposed rule is not expected to affect trade opportunities for U.S. firms doing business abroad or for foreign firms doing business in the United States. The FAA invites comments on the validity of this assertion and any potential impacts related thereto.

**Unfunded Mandates Act of 1995 Assessment**

Title II of the Unfunded Mandates Reform Act of 1995, enacted as Public Law 104–4 on March 22, 1995, requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year. Section 204(a) of the Act, Title 2 of the United States Code 1534(a), requires the Federal agency to develop an effectiveness process to permit timely input by elected officers (or their designees) of State, local, and tribal governments on a proposed ''significant intergovernmental mandate.'' A significant intergovernmental mandate under the Act is any provision in a Federal agency regulation that would impose an enforceable duty upon State, local, and tribal governments, in the aggregate, of $100 million (adjusted annually for inflation) in any one year. Section 203 of the Act, Title 2 of the United States Code 1533, which supplements section 204(a), provides that before establishing any regulatory requirements that might significantly or uniquely affect small governments, the agency shall have developed a plan that, among other things, provides for notice to potentially affected small governments, if any, and for a meaningful and timely opportunity any affected small governments to provide input in the development of proposed rules.

Based on the evaluation and impacts reported herein, the proposed rule is not expected to meet the $100 million per year cost threshold. Consequently, it would not impose a significant cost on uniquely affect small governments. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply to the proposed regulation.

**Federalism Implications**

The regulations proposed herein will not have a substantial direct effect on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

**Environmental Assessment**

FAA Order 1050.1D defines FAA actions that may be categorically excluded from preparation of a National Environmental Policy Act (NEPA) environmental assessment (EA) or environmental impact statement (EIS). In accordance with FAA Order 1050.1D, appendix 4, paragraph 4(i), regulatory documents which cover administrative or procedural requirements qualify for a categorical exclusion. Proposed sections 431.91, 431.93, 433.7, and 433.9 would require an applicant to submit sufficient environmental information for the FAA to comply with NEPA and other applicable environmental laws and regulations during the processing of each license application. Accordingly, the FAA proposes that this rule qualifies for a categorical exclusion because no significant impacts to the environment are expected to result from finalization or implementation of its administrative provisions for licensing.

**List of Subjects**

*14 CFR Part 400*

Space transportation and exploration.

*14 CFR Part 401*

Organization and functions (Government agencies), Space transportation and exploration.

*14 CFR Part 404*

Administrative practice and procedure, Space transportation and exploration.

*14 CFR Part 405*

Investigations, Penalties, Space transportation and exploration.

*14 CFR Part 406*

Administrative practice and procedure, Space transportation and exploration.

*14 CFR Part 413*

Confidential business information, Space transportation and exploration.

*14 CFR Part 415*

Aviation safety, Environmental protection, Space transportation and exploration.

*14 CFR Part 431*

Aviation safety, Environmental protection, Investigations, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

*14 CFR Part 433*

Aviation safety, Environmental protection, Investigations, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

*14 CFR Part 435*

Aviation safety, Environmental protection, Investigations, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

**The Proposed Amendment**

In consideration of the foregoing, the Federal Aviation Administration proposes to amend parts 400, 401, 404, 405, 406, 413, and 415, of Chapter III Title 14, Code of Federal Regulations and add parts 431, 433 and 435 as follows:

## PART 400—BASIS AND SCOPE

1. The authority citation for part 400 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

2. Section 400.2 is revised to read as follows:

**§ 400.2 Scope.**

These regulations set forth the procedures and requirements applicable to the authorization and supervision under 49 U.S.C. Subtitle IX, chapter 701, of commercial space transportation activities conducted in the United States or by a U.S. citizen. The regulations in this chapter do not apply to exempted-class rocket activities.

## PART 401—ORGANIZATION AND DEFINITIONS

3. The authority citation for part 401 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

4. Section 401.5 is revised to read as follows:

**§ 401.5 Definitions.**

As used in this chapter—

*Act* means 49 U.S.C. Subtitle IX, Commercial Space Transportation, ch. 701—Commercial Space Launch Activities, 49 U.S.C. 70101–70121.

*Amateur rocket activities* means launch activities conducted at private sites involving rockets powered by a motor or motors having a total impulse of 200,000 pound-seconds or less and a total burning or operating time of less than 15 seconds, and a rocket having a ballistic coefficient—i.e., gross weight in pounds divided by frontal area of rocket vehicle—less than 12 pounds per square inch.

*Associate Administrator* means the Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, or any person designated by the Associate Administrator to exercise the authority or discharge the responsibilities of the Associate Administrator.

*Contingency abort* means cessation of vehicle flight during ascent or descent in a manner that does not jeopardize public health and safety and the safety of property, in accordance with mission rules and procedures. Contingency abort includes landing at an alternative location that has been designated as a contingency abort location in advance of vehicle flight.

*Emergency abort* means cessation of vehicle flight during ascent or descent in a manner that minimizes risk to public health and safety and the safety of property. Emergency abort involves failure of a vehicle, safety-critical system, or flight safety system such that contingency abort is not possible.

*Federal launch range* means a launch site, from which launches routinely take place, that is owned and operated by the government of the United States.

*Flight safety system* means a system designed to limit or restrict the hazards to public health and safety and the safety of property presented by a launch vehicle or reentry vehicle while in flight by initiating and accomplishing a controlled ending to vehicle flight. A flight safety system may be destructive resulting in intentional break up of a vehicle or nondestructive, such as engine thrust termination enabling vehicle landing or safe abort capability.

*Hazardous materials* means hazardous materials as defined in 49 CFR 172.101.

*Launch* means to place or try to place a launch vehicle or reentry vehicle and any payload from Earth in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space, and includes activities involved in the preparation of a launch vehicle for flight, when those activities take place at a launch site in the United States. 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 a U.S. launch site. Flight ends after the licensee's last exercise of control over its launch vehicle.

*Launch accident* means:

(1) A fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the flight;

(2) Any damage estimated to exceed $25,000 to property not associated with the flight that is not located at the launch site or designated recovery area.

(3) An unplanned event occurring during the flight of a launch vehicle resulting in the known impact of a launch vehicle, its payload or any component thereof:

(i) For an expendable launch vehicle (ELV), outside designated impact limit lines; and

(ii) for an RLV, outside a designated landing site.

*Launch incident* means an unplanned event occurring during the flight of a launch vehicle, other than a launch accident, involving a malfunction of a flight safety system or safety-critical system or failure of the licensee's safety organization, design or operations.

*Launch operator* means a person who conducts or who will conduct the launch of a launch vehicle and any payload.

*Launch site* means the location on Earth from which a launch takes place (as defined in a license the Secretary issues or transfers under this chapter) and necessary facilities at that location.

*Launch vehicle* means a vehicle built to operate in, or place a payload in, outer space or a suborbital rocket.

*Mishap* means a launch or reentry accident, launch or reentry incident, failure to complete a launch or reentry as planned, or an unplanned event or series of events resulting in a fatality or serious injury (as defined in 49 CFR § 830.2), or resulting in greater than $25,000 worth of damage to a payload, a vehicle, a launch or reentry support facility or government property located on the launch or reentry site.

*Operation of a launch site* means the conduct of approved safety operations at a permanent site to support the launching of vehicles and payloads.

*Operation of a reentry site* means the conduct of safety operations at a fixed site on Earth at which a reentry vehicle and its payload, if any, is intended to land.

*Payload* means an object that a person undertakes to place in outer space by means of a launch vehicle, including components of the vehicle specifically designed or adapted for that object.

*Person* means an individual or an entity organized or existing under the laws of a state or country.

*Reenter* means to return or attempt to return, purposefully, a reentry vehicle and its payload, if any, from Earth orbit or from outer space to Earth. The term ''reenter'' includes activities conducted in Earth orbit or outer space to determine reentry readiness and are therefore unique to reentry and critical to ensuring public health and safety and the safety of property during reentry.

*Reentry accident* means any unplanned event occurring during the reentry of a reentry vehicle resulting in the known impact of the reentry vehicle, its payload, or any component thereof outside a designated reentry site; a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the reentry; or any damage estimated to exceed $25,000 to property not associated with the reentry and not located within a designated reentry site.

*Reentry incident* means any unplanned event occurring during the reentry of a reentry vehicle, other than a reentry accident, involving a malfunction of a reentry safety-critical system or failure of the licensee's safety organization, procedures, or operations.

*Reentry operator* means a person responsible for conducting the reentry of a reentry vehicle as specified in a license issued by the FAA.

*Reentry site* means the location on Earth where a reentry vehicle is intended to return. It includes the area within three standard deviations of the intended landing point (the predicted three-sigma footprint).

*Reentry vehicle* means a vehicle designed to return from Earth orbit or outer space to Earth substantially intact. A reusable launch vehicle that is designed to return from Earth orbit or outer space to Earth substantially intact is a reentry vehicle.

*Reusable launch vehicle* (RLV) means a launch vehicle that is designed to return to Earth substantially intact and therefore may be launched more than one time or that contains vehicle stages that may be recovered by a launch operator for future use in the operation of a substantially similar launch vehicle.

*Safety-critical* means essential to safe performance or operation. A safety-critical system, subsystem, condition, event, operation, process or item is one whose proper recognition, control, performance or tolerance is essential to safe system operation.

*Vehicle safety operations personnel* means those persons whose job performance is critical to public health and safety or the safety of property during RLV or reentry operations.

*State and United States* means, when used in a geographical sense, the several States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the United States Virgin Islands, Guam, and any other commonwealth, territory, or possession of the United States; and

*United States citizen* means:

(1) Any individual who is a citizen of the United States;

(2) Any corporation, partnership, joint venture, association, or other entity organized or existing under the laws of the United States or any State; and

(3) Any corporation, partnership, joint venture, association, or other entity which is organized or exists under the laws of a foreign nation, if the controlling interest in such entity is held by an individual or entity described in paragraph (1) or (2) of this definition. *Controlling interest* means ownership of an amount of equity in such entity sufficient to direct management of the entity or to void transactions entered into by management. Ownership of at least fifty-one percent of the equity in an entity by persons described in paragraph (1) or (2) of this definition creates a rebuttable presumption that such interest is controlling.

## PART 404—REGULATIONS AND LICENSING REQUIREMENTS

5. The authority citation for part 404 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

6. Section 404.1 is revised to read as follows:

### § 404.1 Scope.

Under section 49 U.S.C. 70105, this part establishes procedures for issuing regulations to implement the provisions of 49 U.S.C. Subtitle IX, chapter 701, and for eliminating or waiving requirements of Federal law otherwise applicable to the licensing of commercial space transportation activities under 49 U.S.C. Subtitle IX, chapter 701.

7. Section 404.3 is amended by revising the section title and paragraph (a) to read as follows:

### § 404.3 Filing of petitions to the Associate Administrator.

(a) Any person may petition the Associate Administrator to issue, amend, or repeal a regulation to eliminate as a requirement for a license any requirement of Federal law applicable to commercial space launch and reentry activities and the operation of launch and reentry sites or to waive any such requirement in the context of a specific application for a license.

* * * * *

## PART 405—INVESTIGATIONS AND ENFORCEMENT

8. The authority citation for part 405 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

9. Section 405.1 is revised to read as follows:

### § 405.1 Monitoring of licensed and other activities.

Each licensee must allow access by and cooperate with Federal officers or employees or other individuals authorized by the Associate Administrator to observe licensed

facilities and activities, including launch sites and reentry sites, as well as manufacturing, production, and testing facilities, or assembly sites used by any contractor or a licensee in the production, assembly, or testing of a launch or reentry vehicle and in the integration of a payload with its launch or reentry vehicle. Observations are conducted to monitor the activities of the licensee or contractor at such time and to such extent as the Associate Administrator considers reasonable and necessary to determine compliance with the license or to perform the Associate Administrator's responsibilities pertaining to payloads for which no Federal license, authorization, or permit is required.

10. Section 405.5 is amended by revising the introductory text and paragraph (a) to read as follows:

**§ 405.5 Emergency orders.**

The Associate Administrator may immediately terminate, prohibit, or suspend a licensed launch, reentry, or operation of a launch or reentry site if the Associate Administrator determines that—

(a) The licensed launch, reentry, or operation of a launch or reentry site is detrimental to public health and safety, the safety of property, or any national security or foreign policy interest of the United States; and

* * * * *

## PART 406—ADMINISTRATIVE REVIEW

11. The authority citation for part 406 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

12. Section 406.1 is amended by revising paragraphs (a), introductory text, (a)(2), and (a)(3) to read as follows:

**§ 406.1 Hearings.**

(a) Pursuant to 49 U.S.C. 70110, the following are entitled to a determination on the record after an opportunity for a hearing in accordance with 5 U.S.C. 554.

* * * * *

(2) An owner or operator of a payload regarding any decision to prevent the launch or reentry of the payload;

(3) A licensee regarding any decision to suspend, modify, or revoke a license or to terminate, prohibit, or suspend any licensed activity; and

* * * * *

## PART 413—LICENSE APPLICATION PROCEDURES

13. The authority citation for part 413 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

14. Section 413.1 is revised to read as follows:

**§ 413.1 Scope.**

This part prescribes the procedures applicable to applications submitted under this chapter to conduct licensed activities. These procedures apply to all applications for issuance of a license, transfer of an existing license, and renewal of an existing license. More specific requirements applicable to obtaining a launch license or a license to operate a launch site are contained in parts 415 and 417 of this chapter, respectively. More specific requirements applicable to obtaining a license to launch and reenter a reentry vehicle or to operate a reentry site are contained in parts 431, 433 and 435 of this chapter, respectively.

5. Section 413.3 is revised to read as follows:

**§ 413.3 Who must obtain a license.**

(a) A person must obtain a license—

(1) To launch a launch vehicle from the United States;

(2) To operate a launch site within the United States;

(3) To reenter a reentry vehicle in the United States; or

(4) To operate a reentry site within the United States.

(b) An individual who is a U.S. citizen or an entity organized under the laws of the United States or any State must obtain a license—

(1) To launch a launch vehicle outside the United States;

(2) To operate a launch site outside of the United States;

(3) To reenter a reentry vehicle outside of the United States; or

(4) To operate a reentry site outside of the United States.

(c) A foreign entity in which a United States citizen has a controlling interest, as defined in § 401.5 of this chapter, must obtain a launch license to launch a launch vehicle from or a license to operate a launch site within—

(1) Any place that is both outside the United States and outside the territory of any foreign nation, unless there is an agreement in force between the United States and a foreign nation providing that such foreign nation shall exercise jurisdiction over the launch or the operation of the launch site; or

(2) The territory of any foreign nation if there is an agreement in force between the United States and that foreign nation providing that the United States shall exercise jurisdiction over the launch or the operation of the launch site.

(d) A foreign entity in which a U.S. citizen has a controlling interest, as defined in § 401.5 of this chapter, must obtain a license to reenter a reentry vehicle or to operate a reentry site in—

(1) Any place that is outside the United States and outside the territory of any foreign nation, unless there is an agreement in force between the United States and a foreign nation providing that such foreign nation shall exercise jurisdiction over the reentry or the operation of the reentry site; or

(2) The territory of any foreign nation if there is an agreement in force between the United States and that foreign nation providing that the United States shall exercise jurisdiction over the reentry or the operation of the reentry site.

## PART 415—LAUNCH LICENSE

16. The authority citation for part 415 is revised to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

17. Section 415.1 is revised to read as follows:

**§ 415.1 Scope.**

This part prescribes requirements for obtaining a license to launch a launch vehicle, other than a reusable launch vehicle (RLV), and post-licensing requirements with which a licensee shall comply to remain licensed. Requirements for preparing a license application are contained in part 413 of this subchapter. Requirements for obtaining a license to launch an RLV and conduct an RLV mission are contained in part 431 of this subchapter.

18. Part 431 is added to read as follows:

## PART 431—LAUNCH AND REENTRY OF A REUSABLE LAUNCH VEHICLE (RLV)

### Subpart A—General

Sec.



### Subpart B—Policy Review and Approval for Launch and Reentry of a Reusable Launch Vehicle

**Authority:** 49 U.S.C. 70101–70119.

## Subpart A—General

### § 431.1 Scope.

This part prescribes requirements for obtaining a reusable launch vehicle (RLV) mission license and post-licensing requirements with which a licensee must comply to remain licensed. Requirements for preparing a license application are contained in part 413 of this subchapter.

### § 431.3 Types of reusable launch vehicle mission licenses.

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

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

### § 431.5 Policy and safety approvals.

To obtain either type of RLV mission license, an applicant must obtain policy and safety approvals from the FAA. Requirements for obtaining these approvals are contained in subparts B and C of this part. Only the license applicant may apply for the approvals, and may apply for either approval separately and in advance of submitting a complete license application, using the application procedures contained in part 413 of this subchapter.

### § 431.7 Payload and payload reentry determinations.

(a) A payload determination is required to launch a payload unless the proposed payload is exempt from payload review under § 415.53 of this chapter. Requirements for obtaining a payload determination are set forth in part 415, subpart D.

(b) A payload reentry determination is required to transport a payload to Earth on an RLV unless the proposed payload is exempt from payload review.

(c) A payload reentry determination made under a previous license application under this subchapter may satisfy the requirements of paragraph (b) of this section.

(d) The FAA conducts a review, as described in subpart D of this part, to make a payload reentry determination. Either an RLV mission license applicant or a payload owner or operator may request a review of the proposed payload using the application procedures contained in part 413 of this subchapter. Upon receipt of an application, the FAA may conduct a payload reentry review independently of an RLV mission license application.

### § 431.9 Issuance of a reusable launch vehicle mission license.

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

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

### § 431.11 Additional license terms and conditions.

The FAA may amend an RLV mission license at any time by modifying or adding license terms and conditions to ensure compliance with 49 U.S.C. subtitle IX, chapter 701, and applicable regulations.

### § 431.13 Transfer of a reusable launch vehicle mission license.

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

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

### § 431.15 Rights not conferred by a reusable launch vehicle mission license.

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

### §§ 431.16–431.20 [Reserved]

## Subpart B—Policy Review and Approval for Launch and Reentry of a Reusable Launch Vehicle

### § 431.21 General.

The FAA issues a policy approval to an RLV mission license applicant upon completion of a favorable policy review. A policy approval is part of the licensing record on which the licensing determination is based.

### § 431.23 Policy review.

(a) The FAA reviews an RLV mission license application to determine

whether the proposed mission presents any issues, other than those issues addressed in the safety review, that would adversely affect U.S. national security or foreign policy interests, would jeopardize public health and safety or the safety of property, or would not be consistent with international obligations of the United States.

(b) *Interagency consultation.*

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

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

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

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

**§ 431.25 Application requirements for policy review.**

In its RLV mission license application, an applicant must—

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

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

(c) Identify foreign ownership of the applicant as follows:

(1) For a sole proprietorship or partnership, identify all foreign ownership;

(2) For a corporation, identify any foreign ownership interests of 10% or more; and

(3) For a joint venture, association, or other entity, identify any participating foreign entities.

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

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

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

(3) Sequence of planned events or maneuvers during the mission; and

For an orbital mission, the range of intermediate and final orbits of the vehicle and upper stages, if any, and their estimated orbital life times.

**§ 431.27 Denial of policy approval.**

The FAA notifies an applicant, in writing, if the FAA has denied policy approval for an RLV mission license application. The notice states the reasons for the FAA's determination. The applicant may respond to the reasons for the determination and request reconsideration.

**§§ 431.28–431.30 [Reserved]**

## Subpart C—Safety Review and Approval for Launch and Reentry of a Reusable Launch Vehicle

**§ 431.31 General.**

(a) The FAA conducts a safety review to determine whether an applicant is capable of launching an RLV and payload, from a designated launch site, and reentering the RLV and payload, if any, to a designated reentry site, or otherwise landing the RLV and payload, if any, on Earth, without jeopardizing public health and safety and the safety of property.

(b) The FAA issues a safety approval to an RLV mission license applicant that satisfies the requirements of this subpart. The FAA evaluates on an individual basis all public safety aspects of a proposed RLV mission to ensure they are sufficient to support safe conduct of the mission. A safety approval is part of the licensing record on which the FAA's licensing determination is based.

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

**§ 431.33 Safety organization.**

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

(b) An applicant must designate a person responsible for the conduct of all licensed RLV mission activities.

(c) *Safety official.* An applicant shall designate by name, title, and qualifications, a qualified safety official authorized by the applicant to examine all aspects of the applicant's operations with respect to safety of RLV mission activities and to monitor independently compliance by vehicle safety operations personnel with the applicant's safety policies and procedures. The safety official shall report directly to the person responsible for an applicant's licensed RLV mission activities, who shall ensure that all of the safety official's concerns are addressed both before the mission is initiated and before reentry or descent of an RLV is initiated. The safety official is responsible for—

(1) Conducting operational dress rehearsals in accordance with procedures required by § 431.37(a)(4), that ensure the readiness of vehicle safety operations personnel to conduct a safe mission under nominal and non-nominal conditions; and

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

**§ 431.35 Acceptable reusable launch vehicle mission risk.**

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

(b) Acceptable risk for a proposed mission is measured in terms of the expected average number of casualties ($E_c$) to the collective members of the public exposed to vehicle or vehicle debris impact hazards. To obtain safety

approval, an applicant shall demonstrate—

(1) For public risk, the risk level associated with a proposed mission does not exceed an expected average number of 0.00003 casualties per mission (or $E_c$ criterion of $30 \times 10^{-6}$) to members of the public from the applicant's proposed activity; and

(2) For persons within a 100-mile distance from the border of the designated reentry site and contingency abort locations, if any, the risk level associated with a proposed mission does not exceed an expected average number of .000001 casualties per mission (or $E_c$ criterion of $1 \times 10^{-6}$).

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

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

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

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

(3) Identify and describe safety-critical systems;

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

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

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

(7) Provide data that validates the applicant's system safety analyses required in paragraph (c) of this section; and

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

**§ 431.37 Mission readiness.**

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

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

(i) Readiness of the RLV including safety-critical systems and payload for launch and reentry flight;

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

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

(iv) Readiness of vehicle safety operations personnel to support mission flight, including results of dress rehearsals and simulations conducted in accordance with paragraph (a)(4) of this section;

(v) Mission rules and constraints, including contingency abort plans and procedures, if any, as required under § 431.39 of this part;

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

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

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

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

(4) Dress rehearsal procedures that—

(i) Ensure crew readiness under nominal and non-nominal flight conditions;

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

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

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

**§ 431.39 Mission rules, procedures, contingency plans, and checklists.**

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

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

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

**§ 431.41 Communications plan.**

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

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

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

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

(4) Communications affecting the safety of the mission are recorded.

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

**§ 431.43 Reusable launch vehicle mission operational requirements and restrictions.**

(a) An applicant for RLV mission safety approval shall submit procedures—

(1) That ensure RLV mission risks do not exceed the criteria set forth in

§ 431.35 of this part for nominal and non-nominal operations;

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

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

(4) To monitor and verify the status of RLV safety-critical systems immediately before and during mission operations; and

(5) For human activation or initiation of a flight safety system that safely aborts the launch of an RLV if the vehicle is not operating within approved mission parameters and the vehicle poses risk to public health and safety and the safety of property in excess of acceptable flight risk as defined in § 431.35.

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

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

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

(c) For an RLV mission—

(1) A collision avoidance analysis shall be performed in order to maintain at least a 200-kilometer separation from any inhabitable orbiting object during launch and reentry. The analysis shall address:

(i) For launch, closures in a planned launch window for ascent to outer space or, for an orbital RLV, to initial orbit through at least one complete orbit;

(ii) For reentry, the reentry trajectory;

(iii) Expansions of the closure period by subtracting 15 seconds from the closure start-time and adding 15 seconds to the closure end-time for each sequential 90 minutes elapsed time period, or portion there of, beginning at the time the state vectors of the orbiting objects were determined;

(2) The projected instantaneous impact point (IIP) of the vehicle shall not have substantial dwell time over densely populated areas during any segment of mission flight;

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

(4) Vehicle safety operations personnel shall adhere to the following work and rest standards:

(i) A maximum 12-hour work shift with at least 8 hours of rest after 12 hours of work, preceding initiation of a reentry mission or during the conduct of a mission;

(ii) A maximum of 60 hours worked in the 7 days, preceding initiation of an RLV mission;

(iii) A maximum of 14 consecutive work days; and

(iv) A minimum 48-hour rest period after 5 consecutive days of 12-hour shifts.

(d) In addition to requirements of paragraph (c) of this section, any unproven RLV may only be operated—

(1) Such that the projected instantaneous impact point (IIP) of the vehicle does not have substantial dwell time over populated areas; or

(2) Such that the expected average number of casualties to members of the public does not exceed $30 \times 10^{-6}$ ($E_c \leq 30 \times 10^{-6}$) given a probability of vehicle failure equal to 1 ($p_f = 1$) at any time the IIP is over a populated area;

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

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

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

**§ 431.45 Mishap investigation plan and emergency response plan.**

(a) An applicant shall submit a mishap investigation plan (MIP) containing the applicant's procedures for reporting and responding to launch and reentry accidents, launch and reentry incidents, or other mishaps, as defined in § 401.5 of this chapter, that satisfies requirements of § 415.41 of this subchapter. An applicant shall submit an emergency response plan (ERP) that contains procedures for informing the affected public of a planned reentry. An ERP will provide procedures to notify local officials of an off-site landing. The MIP and ERP shall be signed by an individual authorized to sign and certify the application in accordance with § 413.7(c) of this chapter, the person responsible for the conduct of all licensed RLV mission activities designated under § 431.33(b) of this subpart, and the safety official designated under § 431.33(c) of this subpart. MIPs covering launch and reentry flight phases of an RLV mission may be combined in a single document.

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

(1) Immediate notification to the FAA Washington Operations Center in case of an event identified in paragraph (a) of this section. In addition to requirements of § 415.41(b), the notification shall include:

(i) Date and time of occurrence;

(ii) Description of the event;

(iii) Intended and actual location of reentry, or other landing on Earth;

(iv) Identification of the vehicle;

(v) Identification of the payload, if applicable;

(vi) Number and general description of any fatalities and injuries;

(vii) Property damage, if any, and an estimate of its value;

(viii) Identification of any hazardous material, as defined in § 401.5 of this chapter, involved in the event, whether on the vehicle, payload, or on the ground;

(ix) Action taken by personnel to contain the consequences of the event;

(x) Description of weather conditions at the time of the event; and

(xi) Potential consequences for other vehicles or systems of similar type and proposed operations.

(2) Submission of a written preliminary report to the FAA Associate Administrator for Commercial Space Transportation in the event of a reentry accident or reentry incident, as defined in § 401.5 of this chapter, within 5 days of the event. The report shall identify the event as either a reentry accident or reentry incident and must include the information specified in paragraph (b)(1) of this section.

(c) A mishap investigation plan must contain procedures to—

(1) Ensure the consequences of a reentry accident, reentry incident, or other mishap are contained and minimized;

(2) Ensure data and physical evidence are preserved;

(3) Investigate the cause of a reentry accident, reentry incident, or other mishap;

(4) Report the mishap to the FAA;

(5) Designate a point of contact for the FAA and the National Transportation Safety Board;

(6) Cooperate with investigations conducted by the FAA and the National Transportation Safety Board;

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

(8) Report investigation results to the FAA; and

(9) Identify and adopt preventive measures for avoiding a recurrence of the event.

(d) An emergency response plan shall provide for—

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

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

(3) An ERP shall be submitted as part of the application process.

**§ 431.47 Denial of safety approval.**

The FAA notifies an applicant, in writing, if the FAA has denied safety approval for an RLV mission license application. The notice states the reasons for the FAA's determination. The applicant may respond to the reasons for the determination and request reconsideration.

**§§ 431.48–431.50 [Reserved]**

## Subpart D—Payload Reentry Review and Determination

**§ 431.51 General.**

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

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

(c) A payload reentry determination will be made part of the licensing record on which the FAA's licensing determination is based.

**§ 431.53 Classes of payloads.**

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

(b) The RLV mission licensee that will return a payload approved for reentry under this section, is responsible for providing current information in accordance with § 431.57 regarding the payload proposed for reentry no later than 60 days before a scheduled RLV mission involving that payload.

**§ 431.55 Payload reentry review.**

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

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

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

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

(e) The FAA advises a person requesting a payload reentry determination, in writing, of any issue raised during a payload reentry review that would impede the issuance of a favorable determination to reenter that payload. The person requesting a payload reentry review may respond, in writing, or revise its application.

**§ 431.57 Information requirements for payload reentry review.**

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

(a) Payload name or class and function;

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

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

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

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

(f) Designated reentry site(s); and

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

**§ 431.59 Issuance of payload reentry determination.**

(a) The FAA issues a favorable payload reentry determination unless it determines that reentry of the proposed payload would adversely affect U.S. national security or foreign policy interests, would jeopardize public health and safety or the safety of property, or would not be consistent with international obligations of the United States. The FAA responds to any person who has requested a payload reentry review of its determination in writing. The notice states the reasons for the determination in the event of an unfavorable determination.

(b) Any person issued an unfavorable payload reentry determination may respond to the reasons for the determination and request reconsideration.

**§ 431.61 Incorporation of payload reentry determination in license application.**

A favorable payload reentry determination issued for a payload or class of payload may be included by an RLV mission license applicant as part of its application. Before the conduct of an RLV mission involving a payload approved for reentry, any change in information provided under § 431.57 of this subpart must be reported by the licensee in accordance with § 413.17 of this chapter. The FAA determines whether a favorable payload reentry determination remains valid and may conduct an additional payload reentry review.

**§§ 431.62–431.70 [Reserved]**

## Subpart E—Post-Licensing Requirements—Reusable Launch Vehicle Mission License Terms and Conditions

**§ 431.71 Public safety responsibility.**

(a) A licensee is responsible for ensuring the safe conduct of an RLV mission and for protecting public health and safety and the safety of property during the conduct of the mission.

(b) A licensee must conduct a licensed RLV mission and perform RLV safety procedures in accordance with representations made in its license application. A licensee's failure to perform safety procedures in accordance with the representations made in the license application or comply with any license condition is sufficient basis for

the revocation of a license or other appropriate enforcement action.

**§ 431.73 Continuing accuracy of license application; application for modification of license.**

(a) A licensee is responsible for the continuing accuracy of representations contained in its application for the entire term of the license.

(b) After a license has been issued, a licensee must apply to the FAA for modification of the license if'

(1) The licensee proposes to conduct an RLV mission or perform a safety-critical operation in a manner not authorized by the license; or

(2) Any representation contained in the license application that is material to public health and safety or the safety of property is no longer accurate and complete or does not reflect the licensee's procedures governing the actual conduct of an RLV mission. A change is material to public health and safety or the safety of property if it alters or affects the—

(i) Mission rules, reentry plans, contingency abort plans, if any, or emergency plans submitted in accordance with § 431.39 of this part;

(ii) Class of payload;

(iii) Type of RLV;

(iv) Any safety-critical system;

(v) Type and container of the hazardous material carried by the vehicle;

(vi) Flight trajectory;

(vii) Launch site or reentry site; or

(viii) Any safety system, policy, procedure, requirement, criteria, or standard.

(c) An application to modify an RLV mission license must be prepared and submitted in accordance with part 413 of this chapter. The licensee must indicate any part of its license or license application that would be changed or affected by a proposed modification.

(d) The FAA reviews determinations and approvals required by this chapter to determine whether they remain valid after submission of a proposed modification.

(e) Upon approval of a modification, the FAA issues either a written approval to the licensee or a license order amending the license if a stated term or condition of the license is changed, added, or deleted. An approval has the full force and effect of a license order and is part of the licensing record.

**§ 431.75 Agreements.**

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

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

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

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

**§ 431.77 Records.**

(a) Except as specified in paragraph (b) of this section, a licensee shall maintain for 3 years all records, data, and other material necessary to verify that a licensed RLV mission is conducted in accordance with representations contained in the licensee's application.

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

**§ 431.79 Reusable launch vehicle mission reporting requirements.**

(a) Not less than 60 days before each RLV mission conducted under a license, a licensee shall provide the FAA with the following information:

(1) Payload information in accordance with § 431.57 of this part; and

(2) Flight information, including the vehicle, launch site, planned launch and reentry flight path, and intended landing sites including contingency abort sites.

(3) Launch or reentry waivers, approved or pending, from a federal range for which the launch or reentry will take place, that are unique and may affect public safety.

(b) Not later than 15 days before each licensed RLV mission, a licensee must notify the FAA, in writing, of the time and date of the intended launch and reentry or other landing on Earth of the RLV.

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

**§ 431.81 Financial responsibility requirements.**

A licensee under this part must comply with financial responsibility requirements specified in its license.

**§ 431.83 Compliance monitoring.**

A licensee shall allow access by, and cooperate with, federal officers or employees or other individuals authorized by the FAA to observe any activities of the licensee, or of the licensee's contractors or subcontractors, associated with the conduct of a licensed RLV mission.

**§ 431.85 Registration of space objects.**

(a) To assist the U.S. Government in implementing Article IV of the 1975 Convention on Registration of Objects Launched into Outer Space, each licensee shall provide to the FAA the information required by paragraph (b) of this section for all objects placed in space by a licensed RLV mission, including an RLV and any components, except:

(1) Any object owned and registered by the U.S. Government; and

(2) Any object owned by a foreign entity.

(b) For each object that must be registered in accordance with this

section, a licensee shall submit the following information not later than thirty (30) days following the conduct of a licensed RLV mission :

(1) The international designator of the space object(s);

(2) Date and location of the RLV mission initiation;

(3) General function of the space object; and (4) Final orbital parameters, including:

(i) Nodal period;

(ii) Inclination;

(iii) Apogee; and

(iv) Perigee.

(c) A licensee shall notify the FAA when it removes an object that it has previously placed in space.

**§§ 431.86–431.90 [Reserved]**

## Subpart F—Environmental Review

### § 431.91 General.

An applicant shall provide the FAA with sufficient information to analyze the environmental impacts associated with proposed operation of an RLV, including the impacts of anticipated activities to be performed at its reentry site. The information provided by an applicant must be sufficient to enable the FAA to comply with the requirements of the National Environmental Policy Act, 42 U.S.C. 4321 *et seq.*, the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 40 CFR parts 1500–1508, and the FAA's Procedures for Considering Environmental Impacts, FAA Order 1050.1D. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of FAA Order 1050.1D may be obtained from the Office of Environment and Energy, AEE–300, Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20591, (202) 267–3553. Copies of FAA Order 1050.1D may be inspected in the Rules Docket at the Federal Aviation Administration, Office of the Chief Counsel, AGC–200, Room 915G, 800 Independence Avenue SW., Washington, DC 20591 weekdays between 8:30 a.m. and 5:00 p.m., or at the Office of the Federal Register, 800 North Capitol Street NW., Suite 700, Washington, DC 20001.

### § 431.93 Environmental information.

An applicant shall submit environmental information concerning—

(a) A designated reentry site, including contingency abort locations, if any, not covered by existing FAA environmental documentation;

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

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

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

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

19. Part 433 is added to read as follows:

## PART 433—LICENSE TO OPERATE A REENTRY SITE

### Subpart A—General

Sec.
433.1 General.
433.3 Issuance of a license to operate a reentry site.
433.5 Operational restrictions on a reentry site.
433.7 Environmental.
433.9 Environmental information.

**Authority:** 49 U.S.C. 70101–70121

### § 433.1 General.

The FAA evaluates on an individual basis an applicant's proposal to operate a reentry site.

### § 433.3 Issuance of a license to operate a reentry site.

(a) The FAA issues a license to operate a reentry site when it determines that an applicant's operation of the reentry site does not jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States.

(b) A license to operate a reentry site authorizes a licensee to operate a reentry site in accordance with the representations contained in the licensee's application, subject to the licensee's compliance with terms and conditions contained in any license order accompanying the license.

### § 433.5 Operational restrictions on a reentry site.

A license to operate a reentry site authorizes the licensee to offer use of the site to support reentry of a reentry vehicle for which the three-sigma footprint of the vehicle upon reentry is wholly contained within the site.

### § 433.7 Environmental.

An applicant shall provide the FAA with information for the FAA to analyze the environmental impacts associated with proposed operation of a reentry site. The information provided by an applicant must be sufficient to enable the FAA to comply with the requirements of the National Environmental Policy Act, 42 U.S.C. 4321 *et seq.* (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA, 40 CFR Parts 1500–1508, and the FAA's Procedures for Consideration Environmental Impacts, FAA Order 1050.1D.

### § 433.9 Environmental information.

An applicant shall submit environmental information concerning a proposed reentry site not covered by existing environmental documentation for purposes of assessing reentry impacts.

20. Part 435 is added to read as follows:

## PART 435—REENTRY OF A REENTRY VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV)

### Subpart A—General

Sec.
435.1 Scope.
435.3 Types of reentry licenses.
435.5 Policy and safety approvals.
435.7 Payload reentry determinations.
435.9 Issuance of a reentry license.
435.11 Additional license terms and conditions.
435.13 Transfer of a reentry license.
435.15 Rights not conferred by reentry license.
435.16–435.20 [Reserved]

### Subpart B—Policy Review and Approval for Reentry of a Reentry Vehicle

435.21 General.
435.23 Policy review requirements and procedures.
435.24–435.30 [Reserved]

### Subpart C—Safety Review and Approval for Reentry of a Reentry Vehicle

435.31 General.
435.33 Safety review requirements and procedures.
435.35 Acceptable reentry risk for reentry of a reentry vehicle.
435.36–435.40 [Reserved]

### Subpart D—Payload Reentry Review and Determination

435.41 General.
435.43 Payload reentry review requirements and procedures.
435.44–435.50 [Reserved]

### Subpart E—Post-Licensing Requirements—Reentry License Terms and Conditions

435.51 General.
435.52–435.60 [Reserved]

### Subpart F—Environmental Review

435.61 General.
435.62–435.70 [Reserved]

**Authority:** 49 U.S.C. 70101–70119.

## Subpart A—General

### § 435.1 Scope.

This part prescribes requirements for obtaining a license to reenter a reentry vehicle other than a reusable launch vehicle (RLV), and post-licensing requirements with which a licensee must comply to remain licensed. Requirements for preparing a license application are contained in part 413 of this subchapter.

### § 435.3 Types of reentry licenses.

(a) *Reentry-specific license.* A reentry-specific license authorizes a licensee to reenter one model or type of reentry vehicle, other than an RLV, to a reentry site. A reentry-specific license may authorize more than one reentry and identifies each reentry authorized under the license. A licensee's authorization to reenter terminates upon completion of all activities authorized by the license or the expiration date stated in the reentry license, whichever occurs first.

(b) *Reentry operator license.* A reentry operator license authorizes a licensee to reenter any of a designated family of reentry vehicles, other than an RLV, within authorized parameters, including trajectories, transporting specified classes of payloads to any reentry site designated in the license. A reentry operator license is valid for a 2-year renewable term.

### § 435.5 Policy and safety approvals.

To obtain a reentry license, an applicant must obtain policy and safety approvals from the FAA. Requirements for obtaining these approvals are contained in subparts B and C of this part. Only a reentry license applicant may apply for the approvals, and may apply for either approval separately and in advance of submitting a complete license application, using the application procedures contained in part 413 of this subchapter.

### § 435.7 Payload reentry determinations.

(a) A payload reentry determination is required to transport a payload to Earth on a reentry vehicle unless the proposed payload is exempt from payload review.

(b) A payload reentry determination made under a previous license application under this subchapter may satisfy the requirements of paragraph (a) of this section.

(c) The FAA conducts a review, as described in subpart D of this part, to make a payload reentry determination. Either a reentry license applicant or a payload owner or operator may request a review of the proposed payload using the application procedures contained in part 413 of this subchapter. Upon receipt of an application, the FAA may conduct a payload reentry review independently of a reentry license application.

### § 435.9 Issuance of a reentry license.

(a) The FAA issues a reentry license to an applicant who has obtained all approvals and determinations required under this chapter for a reentry license.

(b) A reentry license authorizes a licensee to reenter a reentry vehicle and payload, if any, in accordance with the representations contained in the reentry licensee's application, subject to the licensee's compliance with terms and conditions contained in license orders accompanying the reentry license, including financial responsibility requirements.

### § 435.11 Additional license terms and conditions.

The FAA may amend a reentry license at any time by modifying or adding license terms and conditions to ensure compliance with 49 U.S.C. Subtitle IX, chapter 701, and applicable regulations.

### § 435.13 Transfer of a reentry license.

(a) Only the FAA may transfer a reentry license.

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

### § 435.15 Rights not conferred by reentry license.

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

### §§ 435.16–431.20 [Reserved]

## Subpart B—Policy Review and Approval for Reentry of a Reentry Vehicle

### § 435.21 General.

The FAA issues a policy approval to a reentry license applicant upon completion of a favorable policy review. A policy approval is part of the licensing record on which the licensing determination is based.

### § 435.23 Policy review requirements and procedures.

Unless otherwise indicated in this subpart, regulations applicable to policy review and approval of the reentry of an RLV contained in part 431, subpart B of this subchapter shall apply to the policy review conducted for a license to reenter a reentry vehicle under this part.

### §§ 435.24–435.30 [Reserved]

## Subpart C—Safety Review and Approval for Reentry of a Reentry Vehicle

### § 435.31 General.

The FAA conducts a safety review to determine whether an applicant is capable of reentering a reentry vehicle and payload, if any, to a designated reentry site without jeopardizing public health and safety and the safety of property. A safety approval is part of the licensing record on which the licensing determination is based.

### § 435.33 Safety review requirements and procedures.

Unless otherwise stated in this subpart, regulations applicable to safety review and approval of the reentry of an RLV contained in part 431, subpart C of this subchapter shall apply to the policy review conducted for a license to reenter a reentry vehicle under this part.

### § 435.35 Acceptable reentry risk for reentry of a reentry vehicle.

To obtain safety approval reentry, an applicant must demonstrate that risk for the proposed reentry, when assessed in combination with launch of the reentry vehicle, does not exceed acceptable risk for the conduct of an RLV mission as defined in paragraphs (a) and (b) of § 431.35 of this subchapter.

### §§ 435.36–435.40 [Reserved]

## Subpart D—Payload Reentry Review and Determination

### § 435.41 General.

The FAA conducts a payload reentry review to examine the policy and safety issues related to the proposed reentry of a payload, except a U.S. Government payload, to determine whether the FAA will approve the reentry of the payload.

### § 435.43 Payload reentry review requirements and procedures.

Unless otherwise indicated in this subpart, regulations contained in part 431, subpart B of this subchapter applicable to a payload reentry review and determination for reentering a payload using an RLV shall apply to the payload reentry review conducted for a

license to reenter a reentry vehicle under this part.

**§§ 435.44–435.50 [Reserved]**

## Subpart E—Post-Licensing Requirements—Reentry License Terms and Conditions

**§ 435.51 General.**

Unless otherwise indicated in this subpart, post-licensing requirements contained in part 431 subpart E of this subchapter applicable to a license to reenter an RLV shall apply to a license issued under this part.

**§§ 435.52–435.60 [Reserved]**

## Subpart F—Environmental Review

**§ 435.61 General.**

Unless otherwise indicated in this subpart, environmental review requirements contained in part 431 subpart F, applicable to a license to reenter an RLV shall apply to an application for a reentry license under this part.

**§§ 435.62–435.70 [Reserved]**

Issued in Washington, DC, on April 13, 1999.

**Patricia Grace Smith,**

*Associate Administrator for Commercial Space Transportation.*

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