AST Commercial Space Transportation

Go for launch

The Streamlining Launch and Reentry Licensing Requirements Final Rule

Part 450 Workshop

Day 1

faa.gov/space

Federal Aviation Administration

Opening Remarks

Welcome

- The Streamlined Launch and Reentry Licensing Requirements (SLR2) Rulemaking was posted on the FAA web site on October 15, 2020.
- Rule will be effective 90 days after publication in the Federal Register.
- Purpose of this workshop is to assist industry in understanding the requirements in the new 14 CFR part 450.
- FAA will hold individual sessions with licensees and applicants after the workshop to address questions pertaining to their unique programs.
- FAA also plans to hold quarterly workshops.

Draft document pending clearance pursuant to 49 CFR part 5

Overview of Agenda

- **Wednesday**
  - Part 450 Overview
  - Pre-Application Consultation
  - Subpart A
  - Subpart B
  - Subpart C – Safety Criteria, System Safety Program, Hazard Control Strategies
- **Thursday**
  - Subpart C – Hazard Control Strategies, Flight Safety Analysis, Computing Systems
- **Friday**
  - Subpart C – Safety-Critical Systems, Flight Safety Systems, Other Prescribed Hazard Controls, Ground Safety
  - Subpart D
  - Part 450 Crosswalk Mapping for Legacy Operators
- Note: We plan to keep each day's agenda item on its planned day.

Questions

- Q&A Session will be held after each section or set of sections.
- Participants should use the Q&A function to ask questions.
- We will answer as many questions as time allows.
- Any unanswered questions will be answered after the workshop in a written Q&A document.
- We look forward to better engagement during the individual sessions.

Day 1 Agenda

Time	Topic
10:00 AM	**Opening Remarks**
10:10 AM	**Part 450 Overview**
10:55 AM	**Pre-Application Consultation Tools** Sample Application Letter Template Application Compliance Checklist Sample Compliance Document List Pre-Application Consultation Checklist Means of Compliance Table
11:30 AM	**Q&A**
11:45 AM	**Lunch Break**
12:15 PM	**Subpart A—General Information.** § 450.1 Applicability. § 450.3 Scope of a vehicle operator license. § 450.5 Issuance of a vehicle operator license. § 450.7 Duration of a vehicle operator license. § 450.9 Additional license terms and conditions. § 450.11 Transfer of a vehicle operator license. § 450.13 Rights not conferred by a vehicle operator license.
12:32 PM	**Q&A**

Day 1 Agenda

Time	Topic
12:47 PM	**Subpart B—Requirements to Obtain a Vehicle Operator License.** § 450.31 General. § 450.33 Incremental review and determinations. § 450.35 Accepted means of compliance. § 450.37 Equivalent level of safety. § 450.39 Use of safety element approval. § 450.41 Policy review and approval. § 450.43 Payload review and determination. § 450.45 Safety review and approval. § 450.47 Environmental review.
1:26 PM	Q&A
1:41 PM	**Break**
1:51 PM	**Part 450 Subparts C** **Safety Criteria** § 450.101 Safety Criteria
2:51 PM	Q&A
3:11 PM	**Break**
3:21 PM	§ 450.103 System Safety Program.
3:36 PM	Q&A
3:51 PM	§ 450.107 Hazard Control Strategies
4:06 PM	Q&A
4:26 PM	**End of Day 1**

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An Overview of The Streamlining Launch and Reentry Licensing Requirements Final Rule

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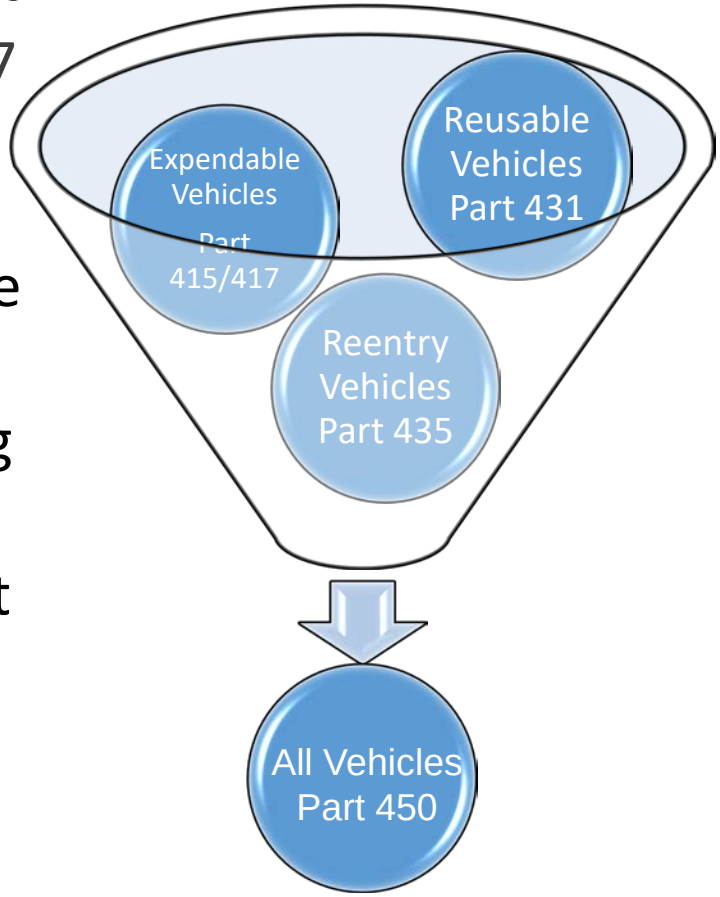
Highlights from the Streamlining Launch and Reentry License Requirements (SLR2) Final Rule

- SLR2 Final Rule Issued September 30, 2020
  - Completed in 2.5 years, normally 5-7 years
- Consolidates multiple regulatory regimes into one set of requirements for all vehicle types
- Performance-based requirements utilizing flexible means of compliance
- Single license may authorize operations at multiple sites
- Extensive coordination with DOD and NASA to minimize duplicative requirements for operators



Part 450 Organization

- Part 450 is divided into subparts A through D:
  - Subpart A: General
  - Subpart B: Requirements to Obtain a Vehicle Operator License
  - Subpart C: Safety Requirements
  - Subpart D: Terms and Conditions of a Vehicle Operator License
- Application requirements are separated from safety requirements to facilitate compliance planning and a more efficient licensing process
  - Safety requirements: what an operator must do to be safe
  - Application requirements: what an applicant must submit in an application

Application Requirement Example:

§ 450.155 Readiness.

(a) *General.* An operator must document and implement procedures to assess readiness to proceed with the flight of a launch or reentry vehicle. These procedures must address, at a minimum, the following:

(1) Readiness of vehicle and launch, reentry, or landing site, including any contingency abort location;

(2) Readiness of safety-critical personnel, systems, software, procedures, equipment, property, and services; and

(3) Readiness to implement the mishap plan required by § 450.173.

(b) *Application requirements.* An applicant must—

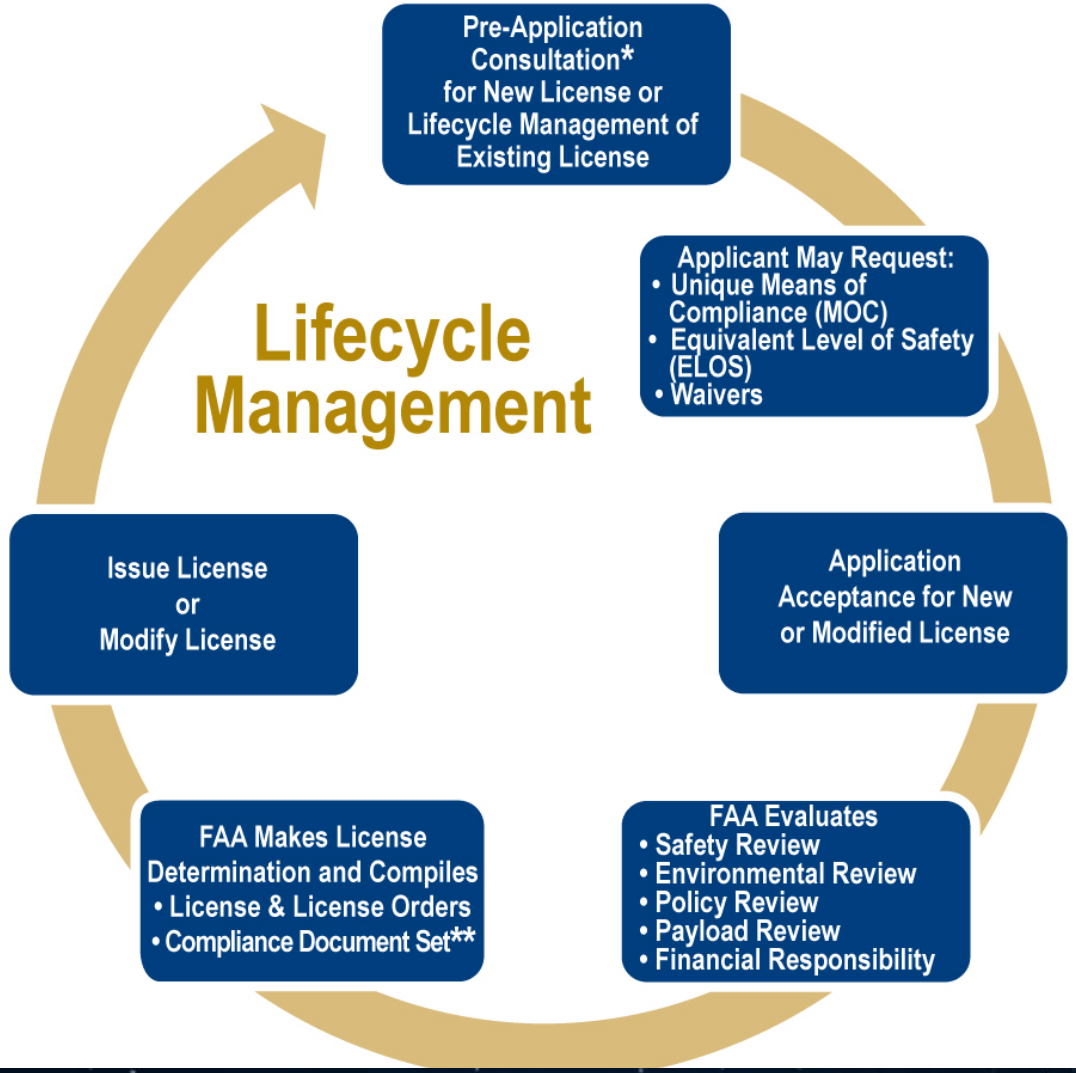
(1) Demonstrate compliance with the requirements of paragraph (a) of this section through procedures that may include a readiness meeting close in time to flight; and

(2) Describe the criteria for establishing readiness to proceed with the flight of a launch or reentry vehicle so that public safety is maintained.

The Vehicle Licensing Process

- The licensing process begins with pre-application consultation, which sets the stage for an applicant to submit a license application.
- The application evaluation consists of five major components:
  1. A Policy Review
  2. A Payload Review
  3. A Safety Review
  4. A Maximum Probable Loss (MPL) Determination
  5. An Environmental Review
- The license specifies the range of activities the licensee may undertake along with any limitations.
- Requirements after a license is issued encompass the licensee's responsibility for public safety and compliance with its license, representations in the license application, and FAA regulations.
- An important component of this compliance is the FAA's authority to perform safety inspections.

Part 450 License Lifecycle Management Process



****License and License Orders Will Reference the Compliance Document Set:**

Compliance document set includes the application data submittals below:

- Application Letter
- Application with Compliance Documents
- Application Compliance Checklist
  - Any Waivers & ELOS

***Pre-Application Compliance Planning Templates and Guidance:**

- Application Letter Template
- Application Compliance Checklist
- Sample Compliance Document List
- Pre-Application Consultation Checklist
- Means of Compliance Table
- Crosswalk Mapping to Legacy Regulations
- Advisory Circulars

Pre-Application Consultation

- Pre-application consultation will increase the efficiency of the licensing process by focusing on compliance planning
- The length of pre-application consultation will vary based on the proposed operation
  - Longer for brand new vehicles that are under development
  - Shorter for previously licensed vehicles or operators experienced with the FAA's regulations
- During pre-application consultation, the FAA expects to discuss the following topics with an applicant:
  - Intended means of compliance to meet part 450 requirements
  - Scope of the license
  - Safety element approvals
  - Incremental review
  - Review period for license evaluation
  - Compliance expectations
  - Time frames

Pre-Application Consultation
Scope of License: Beginning of Launch

- During pre-application consultation, the scope of the license will be discussed,
  - The applicant will describe its launch site and its intended concept of operations leading up to a launch, including any hazardous pre-flight operations
  - FAA will identify the beginning and end of launch on a case-by-case basis and in consultation with an applicant.
- Hazardous pre-flight operations include, but are not limited to
  - Pressurizing or loading of propellants into the vehicle or launch system
  - Operations involving a fueled launch vehicle
  - The transfer of energy necessary to initiate flight, or any hazardous activity preparing the vehicle for flight
- Hazardous pre-flight operations do not include the period between the end of the previous launch and launch vehicle reuse when the vehicle is in a safe and dormant state

To accommodate vehicle reusability, “Impact or Landing” is now used to determine the end of launch and reentry

Pre-Application Consultation
Incremental Review of a Modular Application

- The FAA previously allowed independent review of the payload review, policy review, MPL, and environmental review
  - Part 450 allows incremental approvals of the safety review

- An applicant must have its incremental review approach approved during pre-application consultation. FAA will consider whether the modules
  - Can be reviewed independently
  - Will be submitted in a workable chronological order

- Benefits of incremental review of a modular application
  - Reduces regulatory uncertainty with early approvals
  - Allows for an agreement on a time frame for applicant submittals and FAA review periods that may be less than 180 days

Pre-Application Consultation
Safety Element Approvals

- Part 450 makes it easier to seek a safety element approval in conjunction with a license application
- To increase the efficiency of the licensing process, an applicant may leverage existing safety element approvals
- A safety element approval is a determination that a safety element, when used or employed within a defined envelope, parameter, or situation, will not jeopardize public health and safety or safety of property
- A safety element is any one of the following:
  - A launch vehicle, reentry vehicle, safety system, process, or service
  - Qualified and trained personnel, performing a process or function related to licensed activities or vehicles

FAA updated the part 414 term “safety approval” to “safety element approval” to delineate between the safety approval during a license determination and a safety element approval granted under part 414.

Pre-Application Consultation Flexible Timeframes

- Part 404 Appendix A lists the time frames that an applicant may request a change to the default time frame required by the regulation
- The FAA will conduct its review on a case-by-case basis, taking into account
  - The complexity of the request
  - The timeliness of the request
  - Whether the requested alternative allows sufficient time for the FAA to conduct its review and make its findings
- The FAA expects alternative time frames to be proposed and accepted
  - During pre-application consultation
  - During the application process
  - After a license is issued through the license modification process
- Flexible time frames may be negotiated for all the launches or reentries under the license

Table of Eligible Time Frames	
§ 404.5	Filing a petition for waiver
§ 413.23	License or permit renewal
§ 414.31	Safety element approval renewal
§ 420.57	Notifications
§ 437.89	Pre-flight reporting
§ 440.15	Demonstration of compliance
§ 450.169	Launch and Reentry Collision Avoidance Analysis Requirements.
§ 450.213	Pre-flight reporting
§ 450.215	Post-flight reporting

Pre-Application Consultation
Means of Compliance

- An applicant may demonstrate compliance with part 450 requirements by using accepted means of compliance (MOC)
- MOC may be government standards, industry consensus standards, or unique MOC developed by an individual.
  - An applicant may tailor an accepted MOC and submit it as a unique MOC
- For the following 5 sections, a MOC must be accepted by the FAA prior to application acceptance:
  1. 450.115(b)(1) Flight Safety Analyses
  2. 450.139(e)(1) Toxic Hazards for Flight
  3. 450.145(b) Highly-Reliable Flight Safety System
  4. 450.163(a)(1) Lightning Hazard Mitigation
  5. 450.187(e)(1) Toxic Hazards Mitigation for Ground Operations
- For all other requirements of part 450, an applicant may submit MOC as part of its application for the FAA to review during the application evaluation.
- A MOC may be submitted to the FAA outside of the licensing process

Safety Framework

- Part 450's Safety Framework provides the flexibility needed to accommodate current and future launch and reentry operations.
- *System Safety Program* establishes system safety management principles for both ground safety and flight safety throughout the operational lifecycle of a launch or reentry system.
- *Ground Safety* is achieved primarily through a process-based hazard analysis to derive hazard controls and prescribed hazard controls.
- *Flight Safety* is achieved through a combination of prescribed hazard controls and hazard controls derived from
    - Flight safety analysis
    - Hazard control strategy determination and implementation
- *Safety Criteria* and requirements in § 450.101 that must be met before a launch or reentry can take place
    - Safety Criteria include collective risk, individual risk, aircraft risk, risk to critical assets, protection against high consequence events, disposal of orbiting stages, risk to people and property on-orbit, and notification of planned impacts.

System Safety Program

- All operators are required to have a system safety program that establishes system safety management principles for both ground safety and flight safety throughout the operational lifecycle of a launch or reentry system

- The System Safety Program includes:
  - A Safety Organization
  - Hazard Management
  - Configuration Management And Control
  - Post-flight Data Review

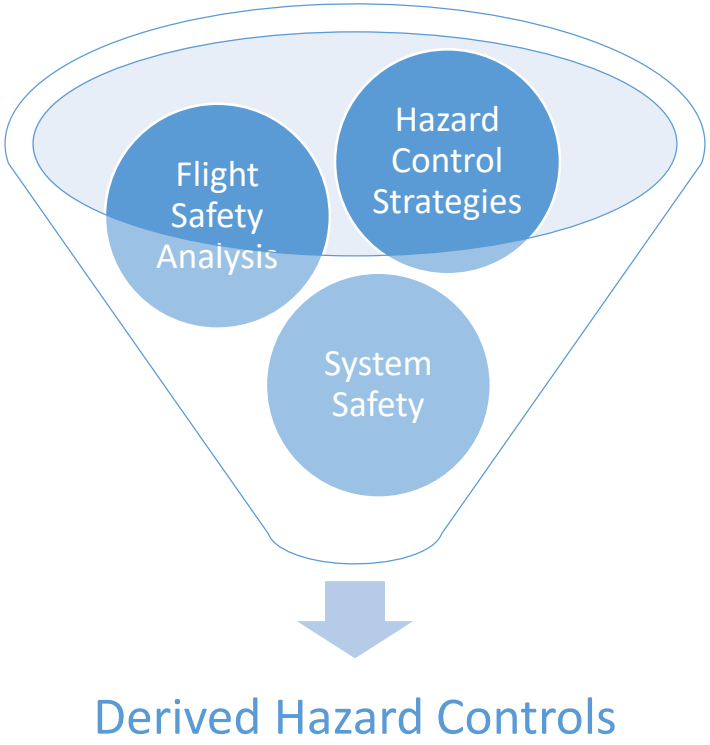
Hazard Control Strategies

- The 4 Hazard Control Strategies in Part 450 accommodate the wide variety of commercial launch and reentry systems and operations concepts: Physical Containment, Wind Weighting, Flight Abort, and Flight Hazard Analysis
- An operator determines the appropriate hazard control strategy by conducting a functional hazard analysis
- An operator may use multiple hazard control strategies during flight because different strategies may be appropriate for different phases of flight
    - Different hazard control strategies may also be appropriate during any one phase of flight to protect different sets of people and property
- An operator is required to use Flight Hazard Analysis if the other hazard control strategies cannot adequately mitigate the public safety hazards to meet the risk criteria in § 450.101(a), (b), and (c)

Derived Hazard Controls

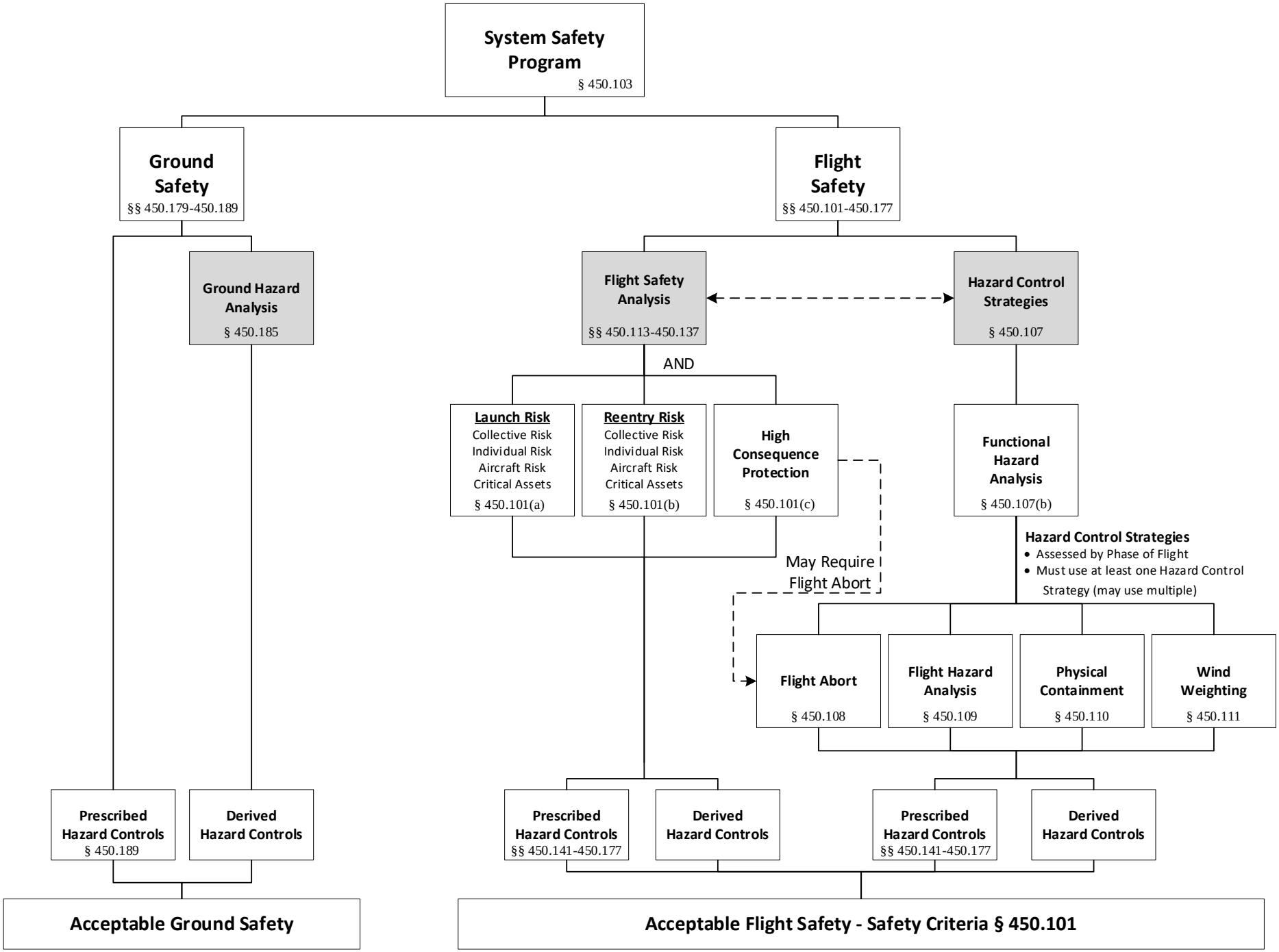
- Derived Hazard Controls are not specified in part 450 because derived hazard controls are typically derived in the process of demonstrating compliance with the safety criteria in § 450.101 and the byproducts of the safety analyses

- Examples of derived hazard controls include flight commit criteria, flight hazard areas, flight abort rules, and other mitigation measures



Prescribed Hazard Controls

- Regardless of the hazard controls derived from a flight hazard analysis and FSA, the FAA requires many other hazard controls.
- **Prescribed Hazard Controls for Computing Systems and Safety-Critical Hardware (§§ 450.141-450.145)**
  - The first set of hazard controls includes requirements for computing systems, safety-critical systems, and highly reliable FSS
- **Other Prescribed Hazard Controls (§§ 450.147-450.177)**
  - The second set of hazard controls have historically been necessary to achieve acceptable flight safety.
  - These include requirements for (1) written agreements, (2) safety-critical personnel qualifications, (2) work shift and rest requirements, (3) radio frequency management, (4) readiness, (5) communications, (6) pre-flight procedures, (7) control of hazard areas, (8) lightning hazard mitigation, (9) flight commit criteria, (10) tracking, (11) collision avoidance, (12) safety at the end of launch, and (13) mishap plans.


System Safety Program
§ 450.103
Ground Safety
§§ 450.179-450.189
Flight Safety
§§ 450.101-450.177
Ground Hazard Analysis
§ 450.185
Flight Safety Analysis
§§ 450.113-450.137
Hazard Control Strategies
§ 450.107
AND
Launch Risk
Collective Risk
Individual Risk
Aircraft Risk
Critical Assets
§ 450.101(a)
Reentry Risk
Collective Risk
Individual Risk
Aircraft Risk
Critical Assets
§ 450.101(b)
High Consequence Protection
§ 450.101(c)
Functional Hazard Analysis
§ 450.107(b)
Hazard Control Strategies
• Assessed by Phase of Flight
• Must use at least one Hazard Control Strategy (may use multiple)
May Require Flight Abort
Flight Abort
§ 450.108
Flight Hazard Analysis
§ 450.109
Physical Containment
§ 450.110
Wind Weighting
§ 450.111
Prescribed Hazard Controls
§ 450.189
Derived Hazard Controls
Prescribed Hazard Controls
§§ 450.141-450.177
Derived Hazard Controls
Prescribed Hazard Controls
§§ 450.141-450.177
Derived Hazard Controls
Acceptable Ground Safety
Acceptable Flight Safety - Safety Criteria § 450.101

Hazard Control Strategy
Physical Containment & Wind Weighting

- **Physical Containment**
  - The physical containment hazard control strategy is designed to be a simple method of protecting public safety by launching within an area that is cleared of public and critical assets, and within an area that contains hazards based on the potential energy of the vehicle.
  - Physical containment would most likely be used for low energy test flights, when a launch vehicle does not have sufficient energy for any hazards associated with its flight to reach the public or critical assets.
- **Wind Weighting**
  - Wind weighting is traditionally used in the launch of unguided suborbital launch vehicles, otherwise known as sounding rockets, where the operator adjusts launcher azimuth and elevation settings to correct for the effects of wind conditions at the time of flight to provide a safe impact location for the launch vehicle or its components.

Hazard Control Strategy
Flight Abort

- Flight abort is the traditional safety approach for expendable launch vehicles, and is a process to limit or restrict the hazards to public safety and the safety of property by initiating and accomplishing a controlled ending to vehicle flight.
- With the exception of phases of flight with demonstrated reliability, flight abort is mandated as a hazard control strategy if the potential for a high consequence event is above a certain threshold.
- Flight Abort requirements in § 450.108 include
  - Flight Safety System Requirements
  - Flight Safety Limit Objectives
  - Flight Safety Limits Constraints
  - End of Flight Abort
  - Flight Abort Rules

Hazard Control Strategy
Flight Abort Requirements Overview

	No	Yes	Yes
Is an FSS Required?	§ 450.101 (c)(2)* CEC < 10^{-3} or § 450.101 (c)(3) Demonstrated Reliability	§ 450.108(b)(2)	§ 450.108(b)(1)
What FSS Reliability is Required?	Not Applicable	§450.143 Compliant FSS Safety-Critical System Requirements	§450.145 Compliant FSS 0.999 with 95% Confidence
When is FSS Activation Required?	Not Applicable	Flight Safety Limits and Flight Abort Rules: § 450.108	Flight Safety Limits and Flight Abort Rules: § 450.108

* In accordance with § 450.37, an applicant may demonstrate an equivalent level of safety to § 450.101(c)(2)

Hazard Control Strategy
Flight Hazard Analysis

- Flight hazard analysis is the traditional safety approach for reusable launch vehicles, and is the most flexible hazard control strategy because an operator derives specific hazard controls unique to its launch or reentry vehicle system and operations concept.
- Flight hazard analysis is mandated as a hazard control strategy if the other three hazard control strategies cannot mitigate the safety hazards sufficient to meet the safety criteria of § 450.101.
- A flight hazard analysis must identify, describe, and analyze all reasonably foreseeable hazards to public safety resulting from the flight of a launch or reentry vehicle, mitigate hazards, and validate and verify the hazard mitigations.
- An operator using Flight Hazard Analysis must
  - Identify new hazards throughout the lifecycle of the launch or reentry system
  - Ensure the FHA is complete and all hazards mitigated prior to flight
  - Continually update the FHA throughout the lifecycle of the launch or reentry system.

Flight Safety Analysis

- Part 450 contains performance-based requirements for Flight Safety Analysis component analyses in the order they are typically performed
- All operators are generally required to conduct an FSA regardless of the hazard control strategy chosen or mandated
  - An operator is not required to perform and document a flight safety analysis for a phase of flight if agreed to by the Administrator based on demonstrated reliability
  - An operator demonstrates reliability by using operational and flight history to show compliance with the risk criteria in § 450.101(a) and (b)
- A Flight Safety Analysis includes trajectory analyses for normal and malfunction flight, a debris analysis, a population exposure analysis, and a probability of failure analysis
  - These analyses provide input to a debris risk analysis, a far-field overpressure blast effects analysis, and a toxic hazard analysis that together demonstrate compliance with the safety criteria of § 450.101, and provide input to a flight hazard area analysis

Ground Safety

- **Ground Safety**. With respect to the safety of ground operations, the safety framework includes
  - Coordination With A Site Operator
  - Explosive Siting
  - A Ground Hazard Analysis
  - Toxic Hazard Mitigations
  - Prescribed Hazard Controls
    - Addressing Visitors
    - Countdown Aborts
    - Fire Suppression
    - Emergency Procedures
- These together provide an acceptable set of public safety considerations for ground operations.

Note: Operators are not required to perform a toxic release hazard analysis for kerosene-based fuels unless directed by the FAA

Safety Criteria and Neighboring Operations Personnel (NOPs)

- **Neighboring operations personnel** means those members of the public located within a launch or reentry site, or an adjacent launch or reentry site, who are not associated with a specific hazardous licensed or permitted operation currently being conducted, but are required to perform safety, security, or critical tasks at the site and are notified of the operation.
- Separate NOPs risk acceptability criteria reduces the need to evacuate neighboring launch operator personnel during a commercial launch or reentry operation
- Part 450 allows for Neighboring Operations Personnel to be protected as members of the public, but to a less stringent risk threshold.
  - Collective risk to the Public: 1×10^{-4} casualties (NOPS 2×10^{-4} casualties)
  - Individual risk to the Public: 1×10^{-6} casualties (NOPS 1×10^{-5} casualties)
- Maximum Probable Loss (MPL) for NOPS is 1 in 100,000 (same as for Government Property), 3rd Party (1 in 10,000,000)
- The Federal or licensed site operator determines who are to be designated as NOPs in coordination with the operators at the site in accordance with definition
- NOPs will be optional at non-federal ranges.

Critical Assets & Critical Payloads

- **Critical assets** include property, facilities, or infrastructure necessary to maintain national defense, or assured access to space for national priority missions
  - Critical assets that are part of the immediate launch or reentry complex used by an operator for a given licensed operation are exempt from the critical asset protection requirements
- **Critical payload** includes a payload and essential infrastructure directly supporting such a payload that is a critical asset
  - That is so costly or unique that it cannot be readily replaced, or
  - For which the time frame for its replacement would adversely affect the national interests of the United States
- The FAA will consult with interagency partners regarding critical asset designation
- The U.S. Government will assess impacts to critical assets in flight hazard, ground hazard, debris or debris risk analyses

High Consequence Event Protection

- An operator must protect against a high consequence, low probability event
- Part 450 allows an operator to use a method other than flight abort in certain situations in which the operator can show sufficient protection against high consequence events.
  - Demonstrated reliability, as approved by the Administrator
  - Demonstrate CE_C is no more than $1x10^{-3}$
- The FAA retains the CE_C requirement as a quantitative criterion that an applicant must use to measure high consequence events, but allows an equivalent level of safety for the CE_C requirement. AC450.101-1 describes an alternative means of compliance.
- Part 450 also allows options for how an applicant may protect against a low likelihood, high consequence event in uncontrolled areas for each phase of flight, by
  - Using flight abort in accordance with § 450.108;
  - Demonstrating that CE_C is below a certain threshold without any FSS; or
  - Demonstrating sufficient vehicle reliability based on CE_C criteria (e.g. see AC450.101-1)

High Consequence Event Protection

An operator may protect against high consequence events by choosing to use flight abort in accordance with § 450.108

CEC is a quantitative criteria that an applicant may use to measure the potential for high consequence events. The FAA revised § 450.37(b) (Equivalent Level of Safety) to allow an applicant to propose an alternative way to measure high consequence events other than by CEC. This allows any vehicle, irrespective of crash rate, to fly without flight abort capability if there are no failure modes expected to produce CEC > 1E-3.

This provision is intended to be used by hybrid launch vehicles for aircraft-like phases of flight. Establishes CEC as the basis for determining sufficient reliability to not require flight abort capability.

450.101(c) ***High consequence event protection.*** An operator must protect against a high consequence event in uncontrolled areas for each phase of flight by:

(1) Using flight abort as a hazard control strategy in accordance with the requirements of § 450.108;

(2) Ensuring the consequence of any reasonably foreseeable failure mode, in any significant period of flight, is no greater than 1 × 10-3 conditional expected casualties;

(3) Establishing the launch or reentry vehicle has sufficient demonstrated reliability as agreed to by the Administrator based on conditional expected casualties during that phase of flight.

Prescribed Hazard Controls
Computing Systems and Software

- Part 450's computing systems requirements are performance-based, and levy requirements for computing system safety items in proportion to their criticality
- An operator must identify software safety items and their criticality
  - Computing system safety items are any software or data that implements a capability that can present a hazard to the public, and
  - The level of criticality of each computing system safety item commensurate with its degree of control over hazards to the public and the severity of those hazards
- An operator must develop safety requirements for each computing system safety item
- An operator must implement and document a development process for computing system safety items appropriate for the level of criticality of the software safety item.
- Part 450 also requires independent verification and validation for computing system safety items that meet the definition of "safety-critical" in § 401.7

Safety-Critical System Design, Test, and Documentation

- Safety-critical system requirements apply to all safety-critical systems except
  - Safety-critical software items, which are regulated by the requirements in § 450.141
  - Highly reliable FSS, which are regulated by the requirements in § 450.145
  - Safety-critical systems for which an operator demonstrates through its flight hazard analysis that the likelihood of any hazardous condition specifically associated with the system that may cause death or serious injury to the public is extremely remote, pursuant to § 450.109(b)(3).
- Part 450.143 has requirements for
  - *Design:* Must be designed such that no credible fault can lead to increased risk to the public beyond nominal safety-critical system operation
  - *Qualification Testing:* Must functionally demonstrate the design of the vehicle's safety-critical systems at conditions beyond its predicted operating environments
  - *Acceptance Testing:* Functionally tested at predicted environments with margin or QA process to ensure functional capability during its service life.
  - *Lifecycle of safety-critical systems:* Monitor the flight environments to validate the predicted operating environments and assess component life remaining and inspection periods

Highly Reliable Flight Safety Systems

Section 450.145 contains the requirements for Highly Reliable FSS used to meet Flight Abort requirements in § 450.108(b)(1)

- Design Reliability
  - Flight safety system onboard the vehicle
    - 0.999 at 95 percent confidence and commensurate design, analysis, and testing
  - Ground-based, space-based, or otherwise not onboard portion of the system (if any)
    - 0.999 at 95 percent confidence and commensurate design, analysis, and testing
- Monitoring
  - An operator must monitor the flight environments experienced by any flight safety system component to the extent necessary to
    - Validate the predicted operating environment, and
    - Assess the actual component life remaining or adjust any inspection period.

One means of compliance for § 450.145 is in Range Commanders Council, RCC 319-19, *Flight Termination Systems Commonality Standard*, dated June 2019.

Other Prescribed Hazard Controls Agreements

- Agreements
  - Have a written agreement with any entity that provides a service or use of property to meet a requirement in part 450
  - Launch and reentry site use agreements.
    - Agreements for notices to mariners
    - Agreements for notices to airmen
    - Mishap response agreements with emergency response providers
  - Agreements must clearly delineate the roles and responsibilities of each party

Other Prescribed Hazard Controls
Safety-Critical Personnel Qualifications and Crew Rest

- **Section § 450.149 Safety-critical personnel qualifications.**
  - Ensure safety-critical personnel are trained, qualified, and capable of performing their safety-critical tasks, and that their training is current
- **Section § 450.151 Work shift and rest requirements.**
  - Document and implement rest requirements that ensure safety-critical personnel are physically and mentally capable of performing all assigned tasks
    - Duration of each work shift and the process for extending this shift
    - Number of consecutive work shift days allowed before rest is required
    - Minimum rest periods

Other Prescribed Hazard Controls
Radio Frequency Management & Readiness

- **§ 450.153 Radio frequency management.**
  - Ensure radio frequency interference does not adversely affect performance of any flight safety system or safety-critical system
  - Coordinate use of radio frequencies with any site operator and any local and Federal authorities
- **§ 450.155 Readiness.**
  - Document and implement procedures to assess readiness to proceed with the flight of a launch or reentry vehicle.
    - Readiness of vehicle and launch, reentry, or landing site, including any contingency abort location
    - Readiness of safety-critical personnel, systems, software, procedures, equipment, property, and services
    - Readiness to implement the mishap plan

Communications

§ 450.157 Communications.

- An operator must implement communication procedures during the countdown and flight of a launch or reentry vehicle that
  - Define the authority of personnel, by individual or position title, to issue "hold/resume," "go/no go," and abort commands;
  - Assign communication networks so that personnel have direct access to real-time, safety-critical information required to issue "hold/resume," "go/no go," and any abort commands
  - Use defined radio telephone communications terminology
- Ensure the currency of the communication procedures, and that all personnel are working with the approved version of the communication procedures.
- Record all safety-critical communications network channels that are used for voice, video, or data transmissions that support safety-critical systems during each countdown.

Mishap

- A mishap includes events that result in a fatality or serious injury, malfunction of a safety-critical system, failure of a safety organization, operation, or procedure, posed a high risk to occupants or the public, substantial damage to property, unplanned loss of vehicle, impact of debris outside of the planned landing site or designated hazard area, or failure to complete a launch or reentry as planned (see full definition in § 401.7)
  - A planned loss of vehicle may not be considered a mishap if it was pre-coordinated with the FAA under the optional test induced damage provision in § 450.175
- An operator must report, respond to, and investigate all mishaps.
  - Report
    - Immediate FAA notification if the mishap involves a fatality or serious injury, otherwise within 24 hours
    - Submit a preliminary written report within 5 days
  - Respond
    - Activate emergency response services to protect the public and property
    - Maintain hazard area and contain and minimize the consequences of the mishap
    - Preserve data and physical evidence
  - Investigate the root cause and report results to the FAA

Subpart D

- Subpart D addresses the terms and conditions of a vehicle operator license, including
  - Compliance monitoring (§ 450.209)
  - Material changes and continuing accuracy (§ 450.211)
  - Pre-flight reporting (§ 450.213)
  - Post-flight reporting (§ 450.215)
  - Registration of space objects (§ 450.217)

Legacy Licenses
5 Year Compliance Period

- The rule is effective 90 days after publication in the Federal Register
- Legacy license operators may operate under the legacy requirements for 5 years after the effective date of Part 450. These operators include:
  - Existing part 415/417, 431, and 435 operators
  - **90-Day Transition Period:** Applicants whose license has been issued or license application has been accepted by the FAA no later than 90 days after the effective date of the final rule (180 days after publication in the Federal Register)
- Legacy license operators must come into compliance on the effective date of the rule with
  - Critical Asset Protection, §§ 450.101(a)(4) and (b)(4)
  - Collision Avoidance Analysis (COLA), § 450.169
- Legacy license operators may apply to operate under part 450 after the effective date of this rule.

Legacy Licenses
Renewals and Modifications

- **Renewals of Legacy Licenses**
  - Legacy License operators may submit requests for license renewals such that their license remains valid for up to five years after the effective date of this rule.
  - If a license expires before the end of this period, an applicant may seek a renewal under the previous provisions in parts 415, 417, 431, and 435, but the renewal will only be valid for however much time remains between the time of issuance of the renewal and the end of the five-year period.
- **Modification of Legacy Licenses**
  - The FAA will determine the applicability of part 450 to modifications on a case-by-case basis
  - In consultation with the applicant, the FAA will consider
    - The extent and complexity of the modification
    - Whether the applicant proposes to modify multiple parts of the application
    - If the application requires significant reevaluation.

SLR2 Highlights

Flexible

- Incorporates The Traditional Hazard Control Strategies From Both Part 431 Flight Hazard Analysis And Part 415/417 Flight Abort
- High Consequence Event Protection Allows Flexibility Through ELOS And Demonstrated Reliability
- Flexible Submittal Timeframes
- Alternatives That Can Be Agreed To By The Administrator
- Flight Safety Analysis Scope Based On Demonstrated Reliability
- Flexible Means Of Compliance (MOC) To Provide Industry Flexibility To Develop Unique MOC That Meet Their Objectives

Responsive

- Relieves Duplication For Ground Safety At Certain Federal Launch Or Reentry Sites
- Generous 5 Year Compliance Period For Legacy Licenses (And Accepted Applications)
- COLA And Critical Asset Analysis Will Be Performed By The Government
- Early Approvals Through Incremental Review Of Modular Application
- Carves Out NOPS As A Separate Category Of The Public Subject To A Less Stringent Risk Threshold As Compared To Other Members Of The Public

Streamlined

- Part 450 Streamlines And Combines The Best Elements Of The Launch And Reentry Regulations Of Parts 415, 417, 431, and 435 Into A Single Performance-based Part To Better Accommodate The Evolving Commercial Space Transportation Industry.
- Part 450 Licenses Are “Vehicle Operator Licenses” Valid Up To 5 Years That Authorize Operations At Multiple Sites
- Scope Of A License Removes Launch Starts At Arrival At The Gate
- Process For Seeking A Safety Element Approval In Conjunction With A Vehicle Operator License

AST Commercial Space Transportation

Go for launch

Pre-Application Consultation Templates and Guidance

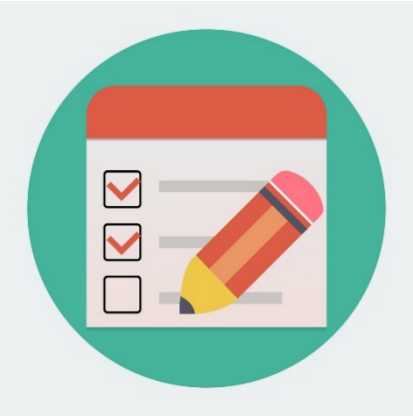
faa.gov/space

Federal Aviation Administration

Application Letter Template

Purpose of Application Letter Template

- Applicant may use application letter template as a cover letter to formally submit a license application to the FAA.
  - Use of this template is not mandatory, but applicants are encouraged to use it as a formal application cover letter for a vehicle operator license and as means to transmit package of required documents.
  - Focus is on compliance planning during pre-application consultation.
- Application letter template serves as a type of checklist that identifies and lists the following to help an applicant submit an acceptable application to the FAA in accordance with §§ 413.7 and 413.11:
  - Compliance documents
  - Any FAA-approved items associated with—
    - Alternative time frames,
    - Accepted means of compliance,
    - Incremental reviews, and
    - Safety element approvals.



Application Letter Template – Address & POC

<Company letterhead with name and address>

<DATE>

Federal Aviation Administration
Associate Administrator for Commercial Space Transportation
800 Independence Avenue SW., Room 331
Washington, DC 20591

SUBJECT: Application for a Vehicle Operator License Under 14 CFR part 450

This cover letter submitted on behalf of <COMPANY NAME>, provides the CERTIFICATION OF ACCURACY in accordance with 14 CFR § 413.7(c) for the subject application and supporting compliance documents.

Applicant Name and Contact Information:

- <COMPANY NAME>
- <COMPANY ADDRESS>
- Point of Contact: <NAME OF PERSON TO WHOM INQUIRIES AND CORRESPONDENCE SHOULD BE DIRECTED>
- Telephone Number: <PHONE NUMBER OF POINT OF CONTACT>
- Email: <EMAIL ADDRESS OF POINT OF CONTACT>

Application Letter Template – License Type

License Type

With this application, <COMPANY NAME> hereby applies for a vehicle operator license for <LAUNCH or REENTRY> as follows:

Time Frame: <APPROXIMATE TIME FRAME OF FIRST LAUNCH/REENTRY & SUBSEQUENT MISSIONS>

Vehicle(s): <IDENTIFY VEHICLE OR VEHICLE CONFIGURATIONS/FAMILY OF VEHICLES>

Payload(s): <IDENTIFY PAYLOAD(S) OR CLASS OF PAYLOADS, IF ANY>

Launch Site(s) and/or Reentry Site(s): <PROVIDE DETAILS AS APPLICABLE>

Human Space Flight: <IDENTIFY ANY CREW OR SPACE FLIGHT PARTICIPANTS>

Application Letter Template – Compliance Documents

Compliance Documents

Enclosed with this application are the following compliance-related documents:

- ***Compliance document list*** (comprehensive list of application documents organized for traceability to each regulatory requirement).
- ***Application compliance checklist*** (identifies each individual regulation and points to <COMPANY NAME's> specific compliance document that demonstrates compliance with the requirement; equivalent level of safety and waiver requests are also identified <if applicable>.

Per § 450.35, <COMPANY NAME> confirms that a means of compliance (MOC) was accepted by the FAA <REFERENCE CORRESPONDENCE WITH DATE> for the following five sections:

- § 450.115(b)(1) Flight Safety Analyses
- § 450.139(e)(1) Toxic Hazards for Flight
- § 450.145(b) Highly-Reliable Flight Safety System
- § 450.163(a)(1) Lightning Hazard Mitigation
- § 450.187(e)(1) Toxic Hazards Mitigation for Ground Operations

Application Letter Template – Alternative Time Frames

Alternative Time Frames <if applicable>

<COMPANY NAME>, in accordance with Appendix A to Part 404—Alternative Time Frames proposes the following alternative time frames for the following regulations:

< Summarize proposed alternative time frames for each corresponding eligible regulation (e.g., § 440.15—Demonstration of compliance, § 450.169— Launch and Reentry Collision Avoidance Analysis Requirements, § 450.213—Pre-flight reporting, and § 450.215—Post-flight reporting) and identify if the FAA already approved the alternative time frames during pre-application consultation. >

Application Letter Template – Incremental Review & Safety Element Approval

Incremental Review <if applicable>

- <COMPANY NAME> applies for a safety approval in an incremental manner pursuant to
- §§ 450.31(c) and 450.33.
- < Summarize incremental review requested and confirm that incremental approach was previously approved by the FAA in accordance with 14 CFR § 450.33(b). Include a schedule of events if warranted to demonstrate that a safety review module or section will be submitted to the FAA in a workable chronological order and reviewed independently within an agreed time frame.>

Safety Element Approval <if applicable>

- <COMPANY NAME>, in accordance with 14 CFR § 413.7(d), proposes to include a safety element for which the FAA issued a safety element approval under part 414 for the proposed license activity or
- <COMPANY NAME>, in accordance with 14 CFR §§ 414.11(b) and 414.15 seeks to obtain a safety element approval concurrent with a vehicle operator license application.
- <Summarize safety element approval COMPANY has received or for which COMPANY is applying.>

Application Letter Template – Certificate of Accuracy & Confidentiality

Certificate of Accuracy per § 413.7(c)

I, <AUTHORIZED PERSON>, as an individual authorized to act for <COMPANY NAME> in licensing matters, certify that the referenced application documents are true, complete, and accurate.

Confidentiality Request

Per § 413.9, <COMPANY NAME> requests <DESCRIBE INFORMATION OR DATA FOR WHICH CONFIDENTIAL TREATMENT IS DESIRED AND FOR WHAT PERIOD OF TIME>.

Sincerely,

<SIGNATURE OF AUTHORIZED PERSON>

<TITLE OF AUTHORIZED PERSON>

Application Letter Template – Enclosures

Enclosures:

<Application compliance checklist>

<Compliance document list & actual application documents>

CC:

< ASA-1>

<ASA-100>

Applicant must file an application with the FAA either by paper, by use of physical electronic storage, or by email in accordance with § 413.7(a).

Application Compliance Checklist and Sample Compliance Document List Demo

Pre-Application Consultation Checklist

Pre-Application Consultation Meeting Agenda

1. Introductions and Overview of Part 450
2. Concept of Operations (CONOPs)
   - Concept of operations
   - Unique mission aspects
   - Mission description
   - Vehicle description
   - Launch or reentry site(s)
   - Organization
   - Program status and desired timeframe

Pre-Application Consultation Checklist

3. Program Schedule

   The prospective applicant should provide a program schedule that includes a definition of significant milestones. These milestones should include dates for design reviews and testing, environmental analyses/reviews, application submission, authorization need, target of first operation (first launch or reentry), etc.

   - Program Schedule
   - Frequency of Interaction with AST

Pre-Application Consultation Checklist

4. Program Maturity

   The prospective applicant should provide information to show that launch or reentry vehicle program is sufficiently mature and stable to perform an initial design review, such as a system requirements review or other preliminary design review. Evidence of maturity may include, but is not limited to:

   - Award of a government contract with program milestones leading to flight.
   - Funding
   - Known investors or assets.
   - Manufacture or testing of hardware

Pre-Application Consultation Checklist

5. Scope of the License
   - Determining the point at which launch or reentry begins and ends will be discussed during pre-application consultation.

Pre-Application Consultation Checklist

6. Compliance Planning
   - During pre-application consultation, the FAA will work with applicants on compliance planning.
   - Below is a list of topics to discuss during compliance planning;
     - Application Compliance Checklist
     - Means of Compliance Table
     - Unique MOC
     - MOC Required Before Application Acceptance (§ 450.35 (a))
     - Equivalent Level of Safety (ELOS)
     - Waivers

Pre-Application Consultation Checklist

7. Process Alternatives Agreed to by the Administrator (if applicable)
   - For some requirements, the FAA anticipated the need for additional regulatory flexibility without the burden of providing an equivalent level of safety or applying for a separate waiver
   - FAA has incorporated the clause “as agreed to by the Administrator” to mean that an operator may submit an alternative to the proposed requirement to the FAA for review
   - FAA has also provided criteria that the Administrator will consider in determining whether to approve the alternative approach, including safety considerations when appropriate
   - These alternatives will typically be agreed to in pre-application consultation

Pre-Application Consultation Checklist

8. Time frames (if applicable)
    - An applicant can propose and the FAA can accept an alternative time frame for any of the requirements listed in Appendix A to part 404
    - The FAA expects alternative time frames to be proposed and accepted during pre-application consultation or during the application process so that the agreed to time frames are then reflected in the license once issued

Pre-Application Consultation Checklist

9. Safety Element Approvals (if applicable)
    - The FAA may issue a safety element approval applied for concurrently with a part 450 license
    - If an applicant is planning to seek a safety element approval, the applicant must continue to consult with the FAA before submitting its application
    - During pre-application consultation, the FAA would expect an applicant to be able to discuss, at a minimum, the following information as outlined in § 414.15:
        - How the applicant will meet the applicable requirements of part 450
        - The information required in § 414.13(b)(3), (c)(2), and (c)(3)
        - The sections of the license application that support the application for a safety element approval

Pre-Application Consultation Checklist

10. Incremental Review and License Review Period (if applicable)
    - An applicant may submit an application in modules using an incremental approach
    - An applicant must have its incremental review approach approved by the FAA prior to submitting its application so that the FAA can ensure the modules can be reviewed independently and in a workable order under an agreed time frame (§ 450.33 (b))
    - The FAA will review each module in accordance with a schedule discussed with the prospective applicant during pre-application consultation
    - In developing the incremental review schedule, the FAA will consider the interdependence of parts of the evaluation and the sequence of their submissions

Advisory Circulars

The table below contains the Part 450 Advisory Circulars that have been published to date. The FAA seeks public comment on each of these documents for a period of 30 days when issued. FAA will issue an updated version if warranted based on comments received. Each guidance document contains a feedback form with instructions on how to provide feedback at any time during the process. The Part 450 Means of Compliance Table (PDF) provides an estimated issuance date for all planned ACs.

Part 450 Guidance Documents	Issuance Date	Comment Period Closes
AC 450.101-1 High Consequence Event Protection (PDF)	October 15, 2020	November 16, 2020
AC 450.115-1 High Fidelity Flight Safety Analysis (PDF)	October 15, 2020	November 16, 2020
AC 450.141-1 Computing Systems and Software (PDF)	October 15, 2020	November 16, 2020

Means of Compliance Table

14 CFR Part 450 Subpart C Accepted Means of Compliance Table

This table provides at least one means of compliance for each section in part 450, subpart C, as applicable.

Section No.	Section Title	Accepted Means of Compliance	Planned Issuance
450.101	**Safety Criteria**	*N/A, except for section below.*	
450.101(c)	High Consequence Event Protection	AC 450.101-1 High Consequence Event Protection	Issued 10/20
450.103	**System Safety Program**	AC 450.103-1 System Safety Program	Q1, 2021
450.107	**Hazard Control Strategies**	AC 450.107-1 Hazard Control Strategy Determination	Q1, 2021
450.108	**Flight Abort**	AC 450-108-1 Flight Abort Rule Development	Q1, 2021
450.108(c)(6)	Flight Safety Limit Objectives	*Legacy Regulations:* § 417.213(a),(b), and (d)	

Q&A

AST Commercial Space Transportation

Go for launch

On Break

Next Session Starts at 12:15 PM EST

faa.gov/space

Federal Aviation Administration

Part 450 Subpart A

Applicability

Operators currently holding an active, valid license will have five years after the effective date of this rule to come into compliance with the entirety of part 450. If a license expires before the end of this period, an applicant may seek a renewal under the previous provisions in parts 415, 417, 431, and 435, but the renewal will only be valid for however much time remains between the time of issuance of the renewal and the end of the five-year period. Legacy licenses may be modified; whether new license modifications need to comply with part 450 is subject to FAA approval on a case-by-case basis.

§ 450.1 Applicability.

This part prescribes requirements for obtaining and maintaining a license to launch, reenter, or both launch and reenter, a launch or reentry vehicle.

Note: Applicants with an **accepted license application** at the time part 450 goes into effect may continue to apply for a license to operate under parts 415, 417, 431, and 435 for up to five years after the effective date of part 450. However, all operators are required to comply with § 450.169 for collision avoidance analysis (COLA) and 450.101(a)(4) and (b)(4) for critical asset protection once part 450 becomes effective.

Definitions: § 401.5

In § 401.5:

- In the part 450 final rule, FAA does not make any immediate changes to § 401.5.
- § 401.5 will remain in effect for five years after the effective date of part 450, and its definitions will be applied to parts 415, 417, 431, and 435.
- After five years, § 401.5 will be removed from part 401 and all operators will use the definitions in the new § 401.7.

Definitions: § 401.7

In § 401.7:

- In the final rule, existing and proposed definitions from § 401.5 are adopted as new § 401.7 (Definitions) specifically applicable to part 450 requirements.
- In addition, § 401.7 does not contain the definitions for “Federal launch range” and “launch site safety assessment” that exist in § 401.5. These definitions are not adopted because they are no longer used in the regulations.
- The FAA adds new definitions, which include critical asset, critical payload, disposal, flight abort, hazardous debris, key flight safety event, neighboring operations personnel, and useful mission.
- § 401.7 Definitions will apply to all of Chapter III except parts 415, 417, 431, 435, and 440, where § 401.5 will continue to apply until five years after the effective date of part 450.

Scope of License

§ 450.3(a) allows the Administrator to agree to a scope of license different from that laid out in § 450.3(b) and (c).

§ 450.3(b)(1) no longer adopts the current practice that hazardous ground pre-flight operations commence when a launch vehicle or its major components arrive a U.S. launch site.

Part 450 clarifies that hazardous pre-flight operations do not include the period between the end of the previous launch and launch vehicle reuse when the vehicle is in a safe and dormant state.

§ 450.3 Scope of a Vehicle Operator License - Beginning of Launch.

(a)A vehicle operator license authorizes a licensee to conduct one or more launches or reentries using the same vehicle or family of vehicles. A vehicle operator license identifies the scope of authorization as defined in paragraphs (b) and (c) of this section or as agreed to by the Administrator.

(b)A vehicle operator license authorizes launch, which includes the flight of a launch vehicle and pre- and post-flight ground operations as follows:

(1)Launch begins when hazardous pre-flight operations commence at a U.S. launch site that may pose a threat to the public. Hazardous pre-flight operations that may pose a threat to the public include pressurizing or loading of propellants into the vehicle, operations involving a fueled launch vehicle, the transfer of energy necessary to initiate flight, or any hazardous activity preparing the vehicle for flight. Hazardous pre-flight operations do not include the period between the end of the previous launch and launch vehicle reuse, when the vehicle is in a safe and dormant state.

(2)At a non-U.S. launch site, launch begins at ignition or at the first movement that initiates flight, whichever occurs earlier.

Scope of License

Clear definition of when launch begins and ends is essential for an operator to understand fully its responsibilities and for the FAA to satisfy its obligations, including calculation of Maximum Probable Loss (MPL).

With the increasing efforts to reuse components, including both impact and landing throughout §§ 450.3(b)(3) and (c) encompasses a broader range of activities because landing includes a soft vertical landing or runway landing of a vehicle or component, whereas impact is more accurate to describe a hard landing of a stage or component.

§ 450.3 Scope of License – End of Launch

(b)(3) Launch ends when any of the following events occur:

(i)For an orbital launch of a vehicle without a reentry of the vehicle, launch ends after the licensee's last exercise of control over its vehicle on orbit, after vehicle component impact or landing on Earth, after activities necessary to return the vehicle or component to a safe condition on the ground after impact or landing, or after activities necessary to return the site to a safe condition, whichever occurs latest;

(ii)For an orbital launch of a vehicle with a reentry of the vehicle, launch ends after deployment of all payloads, upon completion of the vehicle's first steady-state orbit if there is no payload deployment, after vehicle component impact or landing on Earth, after activities necessary to return the vehicle or component to a safe condition on the ground after impact or landing, or after activities necessary to return the site to a safe condition, whichever occurs latest;

(iii)For a suborbital launch that includes a reentry, launch ends after reaching apogee;

(iv)For a suborbital launch that does not include a reentry, launch ends after vehicle or vehicle component impact or landing on Earth, after activities necessary to return the vehicle or vehicle component to a safe condition on the ground after impact or landing, or after activities necessary to return the site to a safe condition, whichever occurs latest

Scope of License

Part 450 requires an applicant intending to launch from a U.S. launch site to identify pre- and post-flight ground operations such that the FAA is able to determine when the launch operation would begin and end. This requirement applies only to launches from a U.S. launch site, as launches from a non-U.S launch site (§ 450.3(b)(2)) begin at ignition or first movement that initiates flight .

§ 450.3 Scope of License

(c) *Scope of reentry.* A vehicle operator license authorizes reentry. Reentry includes activities conducted in Earth orbit or outer space to determine reentry readiness and that are critical to ensuring public health and safety and the safety of property during reentry flight. Reentry also includes activities necessary to return the reentry vehicle, or vehicle component, to a safe condition on the ground after impact or landing.

(d) *Application requirements.* An applicant must identify pre- and post-flight ground operations at a U.S. launch site sufficient for the Administrator to determine the scope of activities authorized under the license.

Issuance of a Vehicle Operator License

Part 450 consolidates the requirements for different types of launch and reentry licenses in parts 415, 431, and 435 into a single vehicle operator license that authorizes operations at multiple site.

§ 450.5 Issuance of a Vehicle Operator License.

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

(b) A vehicle operator license authorizes a licensee to conduct launches or reentries, in accordance with the representations contained in the licensee's application, with subparts C and D of this part, and subject to the licensee's compliance with terms and conditions contained in license orders accompanying the license, including financial responsibility requirements.

Duration of a Vehicle Operator License

FAA considered setting all license durations to five years, but rejected this option to allow an applicant to obtain a license for a limited specific activity rather than for a more general range of activities. An applicant may prefer a shorter license duration for a specific activity because a licensee has obligations under an FAA license, such as requirements to demonstrate financial responsibility and allow access to FAA safety inspectors, and a shorter license duration would relieve an applicant of compliance with these requirements after the activity has ended. FAA plans to continue its current practice of extending licenses through renewals or modifications to accommodate delays in authorized launches or reentries.

§ 450.7 Duration of a Vehicle Operator License.

A vehicle operator license is valid for the period of time determined by the Administrator as necessary to conduct the licensed activity but may not exceed 5 years from the issuance date.

Additional License Terms and Conditions

§ 450.9 consolidates the current additional terms and conditions requirements in §§ 415.11, 431.11, and 435.11.

§ 450.9 Additional License Terms and Conditions.

The FAA may modify a vehicle operator license at any time by modifying or adding license terms and conditions to ensure compliance with the Act and regulations.

Transfer of a Vehicle Operator License

§ 450.11 consolidates requirements to transfer a license in current §§ 415.13, 431.13, and 435.13.

§ 450.11 adds specificity that either the holder of a vehicle operator license or the prospective transferee may request a vehicle operator license transfer, both the holder and prospective transferee must agree to the transfer, and the FAA will provide written notice of its determination. These additions mirror the language used for the transfer of a safety element approval and reflect current practice.

§ 450.11 Transfer of a Vehicle Operator License.

(a) Only the FAA may transfer a vehicle operator license.

(b) Either the holder of a vehicle operator license or the prospective transferee may request a vehicle operator license transfer.

(c) Both the holder and prospective transferee must agree to the transfer.

(d) An applicant for transfer of a vehicle operator license must submit a license application in accordance with part 413 of this chapter and must meet the requirements of part 450 of this chapter.

(e) The FAA will transfer a license to an applicant that has obtained all of the approvals and determinations required under this part for a license. In conducting its reviews and issuing approvals and determinations, the FAA may incorporate by reference any findings made part of the record to support the initial licensing determination. The FAA may modify a license to reflect any changes necessary as a result of a license transfer.

(f) The FAA will provide written notice of its determination to the person requesting the vehicle operator license transfer.

Rights Not Conferred by a Vehicle Operator License

§ 450.13 consolidates the requirements in current §§ 415.15, 431.15, and 435.15 regarding the rights that are not conferred by issuance of a license.

§ 450.13, like § 415.15, plainly states that issuance of a license does not relieve a licensee of its obligation to comply with all applicable requirements of law or regulation.

§ 450.13 Rights Not Conferred by a Vehicle Operator License.

Issuance of a vehicle operator license does not relieve a licensee of its obligation to comply with all applicable requirements of law or regulation that may apply to its activities, nor does issuance confer any proprietary, property, or exclusive right in the use of any Federal launch or reentry site or related facilities, airspace, or outer space.

Q&A

Subpart B – Requirements to Obtain a Vehicle Operator License

Part 450 Subpart B – General

§ 450.31(a)(3) clarifies that a payload review is not always required by adding "if applicable."

Like § 450.31(b), current regulations allow payload (§ 415.57), policy and safety approval (§ 415.5), environmental, and financial responsibility (§ 440.7) portions of an application to be submitted separately.

§ 415.5 allows a launch license applicant to apply for a safety approval separately but not in an incremental manner allowed by § 450.31(c).

§ 450.31 General.

(a) To obtain a vehicle operator license, an applicant must—

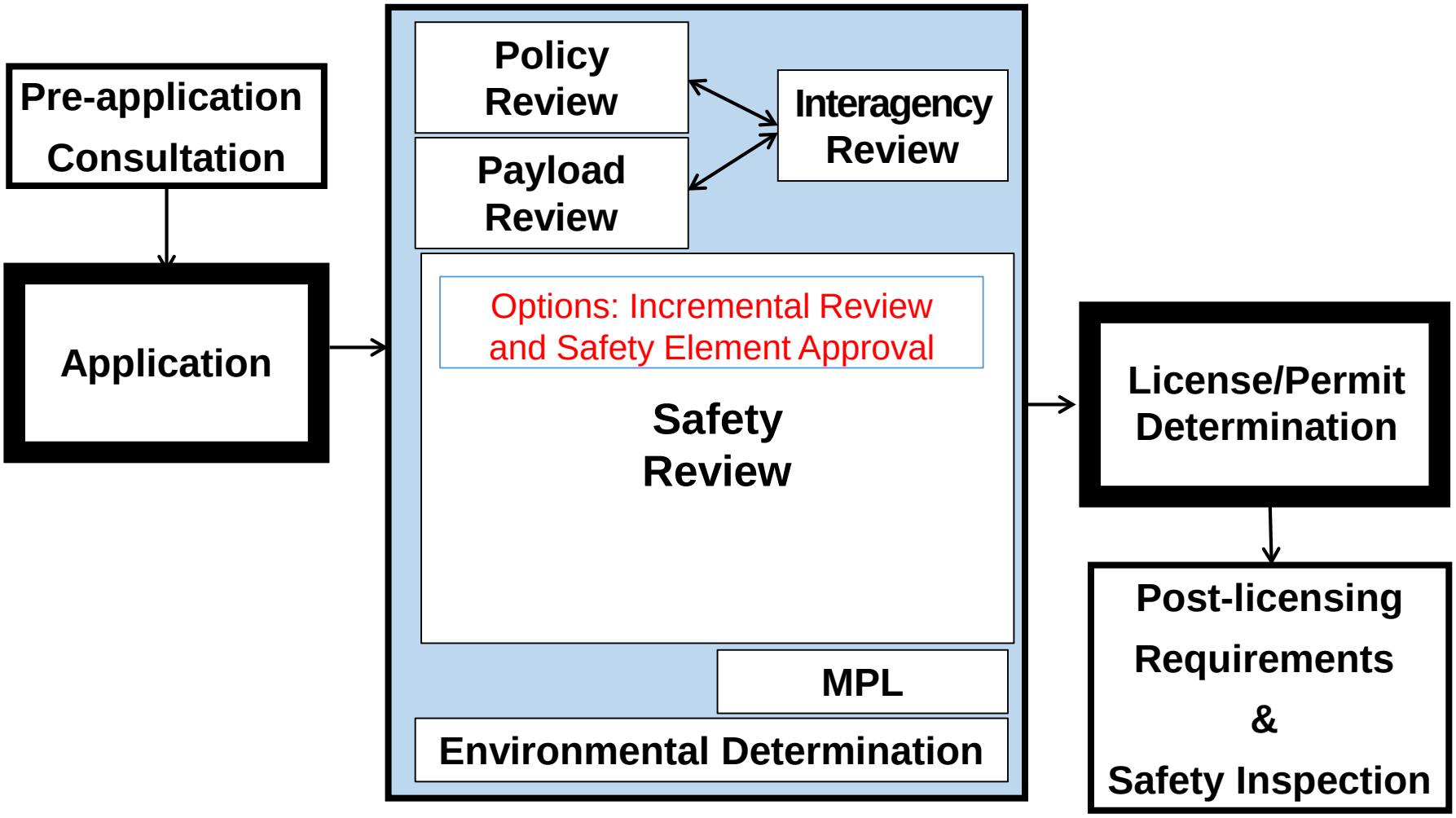
(1) Submit a license application in accordance with the procedures in part 413 of this chapter;
(2) Obtain a policy approval from the Administrator in accordance with § 450.41;
(3) Obtain a favorable payload determination from the Administrator in accordance with § 450.43, if applicable;
(4) Obtain a safety approval from the Administrator in accordance with § 450.45;
(5) Satisfy the environmental review requirements of § 450.47; and
(6) Provide the information required by appendix A of part 440 for the Administrator to conduct a maximum probable loss analysis for the applicable licensed operation.

(b) An applicant may apply for the approvals and determinations in paragraphs (a)(2) through (a)(6) of this section separately or all together in one complete application, using the application procedures contained in part 413 of this chapter.

(c) An applicant may also apply for a safety approval in an incremental manner, in accordance with § 450.33.

(d) An applicant may reference materials previously provided as part of a license application in order to meet the application requirements of this part.

Vehicle Operator Licensing Process



Incremental Review and Determinations

Incremental review provides flexibility by allowing applicant to separate the safety review into modules or sections so that those modules or sections can be submitted separately and approved independently. FAA also revises § 413.1 to clarify the term "application" to mean either an application in its entirety, or a portion of an application for incremental review and determination in accordance with § 450.33.

Applicant must have its incremental review approach approved by FAA prior to submitting its application.

Until FAA has more experience with the incremental review process, FAA will review each module in accordance with a schedule discussed with prospective applicant during pre-application consultation.

§ 450.33 Incremental Review and Determinations.

An applicant may submit its application for a safety review in modules using an incremental approach approved by the Administrator.

(a) An applicant must identify to the Administrator, prior to submitting an application, whether it will submit a modular application for any approval or determination.

(b) An applicant using an incremental approach must have the approach approved by the Administrator prior to submitting an application. In reviewing a proposed approach, the Administrator will consider the following:

(1) Whether the modules can be reviewed independently, and

(2) Whether the modules will be submitted in a workable chronological order.

(c) The Administrator may make incremental determinations as part of this review process.

Incremental Review Candidates

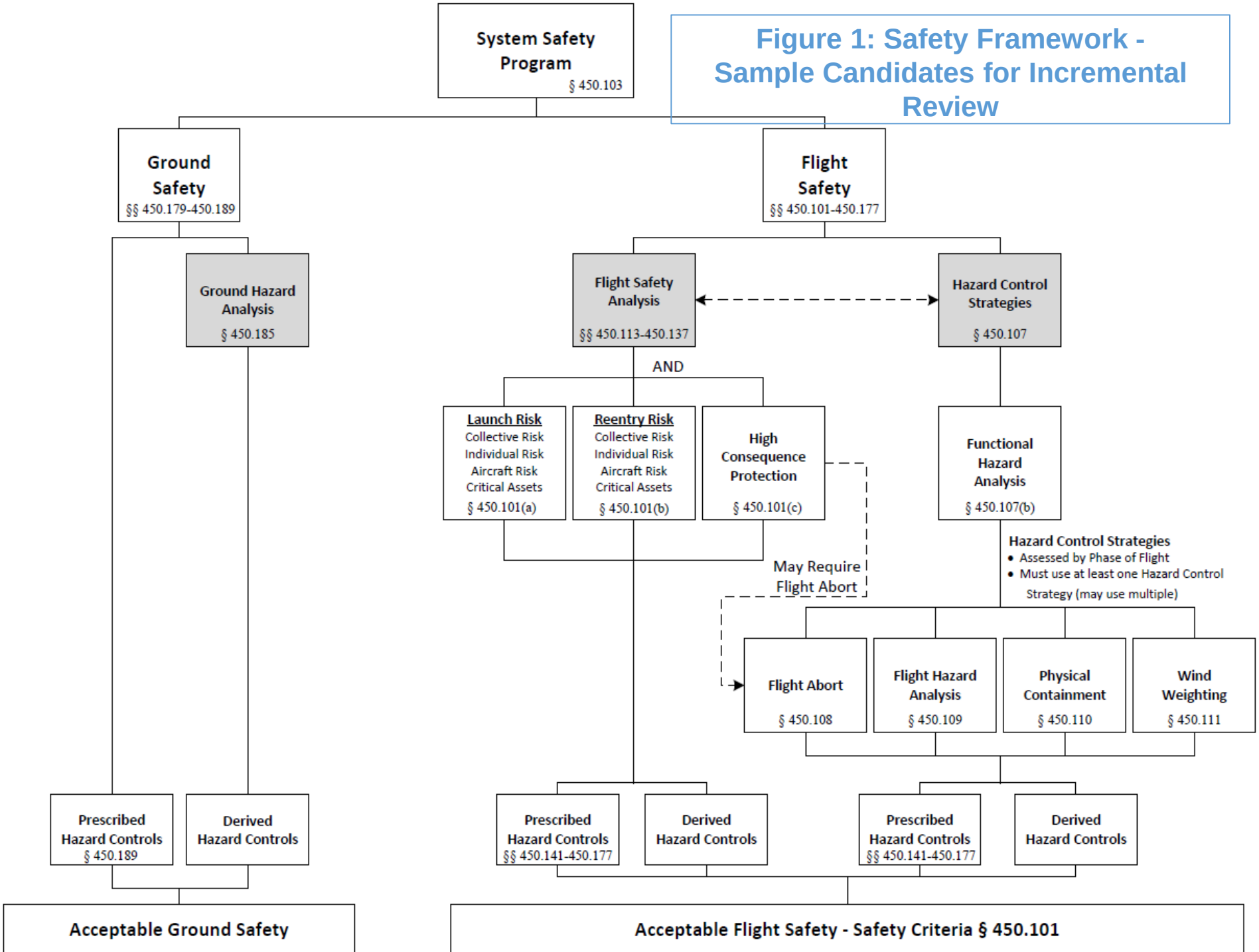
- Sample candidates for an incremental application submission (§§ 450.31(c) and 450.33) are portions of an application that can be submitted in a workable chronological order and reviewed independently.
  - In general, applicants are able to identify and describe standards, methodologies, processes, preliminary designs, and plans for their proposed launch vehicle systems and operations before they are able to submit advanced analysis products or test results.

- Examples of application increments that may be suitable for an incremental safety review include those associated with a

  - system safety program;
  - hazard control strategy;
  - flight safety analysis;
  - flight safety system design; and
  - preflight ground operations.

Safety-related modules and associated regulatory sections identified in Figure 1 are potential candidates for an incremental safety review., but are not the only ones that may be accepted for an incremental review..

Figure 1: Safety Framework - Sample Candidates for Incremental Review



Incremental Review Candidates

- Submitting an application for an incremental review and receiving early approval or buy-in on certain processes such as those pertaining to a hazard control strategy or flight safety method provides some assurance that an applicant is proceeding towards the right direction before it expends additional resources to conduct further analyses and complete its entire license application.

- Some modules will depend on others and many aspects of the safety evaluation are interdependent.
    - For example, FAA would not expect to agree to review a risk analysis before reviewing a debris analysis or probability of failure analysis given that a risk analysis is dependent on these two other analyses.

Incremental Review – Time Frame

§ 413.15 Review period.

(a) *Review period duration.* Unless otherwise specified in this chapter, the FAA reviews and makes a license or permit determination on an accepted application in accordance with the time frame specified in 51 U.S.C. 50905(a)(1). The FAA will establish the time frame for any incremental review and determination with an applicant on a case-by-case basis during pre-application consultation.

(b) *Review period tolled.* If an accepted application does not provide sufficient information to continue or complete the reviews or evaluations required by this chapter for a license, permit, or incremental determination, or an issue exists that would affect a determination, the FAA notifies the applicant, in writing, and informs the applicant of any information required to complete the application. If the FAA cannot review an accepted application because of lack of information or for any other reason, the FAA will toll the review period until the FAA receives the information it needs or the applicant resolves the issue.

(c) *Notice.* Except for applications under incremental review and determination in accordance with § 450.33, if the FAA does not make a decision in accordance with the time frame specified in 51 U.S.C. 50905(a)(1) for an accepted license application or 51 U.S.C. 50906(a) for an accepted permit application, the FAA informs the applicant, in writing, of any outstanding information needed to complete the review, or of any issues that would affect the decision.

Incremental Review – Time Frame

- Review of any modules prior to submittal of a complete application will not initiate or be bound by the statutory 180-day review period.
  - Rather, an agreed upon review period will begin once FAA has a complete enough application in its entirety.
  - During pre-application consultation, an applicant seeking an incremental review may negotiate a time frame shorter than the statutory 180-day review period.
  - As FAA gains more experience with incremental review process, it may develop guidance concerning expected timelines for various sequences of modular submissions.

Means of Compliance

FAA will not accept an application that uses a means of compliance (MOC) that has not already been accepted by the Administrator for any of the five requirements listed here. Because of the complex nature and public safety impact of these requirements, the FAA would be unable to review unique means of compliance for these five requirements during its application evaluation within its review timeframe.

Allows a person to submit an MOC outside licensing process. People or entities other than applicants may wish to submit a proposed MOC, such as operators that plan to be applicants in the future, and voluntary consensus standard bodies.

§ 450.35 Means of Compliance.

(a) Prior to application acceptance, a means of compliance must be approved by the Administrator for the following sections of this part:

(1) 450.115(b)(1) Flight Safety Analyses;

(2) 450.139(e)(1) Toxic Hazards for Flight;

(3) 450.145(b) Highly-Reliable Flight Safety System;

(4) 450.163(a)(1) Lightning Hazard Mitigation; and

(5) 450.187(e)(1) Toxic Hazards Mitigation for Ground Operations.

(b) A person requesting acceptance of a proposed means of compliance outside a license application must submit the proposed means of compliance to the FAA in a form and manner acceptable to the Administrator.

Explanation and details on how to comply with § 450.35 will be included in AC 450.35-1, "FAA Accepted Means of Compliance for 14 CFR Part 450"

Means of Compliance That Must Be Accepted by the FAA in Advance of Application Submittal

14 CFR Section Number	Section Title	Accepted Means of Compliance
Flight Safety Analysis Methods § 450.115	Section 450.115(b)(1), *Level of fidelity of the analysis*.	AC 450.115-1 *High Fidelity Flight Safety Analysis*
Toxic Hazards for Flight § 450.139	Section 450.139(e)(1), Airborne concentration and duration thresholds for toxic propellants and other chemicals.	Acute Exposure Guideline Level 2 (AEGL-2), Emergency Response Planning Guidelines Level 2 (ERPG-2), or Short-term Public Emergency Guidance Level (SPEGL)
Highly Reliable Flight Safety System § 450.145	Section 450.145(b), *Reliability*	Range Commanders Council (RCC) Document 319-19, *Flight Termination Systems Commonality Standard*
Lightning Hazard Mitigation § 450.163	Section 450.163(a)(1), Flight Commit Criteria for Lighting Hazard Mitigation	NASA-STD-4010, NASA *Standard for Lightning Launch Commit Criteria for Space Flight; initial release June 27, 2017.*
Toxic Hazards Mitigation for Ground Operations § 450.187	Section 450.187(d)(1), (1) evacuating, the public from a toxic hazard area, where public is exposed to greater than one percent conditional individual probability of casualty in a worst-case release or maximum release scenario.	Acute Exposure Guideline Level 2 (AEGL-2), Emergency Response Planning Guidelines Level 2 (ERPG-2), or Short-term Public Emergency Guidance Level (SPEGL)

Means of Compliance

- When reviewing a unique means of compliance, the FAA will consider:
  - Past engineering practices
  - The technical quality of the proposal to demonstrate compliance with the intent of the part 450 regulations
  - The safety risk of the proposal
  - Best practice history
  - Consultations with technical specialists for additional guidance.
- MOC may be submitted outside of licensing process by standard organizations and operators.
- Except for unique means of compliance, the FAA will provide public notice of each means of compliance that the Administrator has accepted.

MOC may be government standards, industry consensus standards, or unique means of compliance developed by an individual applicant. During pre-application consultation, FAA will work with applicants on compliance planning and will review submitted MOC to determine whether they satisfy the regulatory safety standard.

Equivalent Level of Safety (ELOS)

Only some portions of § 450.101 are excluded from eligibility for an ELOS approach.

Applicant may propose an ELOS to orbital debris requirement in § 450.101(e)(2) and notification of planned impacts requirement in § 450.101(f). Applicant may also propose an ELOS to use of a CE_C of 1×10^{-3} as the measure of a high consequence event in § 450.101(c)(2).

§ 450.37 Equivalent Level of Safety.

(a) An applicant must demonstrate compliance with each requirement of this part, unless the applicant clearly and convincingly demonstrates that an alternative approach provides an equivalent level of safety to the requirement of this part.

(b) Paragraph (a) of this section does not apply to §§ 450.101(a), (b), (c)(1), (c)(3), (d), (e)(1), and (g).

Per § 401.7 definition, equivalent level of safety means an approximately equal level of safety as determined by qualitative or quantitative means.

Use of Safety Element Approval

Part 450 uses the term "safety element approval" to distinguish it from "safety approval" as used in parts 415, 435, and 450.

Safety Element Approval is defined in § 414.3 as an FAA document containing the FAA determination that one or more of the safety elements listed below, when used or employed within a defined envelope, parameter, or situation, will not jeopardize public health and safety or safety of property.

A safety element includes a launch vehicle, reentry vehicle, safety system, process, service, or any identified component thereof; and qualified and trained personnel, performing a process or function related to licensed activities or vehicles

§ 450.39 Use of Safety Element Approval.

If an applicant proposes to use any vehicle, safety system, process, service, or personnel for which the FAA has issued a safety element approval under part 414 of this chapter, the FAA will not reevaluate that safety element during a license application evaluation to the extent its use is within its approved scope.

The following are eligible to apply for a safety element approval, as stated in § 414.7:

(1) A designer, manufacturer, or operator of a launch or reentry vehicle or component thereof;

(2) The designer or developer of a safety system or process; or

(3) Personnel who perform safety critical functions in conducting a licensed launch or reentry.

Safety Element Approval Application

When part 450 becomes effective, an applicant may request a safety element approval separate from a vehicle operator license application or in conjunction with a license application as specified in § 414.11.

Applying for a safety element approval is voluntary. Allowing an operator to apply for one at the same time it applies for a vehicle operator license may encourage them to seek one if the application process is streamlined or less onerous.

§ 414.11 Application.

An applicant may submit an application for a safety element approval in one of two ways:

(a) Separate from a vehicle operator license application in accordance with § 414.13; or

(b) Concurrent with a vehicle operator license application in accordance with § 414.15.

Applying for a safety element approval in conjunction with a license application would largely use or leverage information contained in license application to satisfy part 414 requirements. This alleviates need to provide separate applications for a vehicle operator license and a safety element approval.

Safety Element Approval Eligibility

FAA applies three-pronged test to help determine eligibility of a safety element:

(1) safety element must fit into one of the categories listed in the statute (51 U.S. Code § 50905);

(2) safety element must be able to be used in conducting licensed or permitted launch or reentry activities; and

(3) safety element must be able to be used to meet licensing or permitting regulations.

§ 414.15: Application concurrent with vehicle operator license application

An applicant planning to seek a safety element approval must consult with the FAA before submitting its application in accordance with § 414.9 (Pre-Application Consultation). This helps ensure that FAA and applicant have a thorough understanding of how applicant will comply with regulatory requirements surrounding a safety element approval before submitting an application. During pre-application consultation, an applicant should be able to discuss, at a minimum, the following information as outlined in § 414.15.

§ 414.15 Application concurrent with vehicle operator license application.

(a) An applicant for a vehicle operator license may also identify one or more sections of its application for which it seeks to obtain a safety element approval concurrently with a license. An applicant applying for a safety element approval concurrently with a license must—

(1) Meet the applicable requirements of part 450;

(2) Provide the information required in § 414.13(b)(3) and (c)(2) and (c)(3); and

(3) Specify the sections of the license application that support the application for a safety element approval.

(b) The scope of the safety element approval will be limited to what the application supports. The technical criteria for reviewing a safety element submitted as part of a vehicle operator license application are limited to the applicable requirements of part 450.

Safety Element Approval – Technical Information

As required by § 414.15(a)(2), an applicant seeking a safety element approval concurrently with a license must provide the following information in its application:

- Identify the safety element as defined under this part for which the applicant seeks a safety element approval (§ 414.13(b)(3)).
- Contain the following technical information:
  - The specific operating limits for which the safety element approval is sought (§ 414.13(c)(2)).
  - The following as applicable (§ 414.13(c)(3)):

    (i) Information and analyses required under this chapter that may be applicable to demonstrating safe performance of the safety element for which the safety element approval is sought.

    (ii) Engineering design and analyses that show the adequacy of the proposed safety element for its intended use, such that the use in a licensed launch or reentry will not jeopardize public health or safety or the safety of property.

    (iii) Relevant manufacturing processes.

    (iv) Test and evaluation procedures.

    (v) Test results.

    (vi) Maintenance procedures.

    (vii) Personnel qualifications and training procedures.

Statement of Conformance letter is only required under § 414.13(c)(1) when applying for a safety element approval separate from a vehicle operator license.

Policy Review and Approval

§ 450.41 consolidates policy requirements contained in §§ 415.25, 431.25, and 435.23.

The FAA notes, consistent with current practice, that if a launch or reentry proposal would potentially jeopardize U.S. national security or foreign policy interests, or international obligations of the United States, the FAA may seek additional information from an applicant in support of interagency consultation to protect U.S. Government interests.

§ 450.41 Policy Review and Approval

(a) *General.* The FAA issues a policy approval to an applicant unless the FAA determines that a proposed launch or reentry would jeopardize U.S. national security or foreign policy interests, or international obligations of the United States.

(b) *Interagency consultation*.

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

(2) The FAA consults with the Department of State to determine whether a license application presents any issues 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 proposal.

Policy Review and Approval

§ 450.41 Policy Review and Approval

(c) *Issues during policy review.* The FAA will advise 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 amend its license application as required by § 413.17 of this chapter.

(d) *Denial of policy approval.* The FAA notifies an applicant, in writing, if it has denied policy approval for a license application. The notice states the reasons for the FAA's determination. The applicant may seek further review of the determination in accordance with § 413.21 of this chapter.

Policy Review and Approval

§ 450.41 removes the current requirements (§§ 415.25(b) and 431.25) that applications information related to the structural, pneumatic, propulsion, electrical, thermal, guidance, and avionics systems used in the launch vehicle and all propellants. This information is not critical for a policy review that does not require the same level of technical detail as a safety review under the § 450.45(e)(3) vehicle description.

§ 450.41 Policy Review and Approval

(e) Application requirements for policy review. In its license application, an applicant must—

(1) Identify the model, type, and configuration of any vehicle proposed for launch or reentry by the applicant;

(2) Describe the vehicle by characteristics that include individual stages, their dimensions, type and amounts of all propellants, and maximum thrust;

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

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

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

(iii) For a joint venture, association, or other entity, identify any participating foreign entities; and

(4) Identify the proposed vehicle flight profile, including:

(i) Launch or reentry site, including any contingency abort locations;

(ii) Flight azimuths, trajectories, and associated ground tracks and instantaneous impact points for the duration of the licensed activity, including any contingency abort profiles;

(iii) Sequence of planned events or maneuvers during flight;

(iv) Normal impact or landing areas for all mission hardware; and

(v) For each orbital mission, the range of intermediate and final orbits of each vehicle upper stage and their estimated orbital lifetimes.

Policy Review and Approval

In developing part 450, the FAA decided not to attempt to develop specific criteria for making a policy determination because it did not believe it could anticipate the full ranges of issues that might arise. Furthermore, policy reviews have not typically raised significant issues.

Important points concerning policy reviews:

- An operator may apply for a policy review independently from a license application.
- There are no published criteria or standards against which an application is evaluated.

Payload Review and Determination

§§ 450.31(a)(3) and 450.43(a) clarify that a payload review is not always required to accommodate the situation where there is no payload.

While the FAA will review all payloads to determine their effect on the safety of launch, the FAA will not make a determination on those aspects of payloads that are subject to regulation by the Federal Communications Commission (FCC) or the Department of Commerce or on payloads owned or operated by the U.S. Government. This is a change from the current regulations that state the FAA does not conduct a payload review in these cases.

§ 450.43 Payload Review and Determination.

(a) General. If applicable, the FAA issues a favorable payload determination for a launch or reentry to a license applicant or payload owner or operator if—

(1) The applicant, payload owner, or payload operator has obtained all required licenses, authorizations, and permits; and

(2) Its launch or reentry would 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) *Relationship to other executive agencies.* The FAA does not make a determination under paragraph (a)(2) of this section for—

(1) Those aspects of payloads that are subject to regulation by the Federal Communications Commission or the Department of Commerce; or

(2) Payloads owned or operated by the U.S. Government.

Payload Review and Determination

The list of agencies that the FAA consults with under § 450.43(e) is not exhaustive and does not preclude consultation with any other Federal entity in order to ensure that a payload meets the criteria set forth in § 450.43. The FAA currently also consults with the DoC, FCC, ODNI, and the US Coast Guard.

§ 450.43 Payload review and determination.

(c) *Classes of payloads.* The FAA may review and issue findings regarding a proposed class of payload, including communications, remote sensing, or navigation. However, prior to a launch or reentry, each payload is subject to verification by the FAA that its launch or reentry would not jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States.

(d) *Payload owner or payload operator may apply.* In addition to a launch or reentry operator, a payload owner or payload operator may request a payload review and determination.

(e) *Interagency consultation.* The FAA consults with other agencies as follows:

(1) The Department of Defense to determine whether launch or reentry of a proposed payload or payload class would present any issues affecting U.S. national security;

(2) The Department of State to determine whether launch or reentry of a proposed payload or payload class would present any issues affecting U.S. foreign policy interests or international obligations; or

(3) Other Federal agencies, including the National Aeronautics and Space Administration, authorized to address issues of public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States, associated with the launch or reentry of a proposed payload or payload class.

Payload Review and Determination

Part 450 preserves the ability of payload, as well as launch or reentry operators, to request a payload review independent of a launch license application that exists in the current regulations.

§ 450.43 Payload review and determination.

(f) *Issues during payload review.* The FAA will advise a person requesting a payload determination, in writing, of any issue raised during a payload review that would impede issuance of a license to launch or reenter that payload or payload class. The person requesting payload review may respond, in writing, or amend its application as required by § 413.17 of this chapter.

(g) *Denial of a payload determination.* The FAA notifies an applicant, in writing, if it has denied a favorable payload determination. The notice states the reasons for the FAA's determination. The applicant may seek further review of the determination in accordance with § 413.21 of this chapter.

(h) *Incorporation of payload determination in license application.* A favorable payload determination issued for a payload or class of payload may be included by a license applicant as part of its application. However, any change in information provided under paragraph (i) of this section must be reported in accordance with § 413.17 of this chapter. The FAA determines whether a favorable payload determination remains valid in light of reported changes and may conduct an additional payload review.

Payload Review and Determination

§ 450.43 Payload review and determination.

(i) Application requirements. A person requesting review of a particular payload or payload class must identify the following:

(1) For launch of a payload:

(i) Payload name or class of payload, and function;

(ii) Description, including physical dimensions, weight, composition, and any hosted payloads;

(iii) Payload owner and payload operator, if different from the person requesting payload review and determination,

(iv) Any foreign ownership of the payload or payload operator, as specified in § 450.41(e)(3);

(v) Hazardous materials as defined in § 401.7 of this chapter, radioactive materials, and the amounts of each;

(vi) Explosive potential of payload materials, alone and in combination with other materials found on the payload;

(vii) For orbital launches, parameters for parking, transfer and final orbits, and approximate transit times to final orbit;

(viii) Delivery point in flight at which the payload will no longer be under the licensee's control;

(ix) Intended operations during the lifetime of the payload, including anticipated life span and any planned disposal;

(x) Any encryption associated with data storage on the payload and transmissions to or from the payload; and

(xi) (Any other information necessary to make a determination based on public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States.

Added informational requirements not in current FAA regulations (§§ 415.59, 431.57, 435.43) to include the composition of the payload and any hosted payloads, anticipated life span of the payload in space, any planned disposal, and any encryption associated with data storage on the payload and transmissions to or from the payload.

Payload Review and Determination

This is intended to capture basic information for a payload that is being returned as cargo on a reentry vehicle.

(2) For reentry of a payload:

(i) Payload name or class of payload, and function;

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

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

(iv) Type, amount, and container of hazardous materials and radioactive materials in the payload;

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

(vi) Designated reentry site.

Payload Review and Determination

The FAA decided not to propose criteria because of the difficulty of anticipating what might be needed for future unique payloads and its limited authority concerning on-orbit activities.

Important points concerning a payload review:

- Just as is the case with a policy review, a payload review may be requested independently of a license application.
- In addition to the launch or reentry operator, a payload owner or operator may request a payload review.
- There are no published criteria or standards against which an application is evaluated.

Safety Review and Approval

These performance-based regulations allow an operator to use DOD and NASA practices as a means of compliance. In addition, this rule introduces a provision that allows operators operating from certain Federal sites to opt out of demonstrating compliance with the FAA's ground safety requirements.

Part 450 does not refer to the launch site safety assessment (LSSA) process.

§ 450.45 Safety Review and Approval.

(a) *General*. The FAA issues a safety approval to an applicant if it determines that an applicant can conduct launch or reentry without jeopardizing public health and safety and safety of property. A license applicant must satisfy the application requirements in this section and subpart C of this part.

(b) *Services or property provided by a Federal launch or reentry site*. The FAA will accept any safety-related launch or reentry service or property provided by a Federal launch or reentry site or other Federal entity by contract, as long as the FAA determines that the launch or reentry services or property provided satisfy this part.

Safety Review and Approval

The FAA assesses each Federal launch or reentry site and determines if the Federal site meets FAA safety requirements. If the FAA assessed a Federal launch or reentry site and found that an applicable safety-related launch service or property satisfies FAA requirements, then the FAA treats the Federal site's launch service or property as that of a launch operator's, and there is no need for further demonstration of compliance to the FAA. The FAA reassesses a site's practices only when the site changes its practice.

§ 450.45 Safety Review and Approval.

(c) *Issues during safety review.* The FAA will advise an applicant, in writing, of any issues raised during a safety review that would impede issuance of a safety approval. The applicant may respond, in writing, or amend its license application as required by § 413.17 of this chapter.

(d) *Denial of a safety approval.* The FAA notifies an applicant, in writing, if it has denied a safety approval for a license application. The notice states the reasons for the FAA's determination. The applicant may seek further review of the determination in accordance with § 413.21 of this chapter.

Safety Review and Approval

§ 450.45 Safety Review and Approval.

(e) *Application requirements*. An applicant must submit the information required in the "Application requirements" paragraphs in individual sections in subpart C of this part, as well as the following:

(1) *General*. An application must—

(i) Contain a glossary of unique terms and acronyms used in alphabetical order; (ii) Contain a listing of all referenced material; (iii) Use equations and mathematical relationships derived from or referenced to a recognized standard or text, and define all algebraic parameters; (iv) Include the units of all numerical values provided; and (v) Include a legend or key that identifies all symbols used for any schematic diagrams.

(2) *Site description*. An applicant must identify the proposed launch or reentry site, including contingency abort locations, and submit the following:

(i) Boundaries of the site; (ii) Launch or landing point locations, including latitude and longitude; (iii) Identity of any site operator; and (iv) Identity of any facilities at the site that will be used for pre- or post-flight ground operations.

(3) *Vehicle description*. An applicant must submit the following:

(i) A written description of the vehicle or family of vehicles, including structural, thermal, pneumatic, propulsion, electrical, and avionics and guidance systems used in each vehicle, and all propellants. The description must include a table specifying the type and quantities of all hazardous materials on each vehicle and must include propellants, explosives, and toxic materials; and

(ii) A drawing of each vehicle that identifies:

(A) Each stage, including strap-on motors; (B) Physical dimensions and weight; (C) Location of all safety-critical systems; (D) Location of all major vehicle control systems, propulsion systems, pressure vessels, and any other hardware that contains potential hazardous energy or hazardous material; and (E) For an unguided suborbital launch vehicle, the location of the rocket's center of pressure in relation to its center of gravity for the entire flight profile.

Safety Review and Approval

§ 450.45 Safety Review and Approval.

(e) *Application requirements*. An applicant must submit the information required in the "Application requirements" paragraphs in individual sections in subpart C of this part, as well as the following:

(4) *Mission schedule*. An applicant must submit a generic launch or reentry processing schedule that identifies any readiness activities, such as reviews and rehearsals, and each safety-critical pre-flight operation to be conducted. The mission schedule must also identify day of flight activities.

(5) *Human space flight.* For a proposed launch or reentry with a human being on board a vehicle, an applicant must demonstrate compliance with §§ 460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, and 460.53 of this chapter.

(6) *Radionuclides*. The FAA will evaluate the launch or reentry of any radionuclide on a case-by-case basis, and issue an approval if the FAA finds that the launch or reentry is consistent with public health and safety, safety of property, and national security and foreign policy interests of the United States. For any radionuclide on a launch or reentry vehicle, an applicant must—

(i) Identify the type and quantity; (ii) Include a reference list of all documentation addressing the safety of its intended use; and (iii) Describe all approvals by the Nuclear Regulatory Commission for pre-flight ground operations.

(7) *Additional material.* The FAA may also request—

(i) Any information incorporated by reference in the license application; and (ii) Additional products that allow the FAA to conduct an independent safety analysis.

§ 450.45(e)(6) addresses potential launch or reentry of radionuclides, similar to current § 415.115(b), but with the addition of reentries. Per Presidential Memorandum on Launch of Spacecraft Containing Space Nuclear Systems, FAA is developing public guidance for applicants seeking a license for launch or reentry of a space nuclear system.

Environmental Review

This rule will not alter the current environmental review requirements. However, the consolidation of the launch and reentry regulations will require a consolidation of the environmental review requirements.

§ 450.47(b) clarifies that the FAA, not the applicant, determines which environmental documentation is required by NEPA. If the FAA determines that under NEPA an EIS is required, the FAA will select a contractor to prepare the EIS for the license applicant who will pay the contractor.

§ 450.47 Environmental Review

(a) *General.* The FAA is responsible for complying with the procedures and policies of the National Environmental Policy Act (NEPA) and other applicable environmental laws, regulations, and Executive Orders prior to issuing a launch or reentry license. An applicant must provide the FAA with information needed to comply with such requirements. The FAA will consider and document the potential environmental effects associated with issuing a launch or reentry license consistent with paragraph (b) of this section.

(b) *Environmental Impact Statement or Environmental Assessment.* When directed by the FAA, an applicant must—

(1) Prepare an Environmental Assessment with FAA oversight;

(2) Assume financial responsibility for preparation of an Environmental Impact Statement by an FAA-selected and -managed consultant contractor; or

(3) Submit information to support a written re-evaluation of a previously submitted Environmental Assessment or Environmental Impact Statement.

Environmental Review

Changes to regulatory text on environmental review do not represent a substantive change to past regulations or to current practice. § 450.47 reflects existing environmental review process that §§ 415.201 and 415.203 broadly described, in which applicants must provide sufficient information to enable FAA to comply with NEPA. § 450.47 replaces this general requirement by identifying specific documents that FAA may require applicants to provide and the process to prepare those documents. Language added to § 450.47 reflects current practice and is consistent with NEPA and FAA policy. According to FAA Order 1050.1, unless FAA determines that a categorical exclusion applies, FAA may prepare an EA, EIS, or written re-evaluation, or direct an applicant to provide information as described in §§ 450.47(b)(1), (2), and (3).

§ 450.47 Environmental Review

(c) *Categorical exclusion.* The FAA may determine that a categorical exclusion is appropriate upon receipt of supporting information from an applicant.

(d) *Application requirements.* An application must include an approved FAA Environmental Assessment, Environmental Impact Statement, categorical exclusion determination, or written re-evaluation, which should address compliance with any other applicable environmental laws, regulations, and Executive Orders covering all planned licensed activities in compliance with NEPA and the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA.

Q&A

AST Commercial Space Transportation

Go for launch

On Break

Next Session Starts at 1:51 PM EST

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Federal Aviation Administration

Part 450 Subpart C

Agenda

Purposes of the Safety Criteria in 450.101

Types of risks governed by § 450.101 Safety Criteria

- Relationships between the types of risks
- *Introduction to the **rationale** for the criteria in § 450.101*

Key features of § 450.101

- New – separate criteria for Neighboring Operations Personnel (NOP)
- New – critical asset criteria
- New – inclusion of ships in collective risk limits
- New – high consequence event protection
- New – disposal criteria
- New – threshold for notification of planned impacts
- New – standard for validity of analyses

Purposes of § 450.101 and FSA

The safety criteria in § 450.101 defines how safe is safe enough

Criteria include individual and collective public risks limits *separately applied* from lift-off through orbital insertion AND for reentry :

Expected Casualty (EC) no more than 1 x 10^{-4} (1E-4 or 0.0001) and

No individual risk greater than 1 x 10^{-6} Probability of Casualty (PC)

A Flight Safety Analysis (FSA) must demonstrate compliance with the safety criteria. A valid FSA is part of a risk management process also:

(1) Provides a basis for well informed safety decisions by identifying the dominant sources of public risks and uncertainties, as well as potential mitigations.

(2) Helps inform the FAA's Maximum Probable Loss (MPL) determination and the USG critical asset risk assessment.

Past AST waivers have been consistent with the individual and collective risk criteria in § 450.101

Risk Concept – Key Elements

Risk is a concept that accounts for three key elements:

1. **Probability** of a dangerous event (e.g. a rocket crash)
2. Size of the "**danger area**" aka casualty area (e.g. the area destroyed by a rocket crash)
3. Nature of the **public exposure** (e.g. the population density and sheltering where a rocket could crash).

- **Risk is** computed as **the product** of **probability and consequence.**
- **Risk controls** (or mitigations) must **address at least one of three key elements** of risk.

Probability is a number from 0 to 1 that expresses the chance of an event outcome.

- **E.g. the probability of a 6 resulting from a single roll of an evenly weighted die is 1/6**

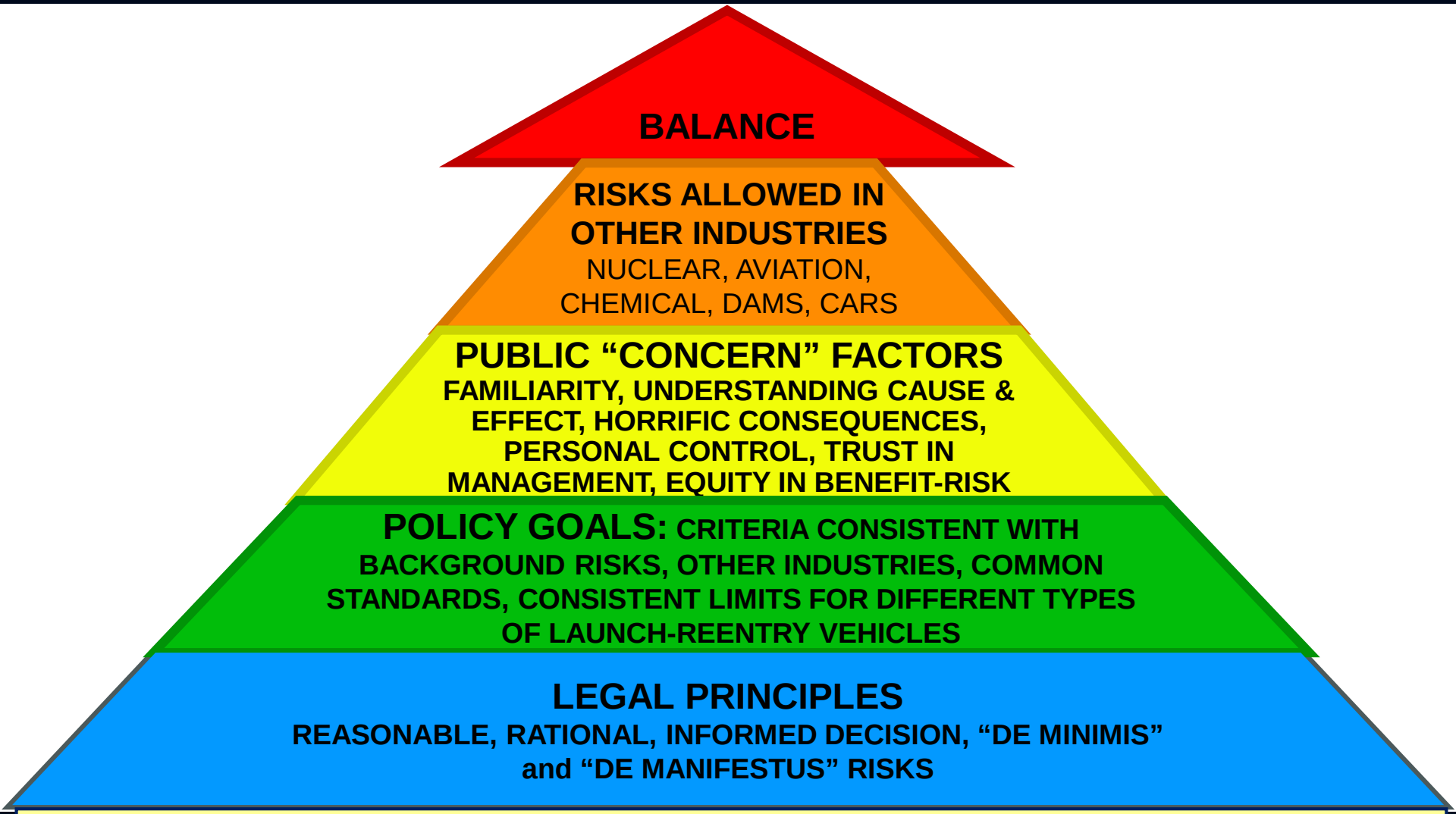
Two Fundamental Types of Risks

AST regulates the risk of casualties, on individual and collective basis

- A **casualty is** defined as a **serious injury or death**. For the purposes of a FSA, serious injury is defined as Abbreviated Injury Scale (AIS) Level 3 or more.
- Individual risk is the chance of a specified individual getting hurt or killed
- **Collective risk is not a probability**, but accounts for the chance that some member of a group of people becomes a casualty.

- A launch or re-entry must separately meet the risk criteria:
  - **Maximum individual risk of 1E-6 Probability of Casualty (PC)** – Individuals must be clear of areas where PC > 1 in a million
  - **Maximum collective risk of 1E-4 Expected Casualties (EC)** – FSA risks managed so 10,000 missions (launch or re-entry) would produce no more than one casualty on average; expect no more than **one casualty on average after 100 missions/yr. for 100 yrs.**

Overview of (Underlying) Rationale for PC and EC Risk Criteria



Wilde, P. Public Risk Tolerability Criteria for Space Launch and Reentry, Presented at the 51st Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, Vienna Austria, 8 Feb. 2014

§ 450.101 Safety Criteria - Overview

§ 450.101 sets the **public and property safety criteria that are fundamental** flight safety requirements for all operators.

§ 450.101 adopts separate individual and collective risk criteria for people that meet the definition of **neighboring operations personnel** in § 401.7

§ 450.101 adds risk criteria for the protection of **critical assets** essential to the national interests of the United States, including a more stringent requirement for the protection of critical payloads.

The FAA received extensive comments and made significant changes to allow for additional flexibility in measuring and mitigating **high consequence events**

§ 450.101(f) requires **public notification** of any planned impact capable of causing a casualty

§ 450.101(g) includes qualitative performance level requirements for the **validity of analysis** methods

§ 450.101 Safety Criteria

- *(a) Launch risk criteria*
  - (1) *Collective risk*
  - (2) *Individual risk*
  - (3) *Aircraft risk*
  - (4) *Risk to critical assets*
- *(b) Reentry risk criteria*
  - (1) *Collective risk*
  - (2) *Individual risk*
  - (3) *Aircraft risk*
  - (4) *Risk to critical assets*
- *(c) High consequence event protection*
- *(d) Disposal safety criteria*
- (e) *Protection of people and property on-orbit*
- (f) *Notification of planned impacts*
- (g) *Validity of the analysis*

Public Safety Criteria – Launch EC

These criteria must be met before an operator may initiate the flight of a launch or reentry vehicle. Therefore, the risk analyses must demonstrate compliance **given the conditions at the time the operation is initiated**.

For launch, flight risk criteria applies **from liftoff through orbital insertion**. Per § 401.7, orbital insertion means the point at which a vehicle achieves a minimum 70-nautical mile perigee based on a computation that accounts for drag

§ 450.101 applies **collective and individual risk criteria to people on waterborne vessels**, enabling risk management techniques that previously required a waiver to 417.

§ 450.101 Safety Criteria

(a) *Launch risk criteria.* For any launch, **an operator may initiate the flight of a launch vehicle only if all risks** to the public satisfy the criteria in this section. For an orbital launch, the criteria in this paragraph apply **from liftoff through orbital insertion**. For a suborbital launch, or a suborbital launch and reentry, the criteria in this paragraph apply from liftoff through final impact or landing.

(1) *Collective risk.* The collective risk, measured as expected number of casualties (E_C), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. Public risk due to any other hazard associated with the proposed flight of a launch vehicle will be determined by the Administrator on a case-by-case basis.

(i) **The risk to all members of the public, excluding persons in aircraft and neighboring operations personnel, must not exceed an expected number of 1×10^{-4} casualties**.

(ii) The risk to all **neighboring operations personnel must not exceed an expected number of 2×10^{-4} casualties**.

Public Safety Criteria – Launch PC

The individual risk **accounts for the aggregated risk posed** by impacting inert and explosive debris, toxic release, and far field blast overpressure

Individual risk cannot exceed 1E-6 PC unless the individual qualifies as NOPs. NOPs are allowed 10 times higher risk: 1E-5 PC

An operator must ensure (e.g. via surveillance) that no member of the public (on land, sea of air) exceeds these PC limits at the time the operation is initiated.

1E-6 PC embraced internationally as broadly acceptable on an annual basis for involuntarily imposed public risks.

If you were at 1E-6 PC during a **daily launch since 720 BC**, then you'd be statistically expected to be a casualty.

§ 450.101 Safety Criteria

(a) *Launch risk criteria.* For any launch, an operator may initiate the flight of a launch vehicle only if all risks to the public satisfy the criteria in this section. For an orbital launch, the criteria in this paragraph apply from liftoff through orbital insertion. For a suborbital launch, or a suborbital launch and reentry, the criteria in this paragraph apply from liftoff through final impact or landing.

(2) *Individual risk.* The individual risk, measured as probability of casualty (P_C), consists of **risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure**. The FAA will determine whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis.

(i) **The risk to any individual member of the public, excluding neighboring operations personnel, must not exceed a probability of casualty of 1×10^{-6} per launch**.

(ii) The risk to any individual neighboring operations personnel must not exceed a probability of casualty of 1×10^{-5} per launch.

Public Safety Criteria – NOP and Aircraft

450 adopts separate individual and collective risk criteria for a subset of the public that meet the definition of neighboring operations personnel

Per § 401.7, **neighboring operations personnel means** those members of the public located **within a launch or reentry site, or an adjacent launch or reentry site, who are not associated with a specific hazardous licensed** or permitted operation currently being conducted, but are **required to perform safety, security, or critical tasks at the site and are notified of the operation**.

NOPs are allowed 10 times higher individual risk (1E-5 PC) and
2 times higher collective risk (2E-4 EC)

450 keeps current aircraft protection criteria: hazard areas with no more than 1E-6 PI capable of causing a casualty.

§ 450.101 Safety Criteria

(a) *Launch risk criteria.* For any launch, an operator may initiate the flight of a launch vehicle only if all risks to the public satisfy the criteria in this section. For an orbital launch, the criteria in this paragraph apply from liftoff through orbital insertion. For a suborbital launch, or a suborbital launch and reentry, the criteria in this paragraph apply from liftoff through final impact or landing.

(1) *Collective Risk…*

(ii) The risk to all neighboring operations personnel must not exceed an expected number of 2×10^{-4} casualties.

(2) *Individual risk...*

(ii) The risk to any individual neighboring operations personnel must not exceed a probability of casualty of 1×10^{-5} per launch.

(3) Aircraft risk. A launch operator must **establish any aircraft hazard areas necessary to ensure** the probability of impact with debris capable of causing a casualty for aircraft does not exceed 1×10^{-6}.

Property Safety Criteria – Critical Assets

450 is the first AST regulation to apply quantitative risk limits to protect property explicitly. Past assumed safety for people provided adequate protection for property.

Per § 401.7, "Critical asset means an asset that is **essential to the national interests of the United States**. Critical assets **include property, facilities, or infrastructure necessary to maintain national defense, or assured access to space for national priority missions**."

450 critical asset criteria are consistent with current NASA and USSF requirements.

USG will determine whether the launch would meet § 450.101(a)(4) and convey any necessary constraints to the operator.

The operator must receive confirmation of compliance prior to launch (or reentry).

§ 450.101 Safety Criteria

(4) Risk to critical assets.

(i) The risk to critical assets, measured as the probability of loss of functionality, must not exceed the following probabilities:

(A) For each critical asset, except for a critical payload, 1×10^{-3}; and

(B) For each critical payload, 1×10^{-4}.

(ii) The Administrator will consult with relevant Federal agencies, and each agency will identify, for purposes of this part, any critical assets that the agency owns or otherwise depends on. For purposes of this part, the Administrator will accept any identification by the Secretary of Defense that an asset is critical to national security.

(iii) The Administrator or Federal site operator will notify the licensee of any risk to critical assets above the risk criteria in paragraph (4)(i) of this section.

Property Safety Criteria – Critical Assets

USG will determine what constitutes a critical asset. FAA reserves the right to apply more stringent criteria if necessary to protect the national interests of the U.S.

Critical asset evaluation can often be completed using preliminary data (during pre-application or the license evaluation).

Where the prevailing weather conditions are important to the critical asset risks, an assessment is performed either close to or on the day-of-launch

§ 450.101(b)(4) does not apply the critical asset risk criteria to property, facilities, or infrastructure supporting the launch that are within the public area distance; e.g. assets that are part of the immediate launch complex used by an operator for a given licensed operation are exempt from the critical asset protection requirements.

§ 450.101 Safety Criteria

(4) Risk to critical assets.

(iv) The Administrator may determine, in consultation with relevant Federal agencies, that a more stringent probability is necessary to protect the national interests of the United States.

(v) The risk criteria in paragraph (4)(i) of this section do not apply to property, facilities, or infrastructure supporting the launch that are within the public area distance, as defined in part 420 Appendix E, Tables E1 and E2 or associated formulae, of the vehicle's launch point.

Public Safety Criteria - Reentry

Re-entry risk criteria applies from final health check prior to initiating deorbit through final impact or landing.

The risk thresholds for the reentry are identical to those for flight of a launch vehicle:

1E-6 PC and 1E-4 EC for public, except

1E-5 PC and 2E-4 EC for NOP

1E-6 PI on aircraft

1E-3 probability of loss of functionality for critical assets

1E-4 for critical payloads

§ 450.101 Safety Criteria

(b) *Reentry risk criteria.* For any reentry, **an operator may initiate the deorbit of a vehicle only if all risks** to the public satisfy the criteria below. The following criteria apply to each reentry, other than a suborbital reentry, **from the final health check prior to initiating deorbit through final impact or landing**:

(1) *Collective risk.* The collective risk, measured as expected number of casualties (E_C), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. Public risk due to any other hazard associated with the proposed deorbit of a reentry vehicle will be determined by the Administrator on a case-by-case basis.

(i) The risk to all members of the public, excluding persons in aircraft and neighboring operations personnel, must not exceed an expected number of 1×10^{-4} casualties.

(ii) The risk to all neighboring operations personnel must not exceed an expected number of 2×10^{-4} casualties.

Safety Criteria – High Consequence Events

450 did not formally define "high consequence event," but the preamble states that "**high consequence events include incidents that could involve multiple casualties, massive toxic exposures, extensive property or environmental damage, or events that jeopardize the national security or foreign policy interests of the United States**."

Uncontrolled area is an area of land not controlled by a launch or reentry operator, a launch or reentry site operator, an adjacent site operator, or other entity by agreement.

This provision is consistent with current practice (e.g. at the ER and WR), and enables the launch site authority to decide the optimal balance between the chance of a casualty and the chance of multiple casualties.

AC 450.101-1: "A period of flight between two milestones in the vehicle flight sequence, which is not necessarily a set period of time."

§ 450.101 Safety Criteria

(c) *High consequence event protection.* An operator **must protect against a high consequence event in uncontrolled areas for each phase of flight by**:

(1) Using flight abort as a hazard control strategy in accordance with the requirements of § 450.108;

(2) Ensuring the consequence of any reasonably foreseeable failure mode, in any significant period of flight, is no greater than 1×10^{-3} conditional expected casualties; or

(3) Establishing the launch or reentry vehicle has sufficient demonstrated reliability as agreed to by the Administrator based on conditional expected casualties criteria during that phase of flight.

High Consequence Protection Options

§ 450.101 allows 3 options to demonstrate adequate high consequence event protection

§ 450.101(c)(1) – choose to use flight abort and meet § 450.108

§ 450.101(c)(2) – compute maximum CEC for each phase of flight (assuming no FSS). If no CEC is greater the 1E-3, then no FSS is required and compliance with § 450.101(c) is demonstrated

§ 450.101(c)(3) – show that your vehicle has a demonstrated reliability equivalent to a specific aircraft type with a standard airworthiness certificate.

§ 450.101 Safety Criteria

(c) *High consequence event protection.* An operator **must protect against a high consequence event in uncontrolled areas for each phase of flight by**:

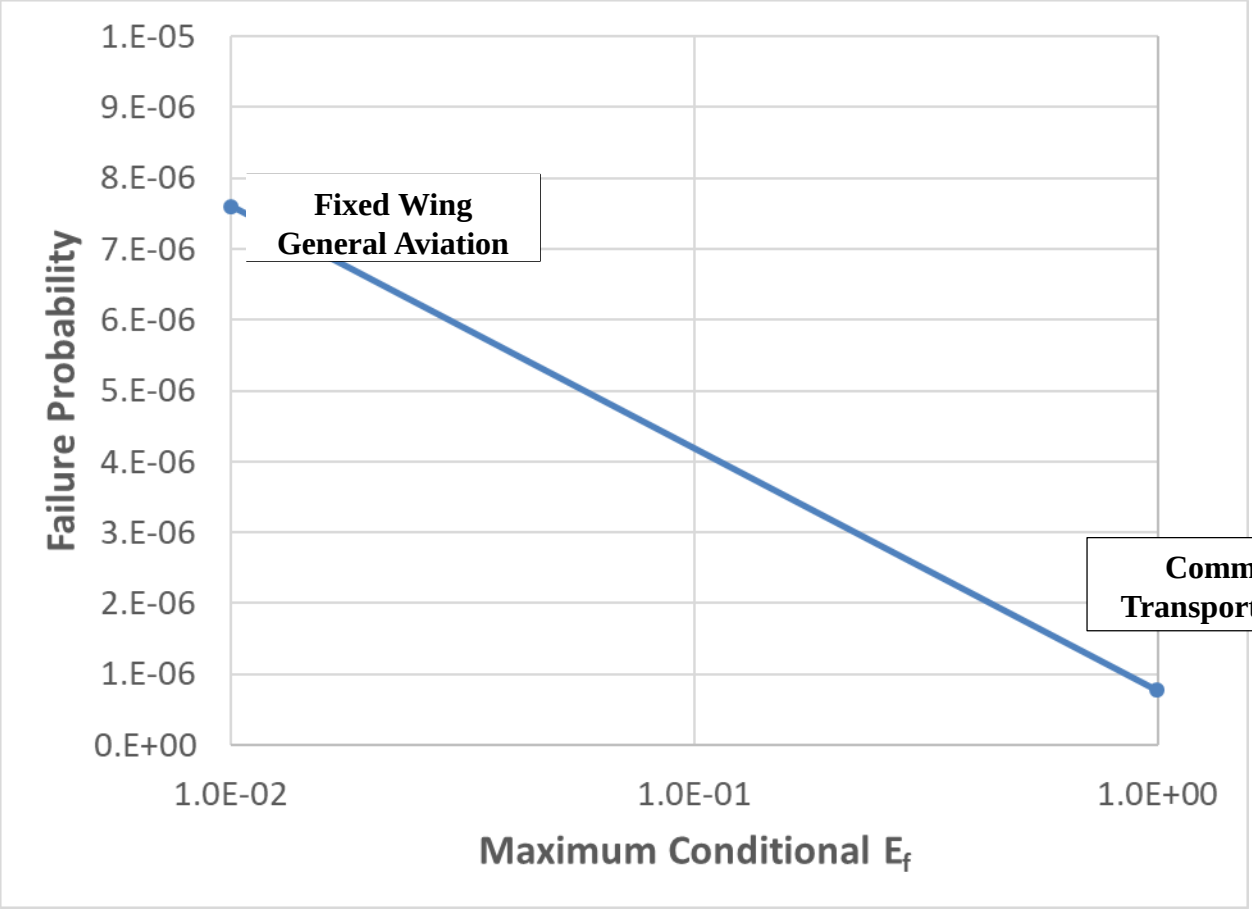
(1) Using flight abort as a hazard control strategy in accordance with the requirements of § 450.108;

(2) Ensuring the consequence of any reasonably foreseeable failure mode, in any significant period of flight, is no greater than 1×10^{-3} conditional expected casualties; or

(3) Establishing the launch or reentry vehicle has sufficient demonstrated reliability as agreed to by the Administrator based on conditional expected casualties criteria during that phase of flight.

Acceptable Reliability Per Flight vs. CEF

Figure 3 from AC 450.101-1



Hazard Control Strategy
Flight Abort Requirements Overview

	No	Yes	Yes
Is an FSS Required?	§ 450.101 (c)(2)* CEC < 10^{-3} or § 450.101 (c)(3) Demonstrated Reliability	§ 450.108(b)(2)	§ 450.108(b)(1)
What FSS Reliability is Required?	Not Applicable	§450.143 Compliant FSS Safety-Critical System Requirements	§450.145 Compliant FSS 0.999 with 95% Confidence
When is FSS Activation Required?	Not Applicable	Flight Safety Limits and Flight Abort Rules: § 450.108	Flight Safety Limits and Flight Abort Rules: § 450.108

* In accordance with § 450.37, an applicant may demonstrate an equivalent level of safety to § 450.101(c)(2)

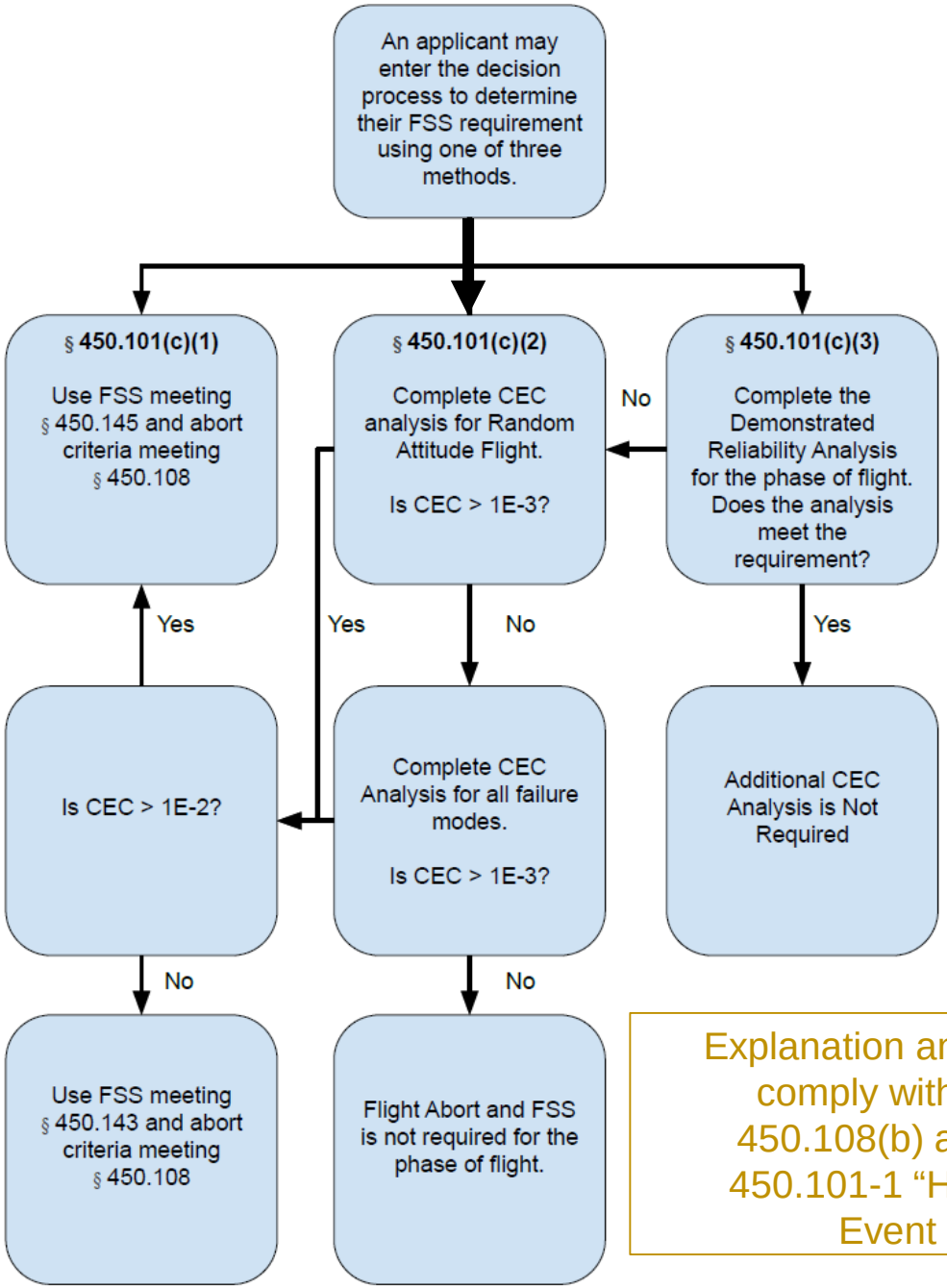
Sample* Flowchart on High consequence Event Protection

An operator can demonstrate compliance with 450.101(c) without any computation of CEC.

However, calculating CEC ensures an operator correctly recognizes certain system failures that may have catastrophic consequences and builds mitigations into the system to account for those failures.

§ 450.37(b) allows an applicant to propose an alternative way to measure high consequence events other than by CEC.

*This flowchart is illustrative, but may not apply to all analyses (e.g. FMs other than RA might be the driver)



An FSS is generally activated in the following context:

(1) the vehicle is no longer performing nominally;

(2) the vehicle is outside the limits of a useful mission; and

(3) continued flight would increase public risks in uncontrolled areas.

STS-51L was an example; the SRBs continued to fly intact until the FSS was activated.

Explanation and details on how to comply with 450.101(c) and 450.108(b) are included in AC 450.101-1 “High Consequence Event Protection”.

Safety Criteria – Disposal and On-orbit Safety

450 sets safety criteria for a "disposal."

§ 401.7 states that disposal means the return or attempt to return, purposefully, a launch vehicle stage or component, not including a reentry vehicle, from Earth orbit to Earth, in a controlled manner.

§ 450.101(d) allows two options to demonstrate that a disposal operation is safe:

1. Demonstrate compliance with the individual and collective risk criteria, or
2. Target a "broad ocean area."

FAA considers "broad ocean" as an area 200 nautical miles (nm) from land.

A disposal that "targets a broad ocean area" would wholly contain the disposal hazard area within a broad ocean area

Protection of people and property on-orbit is the subject of a separate session.

§ 450.101 Safety Criteria

(d) *Disposal safety criteria*. A launch operator must ensure that **any disposal meets the criteria of § 450.101(b)(1), (2), and (3), or targets a broad ocean area**.

(e) *Protection of people and property on-orbit*.

(1) A launch or reentry operator must prevent the collision between a launch or reentry vehicle stage or component and people or property on-orbit, in accordance with the requirements in § 450.169(a).

(2) For any launch vehicle stage or component that reaches Earth orbit, a launch operator must prevent the creation of debris through the conversion of energy sources into energy that fragments the stage or component, in accordance with the requirements in § 450.171.

Safety Criteria – Planned Impacts and Analysis Validity

Some planned impacts (e.g. sounding rocket stages) could be so dispersed that there is no area that exceeds the 1E-6 PC.

§ 450.101(f) requires notification of any planned impacts (i.e. jettisoned items).

"Accurate data" refers to completeness, exactness, and fidelity to the maximum extent practicable.

"Scientific principles" refers to knowledge based on the scientific method, such as that established in the fields of physics, chemistry, and engineering.

A "statistically valid" analysis is the result of a sound application of mathematics and accounts for the uncertainty in any statistical inference due to sample size limits, the degree of applicability of data to a particular system, and the degree of homogeneity of the data

§ 450.101 Safety Criteria

(f) *Notification of planned impacts*. For any launch, reentry, or disposal, **an operator must notify the public of any region of land, sea, or air that contain, with 97 percent probability of containment**, all debris resulting from normal flight events capable of causing a casualty.

(g) *Validity of the analysis.* For any analysis used to demonstrate compliance with this section, **an operator must use accurate data and scientific principles and the analysis must be statistically valid**. The method must **produce results consistent with or more conservative than the results available from previous mishaps, tests, or other valid benchmarks**, such as higher-fidelity methods.

Q&A

AST Commercial Space Transportation

Go for launch

On Break

Next Session Starts at 3:21 PM EST

faa.gov/space

Federal Aviation Administration

System Safety Program

Due to the complexity and variety of vehicle concepts and operations, a system safety program is necessary to ensure that an operator considers and addresses all risks to public safety, which include both design and operational changes to a system.

Explanation and details on how to comply with § 450.103 will be included in AC 450.103-1 “System Safety Program” Planned issuance is Q1 2021.

§ 450.103 System Safety Program.

An operator must implement and document a system safety program throughout the lifecycle of a launch or reentry system that includes the following:

(a) *Safety organization.*

(b) *Hazard management.*

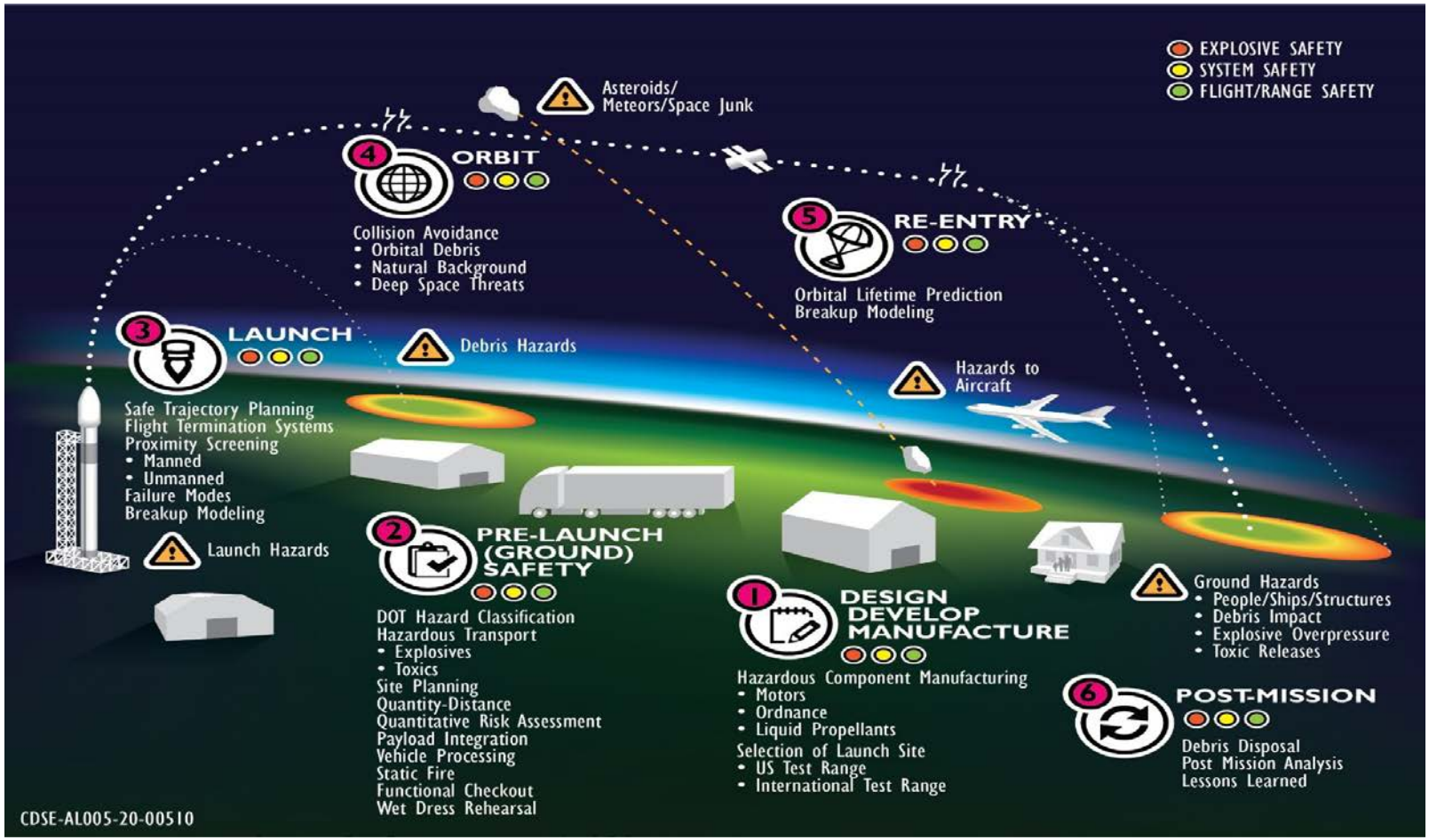
(c) *Configuration management and control.*

(d) *Post-flight data review.*

(e) *Application requirements*

System Safety Program

Generic Lifecycle for Launch and Reentry Systems.



System Safety Program

The FAA notes that a safety official must be named and in place prior to the initiation of any licensed activity, and an operator may use the same safety official for multiple launch or reentry sites. It may be difficult for a single individual to serve as a safety official for multiple sites if launch or reentry activities were to occur close in time to each other. In those instances, an operator may choose to have multiple safety officials.

§ 450.103 System Safety Program.

(a) *Safety organization.* An operator must maintain a safety organization that has clearly defined lines of communication and approval authority for all public safety decisions. At a minimum, the safety organization must have the following positions:

(1) *Mission director*. For each launch or reentry, an operator must designate a position responsible for the safe conduct of all licensed activities and authorized to provide final approval to proceed with licensed activities. This position is referred to as the mission director in this part.

(2) *Safety official.* For each launch or reentry, an operator must designate a position with direct access to the mission director who is—

(i) Responsible for communicating potential safety and noncompliance issues to the mission director; and

(ii) Authorized to examine all aspects of the operator's ground and flight safety operations, and to independently monitor compliance with the operator's safety policies, safety procedures, and licensing requirements.

(3) *Addressing safety official concerns.* The mission director must ensure that all of the safety official's concerns are addressed.

System Safety Program

The FAA added FSA to § 450.103(b)(1) because any analysis used to demonstrate compliance with § 450.101 must use accurate data.

Assessment Methods:

- Document the system safety approach
- Analyze systems/operations to identify/document hazards
- Assess/document risk
- Identify/document risk mitigation measures
- Assess/document residual risk
- Document verification and validation of risk reduction
- Accept risk and document
- Manage lifecycle risk

§ 450.103 System Safety Program.

(b) *Hazard management.* For hazard management:

(1) An operator must implement methods to assess the system to ensure the validity of the hazard control strategy determination and any flight hazard or flight safety analysis throughout the lifecycle of the launch or reentry system;

(2) An operator must implement methods for communicating and implementing any updates throughout the organization; and

Establishment of an integrated system safety organization

(3) Additionally, an operator required to conduct a flight hazard analysis must implement a process for tracking hazards, risks, mitigation measures, and verification activities.

(c) *Configuration management and control*. An operator must—

(1) Employ a process that tracks configurations of all safety-critical systems and documentation related to the operation;

(2) Ensure the use of correct and appropriate versions of systems and documentation tracked in paragraph (c)(1) of this section; and

(3) Document the configurations and versions identified in paragraph (c)(2) of this section for each licensed activity.

System Safety Program

Operator review of post-flight data provides valuable safety information on future operations.

The inconsistencies that need to be resolved are only those that affect safety analyses and associated mitigation and hazard control measures, such as greater population in the launch area than modeled. The anomalies that need to be addressed are only those that may impact any flight hazard analysis, FSA, or safety-critical system, or are otherwise material to public health and safety and the safety of property, such as the momentary drop-out of an FSS.

§ 450.103 System Safety Program.

(d) *Post-flight data review.* An operator must employ a process for evaluating post-flight data to—

(1) Ensure consistency between the assumptions used for the hazard control strategy determination, any flight hazard or flight safety analyses, and associated mitigation and hazard control measures;

(2) Resolve any inconsistencies identified in paragraph (d)(1) of this section prior to the next flight of the vehicle;

(3) Identify any anomaly that may impact any flight hazard analysis, flight safety analysis, or safety-critical system, or is otherwise material to public safety; and

(4) Address any anomaly identified in paragraph (d)(3) of this section prior to the next flight as necessary to ensure public safety, including updates to any flight hazard analysis, flight safety analysis, or safety-critical system.

(e) *Application requirements*. An applicant must submit in its application the following:

(1) A description of the applicant's safety organization as required by paragraph (a) of this section, identifying the applicant's lines of communication and approval authority, both internally and externally, for all public safety decisions and the provision of public safety services; and

(2) A summary of the processes and products identified in the system safety program requirements in paragraphs (b), (c), and (d) of this section.

Q&A

Hazard Control Strategies

In § 450.107 The FAA requires an operator to use a functional hazard analysis to make a hazard control strategy determination.

Section 450.107 characterizes flight hazard analysis as a hazard control strategy. Although a flight hazard analysis is different from the other hazard control strategies in that it does not lay out specific hazard controls, it does lay out a process by which hazard controls can be derived.

Explanation and details on how to comply with § 450.107 will be included in AC 450.107-1 "Hazard Control Strategies" Planned issuance is Q1 2021.

§ 450.107 Hazard Control Strategies.

(a) *General.* To meet the safety criteria of § 450.101(a), (b), or (c) for the flight, or any phase of flight, of a launch or reentry vehicle, an operator must use one or more of the hazard control strategies identified in § 450.108 through § 450.111.

(b)Hazard control strategy determination. For each phase of flight during a launch or reentry, an operator must use a functional hazard analysis to determine a hazard control strategy or strategies that account for—

(1) All functional failures associated with reasonably foreseeable hazardous events that have the capability to create a hazard to the public;

(2) Safety-critical systems; and

(3) A timeline of all safety-critical events.

Hazard Control Strategies

The hazard controls that are derived from the flight hazard analysis, like those defined in the other three hazard control strategies, are then used as part of the input to the FSA that is used to show compliance with § 450.101(a), (b), and (c). Therefore, because a flight hazard analysis is a means by which an operator derives the appropriate hazard controls, the FAA has characterized it as a hazard control strategy in this final rule. As such, throughout the final rule, a flight hazard analysis is listed with physical containment, wind-weighting, and flight abort as a hazard control strategy.

§ 450.107 Hazard Control Strategies.

(c) *Flight hazard analysis.* An operator must conduct a flight hazard analysis in accordance with § 450.109 of this part for the flight, or phase of flight, of a launch or reentry vehicle if the public safety hazards cannot be mitigated adequately to meet the public risk criteria of § 450.101(a), (b), and (c) using physical containment, wind weighting, or flight abort.

(d) *Application requirements.* An applicant must submit in its application—

(1) The results of the hazard control strategy determination, including—

(i) All functional failures identified under paragraph (b)(1) of this section;

(ii) The identification of all safety-critical systems; and

(iii) A timeline of all safety-critical events.

(2) A description of its hazard control strategy or strategies for each phase of flight.

Hazard Control Strategies

Guidance on Functional Hazard Analysis

a) A decomposition of the overall system to its next-level systems and related subsystems to the major component level. Further decomposition may be necessary if relevant to public safety.

   NOTE: The FAA expects the depth of system decomposition within the functional hazard analysis to be variable depending on the level necessary to adequately discern and mitigate impacts to public safety. For example, the FAA may accept a decomposition of "system - avionics - main computer" that may not need to go any further if all related impacts to public safety are confined, and all potential failure mitigations are applied, at that level. Alternatively, lower level mitigations such as an electronic circuit mitigation would require decomposition down to "system - avionics - main computer - circuit board assembly," to demonstrate hazard mitigation at the appropriate level of the system.

b) A functional description of each next-level system, subsystem, and component identified, to include interfaces between subsystems and components.

c) A designation of the implementation method for each function (e.g., hardware, software, etc.).

d) Identification of phases of system operation.

e) Identification of failure modes.

NOTE: Adapted from the guidance of MIL-STD-882E

Hazard Control Strategies

Guidance on Functional Hazard Analysis

f) Assessment of end effect resulting from failure of each function during each phase under each failure mode, excluding mitigation.

g) Assignment of functional failure identification to allow for traceability.

h) Assessment of the severity associated with each failure end effect.

i) A design scrutiny designation for non-hardware related functional failures based on severity of the failure end effect and degree of control.

j) Assessment of whether each failure end effect poses a potential system or mission hazard to the public.

Note: Grouping of different component or subsystem failures that may lead to the same end effect allows for identification of public safety hazards for the overall system.

k) Traceability between each functional failure and associated hazards during each phase of flight to respective hazard control strategies that should mitigate the hazard at the system or mission-level, as per § 450.103(b)(1).

NOTE: Adapted from the guidance of MIL-STD-882E

Hazard Control Strategies

Top-Level System [TBD]	Next-Level System	Subsystem	Component	Function	Implementation	Function ID	Phase	Failure Mode	Failure End Effect	Functional Failure ID or NSI[1]	Severity	SW/FW/DL Design Scrutiny[2]	Potential Hazard to Public[3]	Hazard Control Strategy[4]
	Launch Vehicle Stage 1 [LVS1]	Avionics System (AVI)	Computer [COMP]	Function 1	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-AVI-COMP-001	Launch	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
							Flight	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
							Abort/Reentry	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
							Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
				Function 2; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-AVI-COMP-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
			Battery [BATT]; and so on…	Function 1	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-AVI-BATT-001	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
				Function 2; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-AVI-BATT-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
		Propulsion System [PROP];	Engine(s) [ENG]; and so on…	Function(s) TBD; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-PROP-ENG-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
		Control System [CONT];	Reaction Control System [RCS]; and so on…	Function(s) TBD; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-CONT-RCS-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
		Flight Safety System [FSS]; and so on…	Safe & Arm [S&A]; and so on…	Function(s) TBD; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS1-FSS-S&A-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
	Launch Vehicle Stage 2 [LVS2]	Avionics System; Propulsion System; Control System; Flight Safety System; and so on…	Component(s) TBD; and so on…	Function(s) TBD; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	LVS2-TBD-TBD-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD
	Spacecraft/ Payload [S/P]; and so on…	Avionics System; Propulsion System; Control System; and so on…	Component(s) TBD; and so on…	Function(s) TBD; and so on…	Hardware (HW); Software (SW); Firmware (FW); Discrete Logic (DL)	S/P-TBD-TBD-001; and so on…	Launch; Flight; Abort/Reentry; Landing	Failure to function	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Early / Late	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Out of Sequence / Time	TBD	TBD	TBD	TBD	TBD	TBD
								Functions Inadvertently	TBD	TBD	TBD	TBD	TBD	TBD
								Degraded function or Malfunction	TBD	TBD	TBD	TBD	TBD	TBD

NOTE(S): (1) NSI = No Safety Impact; (2) Level of Rigor [LOR] per MIL-STD-882, or Design Assurance Level [DAL] per DO-178, or other software safety method; (3) Identify potential System/Mission Public Safety Hazard; (4) Per § 450.107 and guidance of AC 450.107-1

Hazard Control Strategies

Guidance on Determination and Validation of Hazard Control Strategies

1) Define the Mission and Vehicle (System)

2) Document a Functional HA

3) Identifies safety-critical systems, functions, and software

4) Utilize FSA data to better understand the end effect of functional failures prior to mitigation

5) Identify the hazard control strategy for each phase of flight

6) Validate the adequacy of the determined hazard control strategy(ies)

- Based on documented compliance data from the following items: Flight Safety Analysis; Flight Hazard Analysis; Software Safety; Safety-Critical Systems Design, Test & Documentation (DT&D); Flight or Wind Weighting Safety System DT&D.

NOTE: Continuous, iterative process

Hazard Control Strategies

Potential Determination Scenarios

- *Flight Abort with Highly Reliable FSS.* As a hazard control strategy for a phase of flight, an operator may utilize a FSS that meets the highly-reliable flight safety requirements specified in § 450.145. This mitigation should be validated by FSA data. In such a scenario, the flight abort strategy should adequately mitigate public safety hazards identified by the functional hazard analysis.
- *Flight Hazard Analysis with Flight Abort.* An operator may utilize a FSS that does not meet the highly-reliable flight safety requirements specified in § 450.145. A combined hazard control strategy of flight abort and flight hazard analysis should identify all necessary mitigations and support documentation of compliance to § 450.143 for safety-critical systems. These mitigations should be validated by FSA data. In such a scenario, the combined flight abort and flight hazard analysis strategy should adequately mitigate public safety hazards identified by the functional hazard analysis.
- *Flight Hazard Analysis.* In accordance with § 450.107(c), an operator must conduct a flight hazard analysis if the public safety hazards cannot be mitigated adequately using physical containment, wind weighting, or flight abort. The flight hazard analysis strategy should identify all necessary mitigations and support documentation of compliance to § 450.143 for safety-critical systems. These mitigations should be validated by FSA data. In such a scenario, the flight hazard analysis strategy should adequately mitigate public safety hazards identified by the functional hazard analysis.

NOTE: Documenting compliance to § 450.143 must be performed for all safety-critical systems other than a § 450.145 compliant highly reliable FSS.

Hazard Control Strategies

Potential Determination Scenarios (Continued)

- *Physical Containment.* For a phase of flight, the hazards identified by the functional hazard analysis may be assessed by the applicant as physically contained within the operating area, without further decomposition of system mitigations via the flight hazard analysis. This mission-level mitigation should be validated by FSA data and shown to contain hazards. In such a scenario, the physical containment strategy should adequately mitigate all public safety hazards during the specified phases of flight, as identified by the functional hazard analysis.
- *Wind Weighting.* An operator may propose a mission involving an unguided suborbital launch vehicle. As a hazard control strategy for a phase of flight, the operator may utilize a wind weighting safety system compliant to § 450.111. This mitigation should be validated by FSA data. In such a scenario, the wind weighing strategy should adequately mitigate public safety hazards identified by the functional hazard analysis.

Q&A

AST Commercial Space Transportation

Go for launch

End of Day 1

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