



Part 450 Industry Workshop – Day 3

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Federal Aviation
Administration

Agenda

Time	Topic
10:00 AM	Opening Remarks
10:05 AM	Prescribed Hazard for Safety-Critical Hardware and Computing Systems § 450.143 Safety-Critical System Design, Test, and Documentation § 450.145 Highly-Reliable Flight Safety System
10:25 AM	Q&A
10:40 PM	Other Prescribed Hazard Controls § 450.147 Agreements § 450.149 Safety-Critical Personnel Qualifications § 450.151 Work Shift and Rest Requirements § 450.153 Radio Frequency Management. § 450.155 Readiness § 450.157 Communications § 450.159 Pre-flight Procedures § 450.161 Control of Hazard Areas (Slides need to be moved from FSA Briefing) § 450.163 Lightning Hazard Mitigation § 450.165 Flight commit criteria § 450.167 Tracking (Slides need to be moved from FSA Briefing) § 450.177 Unique Policies, Requirements and Practices
11:10 PM	Q&A
11:30 PM	Lunch Break
12:00 AM	COLA, Safety at End of Launch § 450.169 Launch and Reentry Collision Avoidance Analysis Requirements § 450.171 Safety at End of Launch
12:15 PM	Q&A



Agenda

Time	Topic
12:30 PM	Mishap & Test Induced Damage § 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.
12:45 PM	Q&A
1:00 PM	§ 450.175 Test-induced Damage
1:15 PM	Q&A
1:30 PM	Break
1:40 PM	Ground Safety § 450.179 Ground Safety—General. § 450.181 Coordination with a Site Operator § 450.183 Explosive Site Plan § 450.185 Ground Hazard Analysis
1:54 PM	Q&A
2:09 PM	§ 450.187 Toxic Hazards Mitigation for Ground Operations § 450.189 Ground Safety Prescribed Hazard Controls
2:25 PM	Q&A
2:40 PM	Break



Agenda

Time	Topic
2:50 PM	Subpart D—Terms and Conditions of a Vehicle Operator License. § 450.201 Public safety responsibility. § 450.203 Compliance with license. § 450.205 Financial responsibility requirements. § 450.207 Human spaceflight requirements. § 450.209 Compliance monitoring. § 450.211 Continuing accuracy of license application; application for modification of license. § 450.213 Pre-flight reporting. § 450.215 Post-flight reporting. § 450.217 Registration of space objects. § 450.219 Records.
3:10 PM	Q&A
3:25 PM	Break
3:35 PM	Part 450 Crosswalk Mapping Tools for Legacy Operators
4:20 PM	Q&A
4:35 PM	End of Day 3



Prescribed Hazard for Safety-Critical Hardware and Computing Systems



Safety-Critical System Design, Test, and Documentation

The FAA anticipates that certain systems will not qualify for the exception in § 450.143(a)(2). Specifically, safety critical systems that prevent hazards from reaching the public given other system failures would likely be required to meet § 450.143. This is also true of systems that create hazards to the public that are not otherwise mitigated by other hazard controls. The FAA anticipates that it is unlikely that an operator would be able to demonstrate that the hazards associated with these systems meet the “extremely remote” standard in § 450.109(b)(3) without subjecting them to the reliability requirements in § 450.143. Furthermore, FSS required by § 450.108(b)(2) must meet § 450.143 without exception.

§ 450.143 Safety-Critical System Design, Test, and Documentation.

- (a) *Applicability.* This section applies to all safety-critical systems, except for—
- (1) Highly reliable flight safety systems covered under § 450.145; or
 - (2) 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).
- (b) *Design.* An operator must design safety-critical systems such that no credible fault can lead to increased risk to the public beyond nominal safety-critical system operation.

Safety-Critical System Design, Test, and Documentation

Valid qualification testing environments should:

- Account for material variation, because all materials have properties that have a variance from nominal values.
- Account for manufacturing variation, because the functionality of a system is not only dictated by the quality of materials used, but also the quality of the manufacturing processes employed.
- Account for environmental variation, because environmental predictions can have a great deal of uncertainty, particularly early in a program.

Operators should demonstrate margin against failure, because safety-critical systems often fail in complex and unpredictable ways.

§ 450.143 Safety-Critical System Design, Test, and Documentation.

(c) Qualification testing of design. An operator must functionally demonstrate the design of the vehicle's safety-critical systems at conditions beyond its predicted operating environments. The operator must select environmental test levels that ensure the design is sufficiently stressed to demonstrate that system performance is not degraded due to design tolerances, manufacturing variances, or uncertainties in the environment.

Safety-Critical System Design, Test, and Documentation

Acceptance testing on flight units should uncover critical workmanship errors, and damaged, weak, or out-of-specification components before they fail in flight. Because this testing is done on flight units, valid acceptance testing should avoid over-testing safety-critical components. This avoidance is accomplished by testing significantly under qualification levels and durations, but still over nominal operation levels and durations

Applicants must account for all operating environments that any safety-critical system is expected to encounter throughout the lifecycle of the system in accordance with § 450.143(e), including storage, transportation, installation, and flight, which generally are built into qualification and acceptance testing levels.

§ 450.143 Safety-Critical System Design, Test, and Documentation.

(d) *Acceptance of hardware.* An operator must—

- (1) Functionally demonstrate any safety-critical system, while exposed to its predicted operating environments with margin, is free of defects, free of integration and workmanship errors, and ready for operational use; or
- (2) Combine in-process controls and a quality assurance process to ensure functional capability of any safety-critical system during its service life.

(e) *Lifecycle of safety-critical systems.*

- (1) The predicted operating environments must be based on conditions predicted to be encountered in all phases of flight, recovery, and transportation.
- (2) An operator must monitor the flight environments experienced by safety-critical system components to the extent necessary to—
 - (i) Validate the predicted operating environments; and
 - (ii) Assess the actual component life remaining or adjust any inspection period.

Safety-Critical System Design, Test, and Documentation

The FAA requires that applicants describe the method used to validate predicted operating environments and any standards used for each safety-critical system.

Explanation and details on how to comply with § 450.143 can be found in AC 450.143-1 “Safety Critical Systems”. Planned issuance Q1 2021.

§ 450.143 Safety-Critical System Design, Test, and Documentation.

(f) *Application requirements.* An applicant must submit to the FAA the following as part of its application:

- (1) A list and description of each safety-critical system;
- (2) Drawings and schematics for each safety-critical system;
- (3) A summary of the analysis to determine the predicted operating environments and duration to be applied to qualification and acceptance testing covering the service life of any safety-critical system;
- (4) A description of any method used to validate the predicted operating environments;
- (5) A description of any instrumentation or inspection processes to monitor aging of any safety-critical system;
- (6) The criteria and procedures for disposal or refurbishment for service life extension of safety-critical system components; and
- (7) A description of the standards used in all phases of the lifecycle of each safety-critical system.

Highly-Reliable Flight Safety System

§ 450.108(b)(1) states that an operator must employ a highly reliable FSS on the vehicle or payload and do not mention the ground component of the FSS.

Operators currently satisfy the design reliability requirement for launches conducted under part 417 by FAA approved tailoring of RCC 319 and RCC 324. An operator could FAA approved tailored RCC 319 and RCC 324 to the FAA as a means of compliance for § 450.145(b).

§ 450.145 Highly-Reliable Flight Safety System.

a) *General.* For each phase of flight for which an operator must implement flight abort to meet the requirement of § 450.108(b)(1), the operator must use a highly reliable flight safety system on the launch or reentry vehicle, vehicle component, or payload with a design reliability in accordance with this section.

Highly-Reliable Flight Safety System

FSS includes any FSS located onboard a launch or reentry vehicle; any ground based command control system and associated support systems, including telemetry and tracking subsystems necessary to support a flight abort decision; and the functions of any personnel who operate the FSS HW or SW

Example means of compliance for § 450.145 are:

- Range Commanders Council Standard (RCC) 319-19: Flight Termination Systems Commonality Standard
- RCC 324-11: Global Positioning and Inertial Measurements Range Safety Tracking Systems' Commonality Standard
 - For airborne tracking sources
- AFSPCI 91-701: Launch and Range Safety Program Policy and Requirements
 - For Flight Safety System related ground systems
- AFI 13-602: Ready Spacecrew Program Training
 - For flight abort crew

§ 450.145 Highly-Reliable Flight Safety System.

b) Reliability. A highly reliable flight safety system must, using a means of compliance accepted by the Administrator—

- (1) Have a design reliability of 0.999 at 95 percent confidence and commensurate design, analysis, and testing for the portion of the flight safety system onboard the vehicle; and
- (2) Have a design reliability of 0.999 at 95 percent confidence and commensurate design, analysis, and testing for the portion of the flight safety system not onboard the vehicle, if used.

(c) *Monitoring*. An operator must monitor the flight environments experienced by any flight safety system component to the extent necessary to—

- (1) Validate the predicted operating environment; and
- (2) Assess the actual component life remaining or adjust any inspection period.

Highly-Reliable Flight Safety System

§ 450.145 Highly-Reliable Flight Safety System.

(d) *Application requirements.* An applicant must submit the information identified below, for any highly reliable flight safety system:

(1) *Flight safety system description.* An applicant must describe the flight safety system and its operation in detail, including all components, component functions, and possible operational scenarios.

(2) *Flight safety system diagram.* An applicant must submit a diagram that identifies all flight safety system subsystems and shows the interconnection of all the elements of the flight safety system. The diagram must include any subsystems used to implement flight abort both on and off the vehicle, including any subsystems used to make the decision to abort flight.

(3) *Flight safety system analyses.* An applicant must submit any analyses and detailed analysis reports of all flight safety system subsystems necessary to calculate the reliability and confidence levels required by paragraph (a) of this section.

(4) *Tracking validation procedures.* An applicant must document and submit the procedures for validating the accuracy of any vehicle tracking data utilized by the flight safety system to make the decision to abort flight.

(5) *Flight safety system test plans.* An applicant must submit acceptance, qualification, and preflight test plans of any flight safety system, subsystems, and components. The test plans must include test procedures and test environments.

(6) *Monitoring plan.* An applicant must submit a description of any method used to validate the predicted operating environments.

Q&A



Other Prescribed Hazard Controls



Agreements

§ 450.147 Agreements.

(a) *General.* An operator must establish a written agreement with any entity that provides a service or property that meets a requirement in this part, including:

The regulation identifies various entities for which agreements may be required including a Federal launch range operator, a licensed launch or reentry site operator, any party that provides access to or use of property and services required to support a safe launch or reentry under part 450, the U.S. Coast Guard, and the FAA.

(1) *Launch and reentry site use agreements.* A Federal launch or reentry site operator, a licensed launch or reentry site operator, or any other person that provides services or access to or use of property required to support the safe launch or reentry under this part;

(2) *Agreements for notices to mariners.* Unless otherwise addressed in agreements with the site operator, for overflight of navigable water, the U.S. Coast Guard or other applicable maritime authority to establish procedures for the issuance of a Notice to Mariners prior to a launch or reentry and other measures necessary to protect public health and safety;

(3) *Agreements for notices to airmen.* Unless otherwise addressed in agreements with the site operator, the FAA Air Traffic Organization or other applicable air navigation authority to establish procedures for the issuance of a Notice to Airmen prior to a launch or reentry, for closing of air routes during the respective launch and reentry windows, and for other measures necessary to protect public health and safety; and

(4) *Mishap response.* Emergency response providers, including local government authorities, to satisfy the requirements of § 450.173.



Agreements

FAA requires an operator to enter into multiple agreements if the operator works with multiple entities. Also, operators will continue to be required to enter into agreements with the appropriate entities for launches and reentries that cross airspace or impact water not under U.S. jurisdiction.

§ 450.147 Agreements.

(b) *Roles and responsibilities.* The agreements required in this section must clearly delineate the roles and responsibilities of each party to support the safe launch or reentry under this part.

(c) *Effective date.* The agreements required in this section must be in effect before a license can be issued, unless otherwise agreed to by the Administrator.

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

- (1) Describe each agreement in this section; and
- (2) Provide a copy of any agreement, or portion thereof, to the FAA upon request.



Safety-Critical Personnel Qualifications

An applicant is required to identify in the application all safety-critical tasks and internal requirements or standards for personnel to meet prior to performing the identified tasks.

§ 450.149 Safety-Critical Personnel Qualifications.

(a) An operator must ensure safety-critical personnel are trained, qualified, and capable of performing their safety-critical tasks, and that their training is current.

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

An example of a means of compliance for § 450.149 can be found in §§ 415.113, Launch personnel certification program and 417.311, Flight safety crew roles and qualifications.

- (1) Identify safety-critical tasks that require qualified personnel;
- (2) Provide internal training and currency requirements, completion standards, or any other means of demonstrating compliance with the requirements of this section; and
- (3) Describe the process for tracking training currency.



Work Shift and Rest Requirements

The performance-based requirement set forth in § 450.151 allows operators to take into account such factors affecting crew rest and adopt mitigations and procedures unique to each launch operation.

§ 450.151 Work Shift and Rest Requirements.

(a) *General.* For any launch or reentry, an operator must document and implement rest requirements that ensure safety-critical personnel are physically and mentally capable of performing all assigned tasks.

Example means of compliance for § 450.151 can be found in § 431.43(c)(4) or AFSPMAN 91-710, *Air Force Space Command Manual – Range Safety Users' Manual*.



Work Shift and Rest Requirements

Section 450.151(b)(1) requires an operator's rest rules to include the duration of each work shift and the process for extending this shift, including the maximum allowable length of any extension.

§ 450.151 Work Shift and Rest Requirements.

(b) *Work shifts and deviation approval process.* An operator's rest requirements must address the following:

- (1) Duration of each work shift and the process for extending this shift, including the maximum allowable length of any extension;
- (2) Number of consecutive work shift days allowed before rest is required;
- (3) Minimum rest period required—
 - (i) Between each work shift, including the period of rest required immediately before the flight countdown work shift; and
 - (ii) After the maximum number of work shift days allowed; and
- (4) Approval process for any deviation from the rest requirements

Section 450.151(b)(3) requires an operator's rest rules to include the minimum rest period required between each work shift, including the period of rest required immediately before the flight countdown work shift. Applicants would be required to submit their rest rules as part of the license application.

(c) *Application requirements.* An applicant must submit rest rules that demonstrate compliance with the requirements of this section.



Radio Frequency Management

Operators are required to ensure that radio frequency does not adversely affect the performance of FSS or safety-critical systems and to coordinate use of radio frequencies with any site operator and local and Federal authorities.

An example of a means of compliance for § 450.153 can be found in § 417.111(f), *Frequency management plan*.

§ 450.153 Radio Frequency Management.

(a) *General*. For any radio frequency used, an operator must—

- (1) Ensure radio frequency interference does not adversely affect performance of any flight safety system or safety-critical system; and
- (2) Coordinate use of radio frequencies with any site operator and any local and Federal authorities.

(b) *Application requirements*. An applicant must submit procedures or other means to demonstrate compliance with the radio frequency requirements of this section.



Readiness

§ 450.155 Readiness.

In § 450.155(b)(2), the phrase “so that public safety is maintained” emphasizes developing criteria to determine readiness to proceed with launch or reentry, and clarifies that the operator need only identify those criteria that affect public safety.

An example of a means of compliance for § 450.155 can be found in § 417.117, *Reviews*.

(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.



Communications

The FAA will verify compliance with § 450.157 during inspections. The inspections will be consistent with current practice, where FAA inspectors often review the operator's final communications procedures. Given that operators do not need to demonstrate compliance with § 450.157 at the application stage, operators may be required to revise their communication procedures to resolve issues identified during compliance monitoring.

An example of a means of compliance for § 450.157 can be found in § 417.111(k), *Communications plan*.

§ 450.157 Communications.

(a) An operator must implement communication procedures during the countdown and flight of a launch or reentry vehicle that—

- (1) Define the authority of personnel, by individual or position title, to issue “hold/resume,” “go/no go,” and abort commands;
- (2) Assign communication networks so that personnel identified in paragraph (a)(1) of this section have direct access to real-time, safety-critical information required to issue “hold/resume,” “go/no go,” and any abort commands; and
- (3) Implement a protocol for using defined radio telephone communications terminology.

(b) An operator must ensure the currency of the communication procedures, and that all personnel are working with the approved version of the communication procedures.

(c) An operator must record all safety-critical communications network channels that are used for voice, video, or data transmissions that support safety-critical systems during each countdown.



Pre-flight Procedures

The FAA adopts a performance-based requirement in which an operator who needs to implement pre-flight procedures would verify that all flight commit criteria are satisfied before flight and ensure the operator is capable of returning the vehicle to a safe state after a countdown abort or delay.

Flight commit criteria involve much more than the launch sequence of events, including interdependent conditions such as meteorological conditions, lightning protection equipment measurements, and status of safety system components. Therefore, the requirements of § 450.159 cannot be satisfied by merely having operators identify the launch sequence of events. The FAA notes that the requirements for the flight commit criteria itself are clearly provided in § 450.165(b).

§ 450.159 Pre-flight Procedures.

(a) An operator must implement pre-flight procedures that—

- (1) Verify that each flight commit criterion is satisfied before flight is initiated; and
- (2) Ensure the operator can return the vehicle to a safe state after a countdown abort or delay.

(b) An operator must ensure the currency of the pre-flight procedures, and that all personnel are working with the approved version of the pre-flight procedures.

An example of a means of compliance for § 450.159 can be found in § 417.121, *Safety critical preflight operations*.



Control of Hazard Areas

The FAA notes that the requirements in § 450.161 are consistent with the recommendations made by the National Academy of Sciences National Research Council. An applicant could apply conservative estimates of the ship traffic and vulnerability to demonstrate acceptable public risks. However the operators still have the option to use the current approach in part 417, where surveillance is required to ensure no ship is exposed to more than $1 \times 10^{-5} P_1$, because that would be sufficient to ensure compliance with § 450.101.

§ 450.161 Control of Hazard Areas.

(a) *General*. The operator must publicize, survey, control, or evacuate each flight hazard area identified in accordance with § 450.133 prior to initiating flight of a launch vehicle or the reentry of a reentry vehicle to the extent necessary to ensure compliance with § 450.101.

(b) *Verification*. The launch or reentry operator must perform surveillance sufficient to verify or update the assumptions, input data, and results of the flight safety analyses.

An example of means of compliance for § 450.161 can be found in AC 450.161-1, “Surveillance and Publication of Hazard Areas”. Planned issuance is Q2 2021.



Control of Hazard Areas

§ 450.161(c) changed the previous requirement to “verify that the warnings have been issued” to “determine whether the warnings have been issued” because an operator cannot verify the warnings have been issued if the foreign Air Navigation Service Provider (ANSP) fails to publicize the warnings (despite agreeing to do so).

Another party may determine whether the warnings have been issued (pursuant to the agreements the operator has with them). In cases in which a foreign ANSP does not issue the warnings in a timely manner, the operator must notify the FAA in accordance with a means of compliance accepted by the FAA. The means of compliance will describe information that the operators should communicate to the FAA to (1) show due diligence in the fulfillment of their requirements in accordance with agreements in place, and (2) enable FAA to issue warnings to U.S. aircraft.

§ 450.161 Control of Hazard Areas.

(c) *Publication.* An operator must publicize warnings for each flight hazard area, except for regions of land, sea, or air under the control of the vehicle operator, site operator, or other controlling authority with which the operator has an agreement. If the operator relies on another entity to publicize these warnings, it must:

- (1) Determine whether the warnings have been issued; and
- (2) **Notify the FAA if the warnings have not been issued so that the FAA can determine if the launch or reentry can be conducted in a manner that sufficiently protects the public.** This notification must provide sufficient information to enable FAA to issue warnings to U.S. aircraft.



Control of Hazard Areas

The FAA notes that the nature of any surveillance (in terms of extent and frequency) necessary to ensure conditions consistent with flight commit criteria is naturally linked to the level of control an operator can exercise to limit access to a flight hazard area.

§ 450.161(d)(2) is necessary for the FAA to evaluate compliance with the requirements of § 450.161(c), including verifying whether the warnings have been issued.

§ 450.161 Control of Hazard Areas.

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

- (1) A description of how the applicant will provide for day-of-flight surveillance and control of flight hazard areas, if necessary, to ensure that the presence of any member of the public in or near a flight hazard area is consistent with flight commit criteria developed for each launch or reentry as required by § 450.165(b);
- (2) A description of how the applicant will provide for any publication of flight hazard areas necessary to meet the requirements of this section; and
- (3) A description of how the applicant will establish flight commit criteria based on the results of its toxic release hazard analysis, toxic containment, or toxic risk assessment for any necessary evacuation of the public from any toxic hazard area.



Lightning Hazard Mitigation

The FAA notes that § 450.163(a) provides two ways for an operator to mitigate natural and triggered lightning and does not mandate a lightning-related design change. The decision to pursue flight commit criteria versus a lightning-resistant vehicle rests with the operator.

§ 450.163 Lightning Hazard Mitigation.

(a) *Lightning hazard mitigation.* An operator must—

- (1) Establish flight commit criteria that mitigate the potential for a launch or reentry vehicle intercepting or initiating a direct lightning strike, or encountering a nearby discharge, using a means of compliance accepted by the Administrator; or
- (2) Use a vehicle designed to protect safety-critical systems in the event of a direct lightning strike or nearby discharge.

An example of a means of compliance for § 450.163(a)(1) can be found in NASA-STD-4010, *Standard for Lightning Launch Commit Criteria for Space Flight*.

Further explanation and details on how to comply with § 450.163 will be included in AC 450.163-1, “Lightning Hazard Mitigation”. Planned issuance is Q1 2021.

(b) *Application requirements.*

- (1) An applicant electing to comply with paragraph (a)(1) of this section must submit flight commit criteria that mitigate the potential for a launch or reentry vehicle intercepting or initiating a direct lightning strike, or encountering a nearby lightning discharge.
- (2) An applicant electing to comply with paragraph (a)(2) of this section must submit documentation providing evidence that the vehicle is designed to protect safety-critical systems against the effects of a direct lightning strike or nearby discharge.



Flight commit criteria

§ 450.165 Flight commit criteria.

(a) *General.* For each launch or reentry, an operator must establish and observe flight commit criteria that identify each condition necessary prior to flight to satisfy the requirements of § 450.101, and must include:

- (1) Surveillance of any region of land, sea, or air in accordance with § 450.161;
- (2) Monitoring of any meteorological condition necessary to—
 - (i) Be consistent with any safety analysis required by this part; and
 - (ii) If necessary in accordance with § 450.163, mitigate the potential for a launch or reentry vehicle intercepting a direct lightning strike, or encountering a nearby discharge;
- (3) Implementation of any launch or reentry window closure in the launch or reentry window for the purpose of collision avoidance in accordance with § 450.169;



Flight commit criteria (con't)

The FAA will work with the applicant to create a streamlined process to achieve confirmation that the risk to critical assets satisfies the requirements of § 450.101(a)(4) or (b)(4).

The FAA anticipates that it will generally be able to provide this confirmation well before the actual flight countdown.

(4) Confirmation that any safety-critical system is ready for flight;

(5) Confirmation from the FAA that the risk to critical assets satisfies the requirements of § 450.101(a)(4) or (b)(4);

(6) For any reentry vehicle, except a suborbital vehicle, monitoring by the operator or an onboard system that the status of safety-critical systems is healthy before enabling reentry flight, to assure the vehicle can reenter safely to Earth; and

(7) Any other hazard controls derived from any safety analysis required by this part.

(b) *Application requirements.* An applicant must submit a list of all flight commit criteria.



Tracking

Tracking data are generally necessary to ensure a proper response to an emergency, facilitate flight abort, obtain vehicle performance data for comparison with the preflight performance predictions in accordance with § 450.103(d), and facilitate safe and efficient integration of launch and reentry operations into the NAS.

“Real time” does not mean “zero lag time.” The tracking must be sufficient to meet the requirements in § 450.167(a) to predict the expected impact locations and obtain vehicle performance data for comparison with pre-flight predictions. The requirement is not to track components to impact, but to allow a prediction of the impact location.

§ 450.167 Tracking.

(a) *General.* During the flight of a launch or reentry vehicle, an operator must measure and record in real time the position and velocity of the vehicle. The system used to track the vehicle must provide data to predict the expected impact locations of all stages and components, and to obtain vehicle performance data for comparison with the pre-flight performance predictions.

(b) *Application requirements.* An applicant must identify and describe each method or system used to meet the tracking requirements of paragraph (a) of this section.

Further explanation and details on how to comply with § 450.167 will be included in AC 450.167-1, “Tracking”. Planned issuance is Q3 2021.

Example means of compliance for § 450.167 are §§ 417.113(c)(2)(iii), 417.307(b), and RCC 324-11: Global Positioning and Inertial Measurements Range Safety Tracking Systems’ Commonality Standard.



Unique Policies, Requirements and Practices

The necessity for § 450.177 is the same as that for § 417.127. The FAA expects that advances in technology and implementation of innovations by launch and reentry operators will likely introduce new and unforeseen safety challenges. These advances and innovations can present regulatory challenges that are unforeseen in existing regulations. In this case, the FAA must work with operators on a case-by-case basis to identify and mitigate those unique hazards posed to public health and safety, which are not addressed by part 450. The FAA expects the need for the use of this provision to be rare due to the comprehensiveness and performance-based nature of part 450.

§ 450.177 Unique Policies, Requirements and Practices.

- (a) *Unique hazards.* An operator must review operations, system designs, analysis, and testing, and identify any unique hazards not otherwise addressed by this part. An operator must implement any unique safety policy, requirement, or practice needed to protect the public from the unique hazard.
- (b) *Unique requirements.* The FAA may identify and impose a unique policy, requirement, or practice as needed to protect the public health and safety.
- (c) *Application requirements.* An applicant must—
 - (1) Identify any unique safety policy, requirement, or practice necessary in accordance with paragraph (a) of this section, and demonstrate that each unique safety policy, requirement, or practice protects public health and safety.
 - (2) Demonstrate compliance with each unique safety policy, requirement, or practice imposed by the FAA in accordance with paragraph (b) of this section.



Q&A





On Break

**Next Session Starts at
12:00 PM EST**

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Launch and Reentry Collision Avoidance Analysis Requirements

The finalized LCOLA rules better align with the existing processes used at Federal sites, provide adequate orbital safety measures for launch and reentry operations, and incorporate updated options for collision avoidance analysis. The FAA maintains that all operators must come into compliance with the LCOLA requirements by the effective date of this rule.

§ 450.169 Launch and Reentry Collision Avoidance Analysis Requirements.

(a) *Criteria.* Except as provided in paragraph (d), for an orbital or suborbital launch or reentry, an operator must establish window closures needed to ensure that the launch or reentry vehicle, any jettisoned components, or payloads meet the following requirements with respect to orbiting objects, not including any object being launched or reentered.

(1) For inhabitable objects, one of three criteria below must be met:

- (i) The probability of collision between the launching or reentering objects and any inhabitable object must not exceed 1×10^{-6} ;
- (ii) The launching or reentering objects must maintain an ellipsoidal separation distance of 200 km in-track and 50 km cross-track and radially from the inhabitable object; or
- (iii) The launching or reentering objects must maintain a spherical separation distance of 200 km from the inhabitable object.

(2) For objects that are neither orbital debris nor inhabitable, one of the two criteria below must be met:

- (i) The probability of collision between the launching or reentering objects and any object must not exceed 1×10^{-5} ; or (ii) The launching or reentering objects must maintain a spherical separation distance of 25 km from the object.

(3) For all other known orbital debris identified by the FAA or other Federal Government entity as large objects with radar cross section greater than 1 m^2 and medium objects with radar cross section 0.1 m^2 to 1 m^2 :

- (i) The probability of collision between the launching or reentering objects and any known orbital debris must not exceed 1×10^{-5} ; or (ii) The launching or reentering objects must maintain a spherical separation distance of 2.5 km.

RCS Size Range(m^2)	Bin
RCS < 0.1	Small
0.1 < RCS < 1.0	Medium
1.0 < RCS	Large



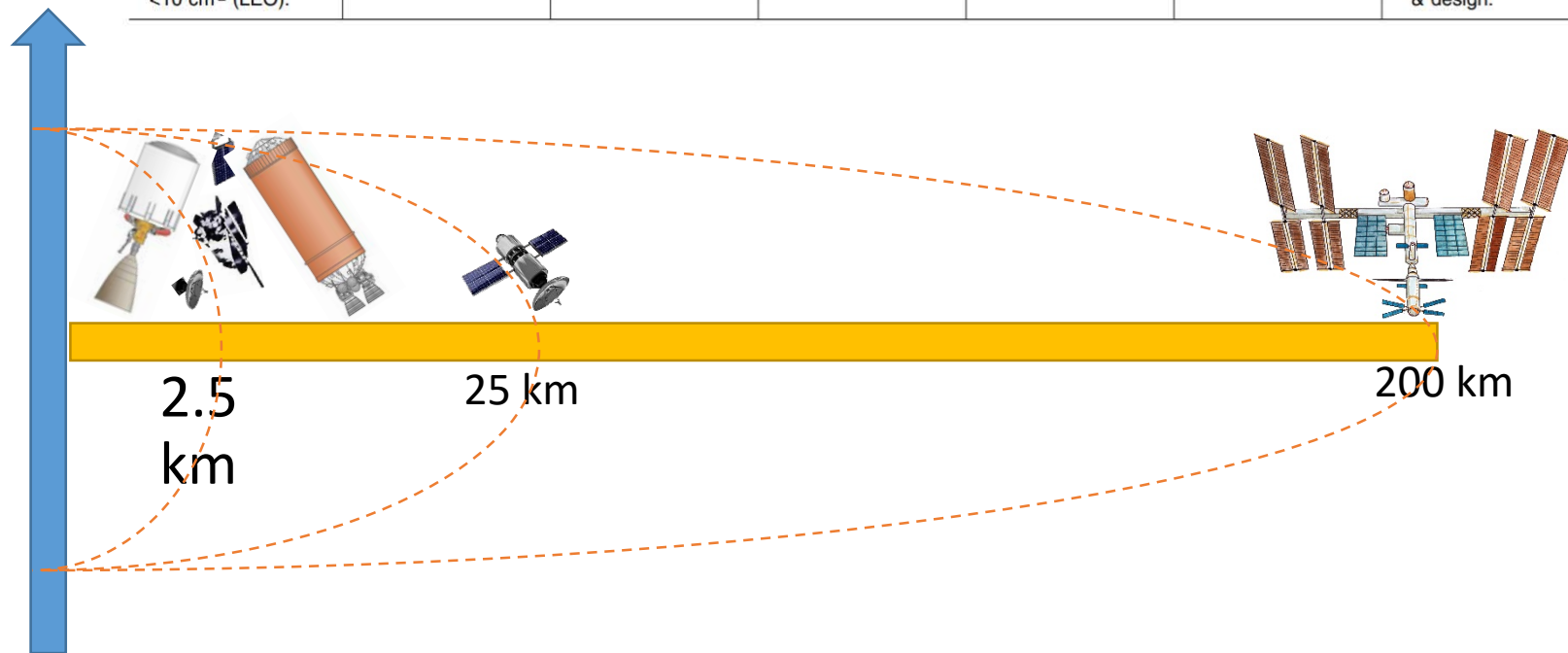
Launch and Reentry Collision Avoidance Analysis Stand-off Distance Requirements

15346

Federal Register / Vol. 84, No. 72 / Monday, April 15, 2019 / Proposed Rules

FIGURE 2—LAUNCH COLLISION AVOIDANCE JUSTIFICATIONS AND TIERS

	Separation distance	Protect public health and safety	Safety of property	U.S. national security or foreign policy interests	International obligations	Avoid debris generation
Inhabitable Objects	200 km	Yes	Yes	Yes	Yes	Yes.
Active Satellites	25 km .....	.....	Yes	Yes	Yes	Yes.
Trackable Debris >10 cm ² (LEO).	2.5 km .....	.....	.....	Yes, if it creates significant debris.	Yes, if it creates significant debris.	Yes.
Un-trackable Debris <10 cm ² (LEO).	Not applicable	Protect with shielding & design.



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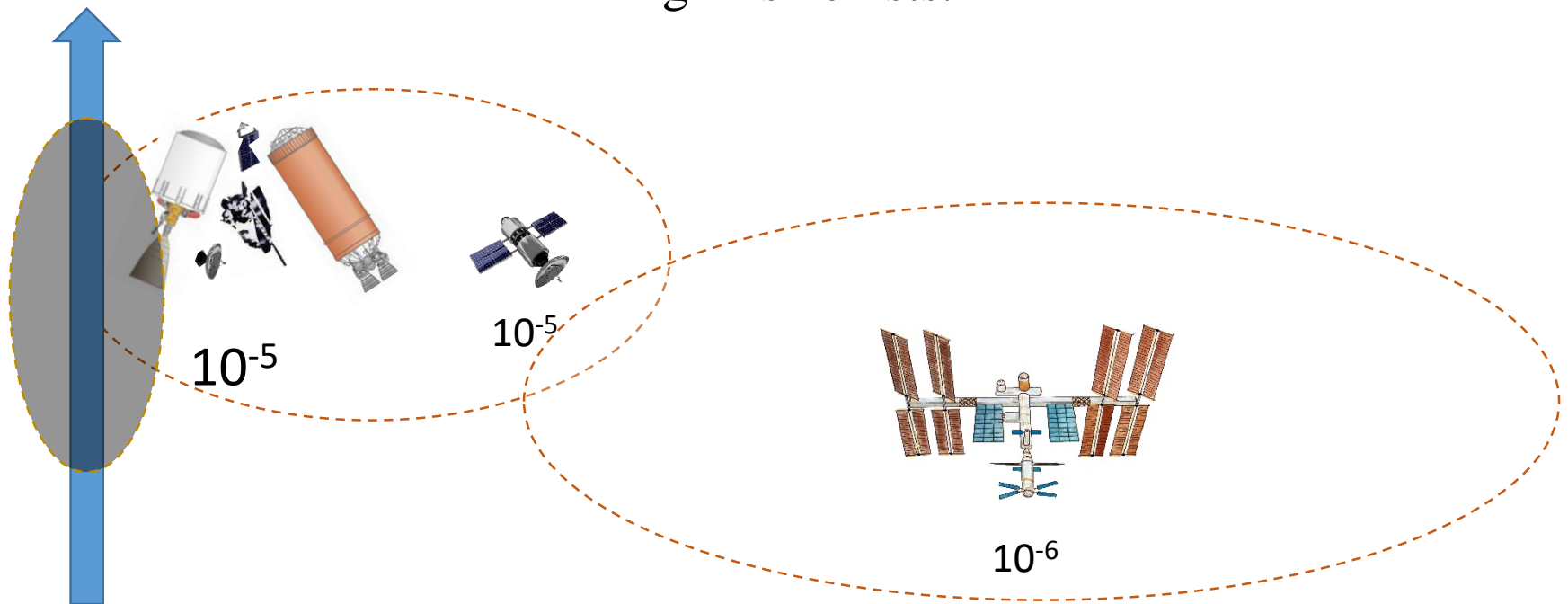
November 6, 2020 | 35

DRAFT

Launch and Reentry Collision Avoidance Analysis

Probability of Collision Requirements

When an operator can provide sufficient covariance (as identified in proposed Appendix A to part 450, paragraph (d)(3)), the probability of its collision with an inhabitable object can be accurately calculated and launch window closures can be limited to only those times where actual high risk exists.



Launch and Reentry Collision Avoidance Analysis Requirements

§ 450.169(b)(1) requires LCOLA analysis only for the entire segment of flight of a suborbital launch vehicle above 150 km.

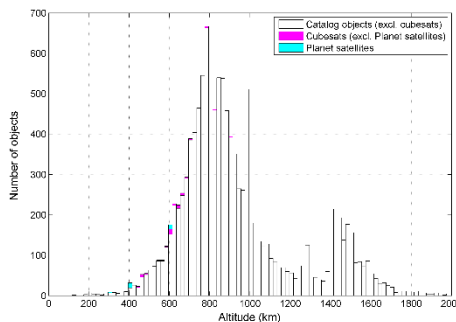
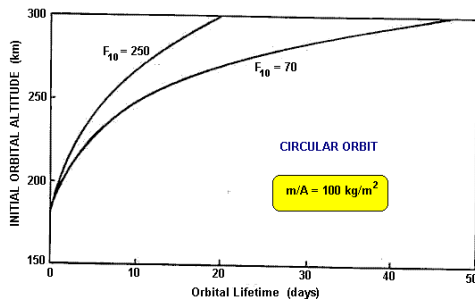
§ 450.169 Launch and Reentry Collision Avoidance Analysis Requirements.

(b) *Screening time.* A launch or reentry operator must ensure the requirements of paragraph (a) of this section are met as follows:

- (1) Through the entire segment of flight of a suborbital launch vehicle above 150 km;
- (2) For an orbital launch, during ascent from a minimum of 150 km to initial orbital insertion and for a minimum of 3 hours from liftoff;
- (3) For reentry, during descent from initial reentry burn to 150 km altitude; and
- (4) For disposal, during descent from initial disposal burn to 150 km altitude.

(c) *Rendezvous.* Planned rendezvous operations that occur within the screening time frame are not considered a violation of collision avoidance if the involved operators have pre-coordinated the rendezvous or close approach.

(d) *Exception.* A launch collision avoidance analysis is not required for any launched object if the maximum planned altitude by that object is less than 150 km.



Launch and Reentry Collision Avoidance Analysis Requirements

In performing a launch or reentry collision avoidance analysis against inhabitable objects, an operator may choose to stipulate an ellipsoidal separation distance, a spherical separation distance, or satisfy the probability of collision threshold (1×10^{-6}). Collision avoidance analyses must also account for other orbital objects, such as spacecraft, and tracked debris. For these uninhabitable active objects, operators must satisfy either a less restrictive probability of collision threshold (1×10^{-5}) or a spherical separation distance of 25 km & 2.5 km.

§ 450.169 Launch and Reentry Collision Avoidance Analysis Requirements.

(e) *Analysis.* Collision avoidance analysis must be obtained for each launch or reentry from a Federal entity identified by the FAA, or another entity agreed to by the Administrator.

- (1) An operator must use the results of the collision avoidance analysis to establish flight commit criteria for collision avoidance; and
- (2) The collision avoidance analysis must account for uncertainties associated with launch or reentry vehicle performance and timing, and ensure that each window closure incorporates all additional time periods associated with such uncertainties.



Input Form 22

Input Trajectories



Output Closures



Launch and Reentry Collision Avoidance Analysis Requirements

Further explanation and details on how to comply with § 450.167 will be included in AC 450.169-1 Collision Avoidance Analysis. Planned issuance is Q3 2021.

Trajectory files are due
7 days prior to launch;
15 days for first-time operators.

§ 450.169 Launch and Reentry Collision Avoidance Analysis Requirements.

(f) *Timing and information required.* An operator must prepare a collision avoidance analysis worksheet for each launch or reentry using a standardized format that contains the input data required by Appendix A to part 450, as follows:

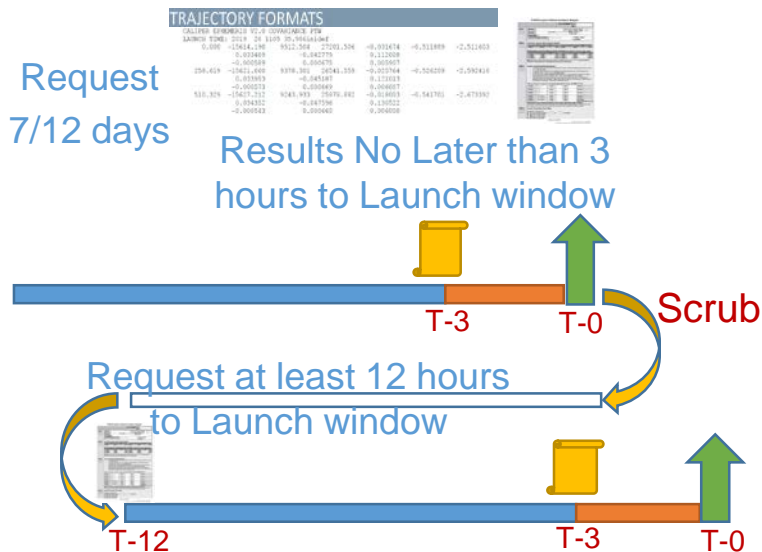
(1) Except as specified in paragraphs (1)(i) and (1)(ii) of this subsection, an operator must file the input data with an entity identified in paragraph (e) of this section and the FAA at least 7 days before the first attempt at the flight of a launch vehicle or the reentry of a reentry vehicle.

(i) Operators that have never received a launch or reentry conjunction assessment from the entity identified in paragraph (e) of this section, must file the input data at least 15 days in advance.

(ii) The Administrator may agree to an alternative time frame in accordance with § 404.15;

(2) An operator must obtain a collision avoidance analysis performed by an entity identified in paragraph (e) of this section, no later than 3 hours before the beginning of a launch or reentry window; and

(3) If an operator needs an updated collision avoidance analysis due to a launch or reentry delay, the operator must file the request with the entity identified in paragraph (e) of this section and the FAA at least 12 hours prior to the beginning of the new launch or reentry window.



Safety at End of Launch

§ 450.171 provides requirements for the prevention of creating orbital debris, with which an applicant would be required to demonstrate compliance in its application.

An example means of compliance for § 450.171 is the Inter-Agency Space Debris Coordination Committee IADC-02-01: *IADC Space Debris Mitigation Guidelines*

§ 450.171 Safety at End of Launch.

(a) *Orbital Debris Mitigation.* An operator must ensure for any proposed launch that for all vehicle stages or components that reach Earth orbit—

- (1) There is no unplanned physical contact between the vehicle or any of its components and the payload after payload separation;
- (2) Debris generation does not result from the conversion of energy sources into energy that fragments the vehicle or its components. Energy sources include chemical, pressure, and kinetic energy; and
- (3) For all vehicle stages or components that are left in orbit, stored energy is removed by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy.

(b) *Application requirement.* An applicant must demonstrate compliance with the requirements in paragraph (a) of this section.



Q&A



Mishap and Test Induced Damage



Mishap - § 401.7 Definitions – Anomaly

The FAA redefined the term “anomaly” and expanded its application to include licensed activities:

- The definition clarifies what a “problem” is by adding “deviates from what is standard, normal, or expected” to the existing definition
- Revised definition included in § 401.7, removed from § 437.3.

Anomaly means any condition during licensed or permitted activity that deviates from what is standard, normal, or expected, during the verification or operation of a system, subsystem, process, facility, or support equipment.

Related Part 450 requirements:

- § 450.103(d) - Post flight data review
- § 450.131 - Probability of failure analysis.
- § 450.215 - Post-flight reporting



§ 401.7 Definitions – Mishap

Mishap means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

- (1) A fatality or serious injury (as defined in 49 CFR 830.2);
- (2) A malfunction of a safety-critical system;
- (3) A failure of the licensee's or permittee's safety organization, safety operations, safety procedures;
- (4) High risk, as determined by the FAA, of causing a serious or fatal injury to any space flight participant, crew, government astronaut, or member of the public;
- (5) Substantial damage, as determined by the FAA, to property not associated with licensed or permitted activity;
- (6) Unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity;
- (7) Unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;
- (8) The impact of hazardous debris outside the planned landing site or designated hazard area; or
- (9) Failure to complete a launch or reentry as planned as reported in § 450.213(b).

§ 401.7 Definitions – Mishap

Examples of “high risk”:

- The impact of hazardous launch debris in a populated public area that by random chance did not result in a serious or fatal injury;
- Loss of vehicle control or off-nominal maneuvers taken by a crewmember that were not in accordance with approved emergency or abort procedures, which did not result in a serious or fatal injury.

Mishap means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

- (1) A fatality or serious injury (as defined in 49 CFR 830.2);
- (2) A malfunction of a safety-critical system;
- (3) A failure of the licensee’s or permittee’s safety organization, safety operations, safety procedures;
- (4) High risk, as determined by the FAA, of causing a serious or fatal injury to any space flight participant, crew, government astronaut, or member of the public;
- (5) Substantial damage, as determined by the FAA, to property not associated with licensed or permitted activity;
- (6) Unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity;
- (7) Unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;
- (8) The impact of hazardous debris outside the planned landing site or designated hazard area; or
- (9) Failure to complete a launch or reentry as planned as reported in § 450.213(b).



§ 401.7 Definitions – Mishap

Examples of “Substantial Damage”:

- Structural damage to public property exceeding 50 percent of its market value may be deemed as substantial damage;
- A failed launch attempt with debris impacts outside a defined hazard area resulting in a post-impact fire and loss of a residential structure.

Mishap means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

- (1) A fatality or serious injury (as defined in 49 CFR 830.2);
- (2) A malfunction of a safety-critical system;
- (3) A failure of the licensee’s or permittee’s safety organization, safety operations, safety procedures;
- (4) High risk, as determined by the FAA, of causing a serious or fatal injury to any space flight participant, crew, government astronaut, or member of the public;
- (5) Substantial damage, as determined by the FAA, to property not associated with licensed or permitted activity;
- (6) Unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity;
- (7) Unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;
- (8) The impact of hazardous debris outside the planned landing site or designated hazard area; or
- (9) Failure to complete a launch or reentry as planned as reported in § 450.213(b).



Part 450 – Other Prescribed Hazard Controls

In Part 450, the consolidated mishap definition more closely relates to the one uniform mishap plan. Legacy licenses will still adhere to the previous construct on definitions and plan/requirements.

All 450 licenses, whether ELV, RLV, RV, launching, or reentering will adhere to the same set of requirements.

Additionally, both 420 and 437 mishap requirements will be mapped back to 450.173.

Part 450 removes the mishap plan signature requirements, placing more emphasis on ensuring responsibilities are documented. (i.e. Who is implementing and participating?)

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(a) *General.* An operator must report, respond, and investigate mishaps, as defined in § 401.7 of this chapter, in accordance with paragraphs (b) through (g) of this section using a plan or other written means.

(b) *Responsibilities.* An operator must document—

- (1) Responsibilities for personnel assigned to implement the requirements of this section;
- (2) Reporting responsibilities for personnel assigned to conduct investigations and for anyone retained by the operator to conduct or participate in investigations; and
- (3) Allocation of roles and responsibilities between the launch operator and any site operator for reporting, responding to, and investigating any mishap during ground activities at the site.



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

Other written means – Checklists, electronic procedures, Service Contracts, and Agreements

(a) *General*. An operator must report, respond, and investigate mishaps, as defined in § 401.7 of this chapter, in accordance with paragraphs (b) through (g) of this section using a plan or other written means.

Mishap plan should document each individual's authority and define lines of communication.

(b) *Responsibilities*. An operator must document—

The delegation of roles and responsibilities may be shared between the applicant's organization and site operator, subject to mutual agreement.

- (1) Responsibilities for personnel assigned to implement the requirements of this section;
- (2) Reporting responsibilities for personnel assigned to conduct investigations and for anyone retained by the licensee to conduct or participate in investigations; and
- (3) Allocation of roles and responsibilities between the launch operator and any site operator for reporting, responding to, and investigating any mishap during ground activities at the site.



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(c) *Mishap reporting requirements.* An operator must—

- (1) Immediately notify the FAA Washington Operations Center in case of a mishap that involves a fatality or serious injury (as defined in 49 CFR 830.2);
- (2) Notify within 24 hours the FAA Washington Operations Center in the case of a mishap that does not involve a fatality or serious injury (as defined in 49 CFR 830.2); and

Washington Operations Center (WOC)

Phone: (202) 267-3333 or toll-free at (800) 322-3804

Email: 9-awa-ash-woc@faa.gov

Fax: (202) 267-5289

The immediate and 24-hour mishap reporting requirements are consistent with existing requirements, with the exception that all notifications now go to a common source.



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(3) Submit a written preliminary report to the FAA Office of Commercial Space Transportation within five days of any mishap. The preliminary report must include the following information, as applicable:

- (i) Date and time of the mishap;
- (ii) Description of the mishap and sequence of events leading to the mishap, to the extent known;
- (iii) Intended and actual location of the launch or reentry or other landing on Earth;
- (iv) Hazardous debris impact points, including those outside a planned landing site or designated hazard area;
- (v) Identification of the vehicle;
- (vi) Identification of any payload;
- (vii) Number and general description of any fatalities or injuries;
- (viii) Description and estimated costs of any property damage;
- (ix) Identification of hazardous materials, as defined in § 401.7 of this chapter, involved in the event, whether on the vehicle, any payload, or on the ground;
- (x) Action taken by any person to contain the consequences of the event; (xi) Weather conditions at the time of the event; and
- (xii) Potential consequences for other similar vehicles, systems, or operations.

Part 450 requires the submittal of a preliminary written report for all mishaps.



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(d) *Emergency response requirements.* An operator must—

(1) Activate emergency response services to protect the public and property following a mishap as necessary including, but not limited to:

- (i) Evacuating and rescuing members of the public, taking into account debris dispersion and toxic plumes; and
- (ii) Extinguishing fires;

(2) Maintain existing hazard area surveillance and clearance as necessary to protect public safety;

(3) Contain and minimize the consequences of a mishap, including:

- (i) Securing impact areas to ensure that no members of the public enter;
- (ii) Safely disposing of hazardous materials; and
- (iii) Controlling hazards at the site or impact areas.

(4) Preserve data and physical evidence; and

(5) Implement agreements with government authorities and emergency response services, as necessary, to satisfy the requirements of this section.

Part 450 consolidates previous emergency response requirements necessary to ensure the public safety and safety of property in the event of a mishap



Part 450 – Other Prescribed Hazard Controls

Licensees continue to be responsible for investigating root cause, implementing preventative measures, and maintaining records. The core intent of these requirements have not changed.

Part 450 removes the requirement to cooperate with FAA and NTSB investigations.

- The FAA determined this requirement was duplicative.
- Issuance of a license does not relieve a licensee of its obligation to comply with all applicable requirements of law or regulation, including lawful investigations, whether conducted by the FAA or another entity with investigative authority.

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(e) *Mishap investigation requirements.* In the event of a mishap, an operator must—

- (1) Investigate the root causes of the mishap; and
- (2) Report investigation results to the FAA.

(f) *Preventative measures.* An operator must identify and implement preventive measures for avoiding recurrence of the mishap prior to the next flight, unless otherwise approved by the Administrator.

(g) *Mishap Records.* An operator must maintain records associated with the mishap in accordance with § 450.219(b).



Part 450 – Other Prescribed Hazard Controls

Plan should provide for:

- Composition of the mishap investigation team
- Coordination with industry and government stakeholders
- Documented method for determining root cause of the event
- Documented description of the investigative review process
- Detail/explanation on how applicable supporting analysis will be performed
- Periodic updates to the FAA during the course of an investigation

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(e) *Mishap investigation requirements.* In the event of a mishap, an operator must—

- (1) Investigate the root causes of the mishap; and
- (2) Report investigation results to the FAA.

(f) *Preventative measures.* An operator must identify and implement preventive measures for avoiding recurrence of the mishap prior to the next flight, unless otherwise approved by the Administrator.

(g) *Mishap Records.* An operator must maintain records associated with the mishap in accordance with § 450.219(b).



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(e) *Mishap investigation requirements.* In the event of a mishap, an operator must—

- (1) Investigate the root causes of the mishap; and
- (2) Report investigation results to the FAA.

(f) *Preventative measures.* An operator must identify and implement preventive measures for avoiding recurrence of the mishap prior to the next flight, unless otherwise approved by the Administrator.

(g) *Mishap Records.* An operator must maintain records associated with the mishap in accordance with § 450.219(b).

Preventative measures or corrective actions should not only address technical root causes, but also organizational root causes.

The FAA may make a public safety determination authorizing an operator to return to flight prior to implementing preventative measures if no public safety risks are identified.



Part 450 – Other Prescribed Hazard Controls

§ 450.173 Mishap Plan—Reporting, Response, and Investigation Requirements.

(h) *Application requirements.* An applicant must submit the plan or other written means required by this section.

Further explanation and details on how to comply with § 450.173 will be included in AC 450.173-1 “Mishap Reporting, Response, and Investigation.” Planned issuance is Q1 2021.

Part 450 – Other Prescribed Hazard Controls

Mishap Plan Summary

- One size fits all, single mishap plan submittal satisfies the requirements of §§ 420.59(a), 437.41, and 450.173 – Mishap plan
- Mishap plan signature requirement removed
- Provides for the allocation of roles and responsibilities between launch and site operators
- All mishap notifications to common source, FAA Washington Operations Center
- Preliminary five-day written report due for all mishaps
- Removes requirement to report to and cooperate with FAA and NTSB investigations
- Requires implementation of preventative measures prior to next flight, unless otherwise approved
- Plan or other written means submittal acceptable

Q&A



Test-Induced Damage Overview

- An optional process allowing a license applicant or licensee to coordinate potential test-induced damages with the FAA prior to the planned test activity taking place.
- Some tests are designed and intended to result in failures, other tests are aggressive in nature and damage often occurs.
- Any test failure covered by this section would be considered test-induced damage and not a mishap, so long as the failure falls within the pre-coordinated and FAA-approved testing profile.
- This process is similar to NASA's test-induced damages process.
 - As defined in NPR 8621.1C (NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping), and
 - Tailored to satisfy the FAA's public safety mission.

Part 450 – Other Prescribed Hazard Controls

The test-induced damage exception is optional and a license applicant or licensee is not be required to take this path. However, absent a test-induced damage exception, the FAA would categorize an unplanned event during licensed test activities a mishap.

The FAA does not intend the test-induced damage exception to apply to the operation of an entire vehicle, but rather the testing of specific components and systems. However, the FAA recognizes that the testing of specific components could result in significant damage to, or loss of a vehicle.

§ 450.175 Test-induced damage.

(a) *Applicability.* This section applies to license applicants or operators seeking an optional test-induced damage exception.



Part 450 – Other Prescribed Hazard Controls

Test-induced damage exception requires an operator to coordinate test activities with and obtain approval from the FAA before the planned activity. Coordinated with sufficient time for the FAA to evaluate the proposal during the license application or modification process

Any event involving a serious injury or fatality, damage to property not associated with the licensed activity, or hazardous debris leaving the predefined hazard area would be treated as a mishap.

The FAA will consider damages resulting from test activities that fall outside the scope of approved activity (e.g., before scheduled test activities begin or exceeding operation limits) as a mishap

§ 450.175 Test-induced damage.

(b) *Coordination of potential test-induced damage.*
Test-induced damage is not a mishap if all of the following are true:

- (1) A license applicant or operator coordinates potential test-induced damage with the FAA before the planned activity, and with sufficient time for the FAA to evaluate the operator's proposal during the application process or as a license modification;
- (2) The test-induced damage did not result in any of the following:
 - (i) Serious injury or fatality (as defined in 49 CFR 830.2);
 - (ii) Damage to property not associated with the licensed activity; or
 - (iii) Hazardous debris leaving the pre-defined hazard area; and
- (3) The test-induced damage falls within the scope of activities coordinated with the FAA in paragraph (b)(1) of this section.



Part 450 – Other Prescribed Hazard Controls

To seek an exception, an applicant must submit the information listed in § 450.175(c). Although the FAA anticipates the amount of time required to evaluate an applicant's proposal will be minimal, the scope of review required will vary based on the proposed test activities and completeness of information provided.

Test objectives:

- The applicant should submit test objectives in a complete, clear, and concise manner to help the FAA distinguish between nominal operations and specific test objectives.

§ 450.175 Test-induced damage.

(c) *Application requirements.* An applicant must submit the following information—

(1) Test objectives;

- (2) Test limits;
- (3) Expected outcomes;
- (4) Potential risks, including the applicant's best understanding of the uncertainties in environments, test limits, or system performance;
- (5) Applicable procedures;
- (6) Expected time and duration of the test; and
- (7) Additional information as required by the FAA to ensure protection of public health and safety, safety of property, and the national security and foreign policy interests of the United States.



Part 450 – Other Prescribed Hazard Controls

§ 450.175 Test-induced damage.

(c) *Application requirements.* An applicant must submit the following information—

Test limits, including:

- expected environments,
- personnel,
- equipment, or
- environmental limits.

Expected outcomes:

- The applicant needs to identify expected outcomes for later comparison to actual outcomes.

(1) Test objectives;

(2) Test limits;

(3) Expected outcomes;

(4) Potential risks, including the applicant's best understanding of the uncertainties in environments, test limits, or system performance;

(5) Applicable procedures;

(6) Expected time and duration of the test; and

(7) Additional information as required by the FAA to ensure protection of public health and safety, safety of property, and the national security and foreign policy interests of the United States.



Part 450 – Other Prescribed Hazard Controls

§ 450.175 Test-induced damage.

(c) *Application requirements.* An applicant must submit the following information—

Potential risks, including:

- Applicant's best understanding of the uncertainties in environments,
- test limits, or
- system performance.

Applicable procedures or steps taken to execute the tests and the expected time and duration of the test would also be required.

- (1) Test objectives;
- (2) Test limits;
- (3) Expected outcomes;

(4) Potential risks, including the applicant's best understanding of the uncertainties in environments, test limits, or system performance;

(5) Applicable procedures;

(6) Expected time and duration of the test; and

(7) Additional information as required by the FAA to ensure protection of public health and safety, safety of property, and the national security and foreign policy interests of the United States.



Test-Induced Damage Summary

- Test-induced damage exception process:
 - Optional process
 - Is responsive to FAA Aviation Rulemaking Committee (ARC) and industry testing comments,
 - Recognizes the differences between operational missions and higher risk experimental or test missions,
 - Allows the operator and FAA to reach a common understanding of what events would be categorized as test-induced damage or a mishap,
 - Allows test failures without need for protracted mishap investigation, saving time and money, and
 - Eliminates mishap notification and reporting requirements.



Q&A





On Break

**Next Session Starts at
1:40 PM EST**

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**Federal Aviation
Administration**

Ground Safety



Ground Safety — General

In § 450.179 an operator would be required to protect the public from the adverse effects of hazardous operations and systems associated with preparing a launch vehicle for flight, returning a launch or reentry vehicle to a safe condition after flight, or after an aborted launch attempt, and returning a site to a safe condition.

Explanation and details on how to comply with § 450.179 will be included in AC 450.179-1, “Ground Safety.” Planned issuance is Q3 2021.

§ 450.179 Ground Safety—General.

(a) At a U.S. launch or reentry site, an operator must protect the public and property from adverse effects of hazardous operations and systems associated with—

- (1) Preparing a launch vehicle for flight;
- (2) Returning a launch or reentry vehicle to a safe condition after landing, or after an aborted launch attempt; and
- (3) Returning a site to a safe condition.

(b) An operator is not required to comply with §§ 450.181 through 450.189 of this part if:

- (1) The launch or reentry is being conducted from a Federal launch or reentry site;
- (2) The operator has a written agreement with the Federal launch or reentry site for the provision of ground safety services and oversight; and
- (3) The Administrator has determined that the Federal launch or reentry site’s ground safety processes, requirements, and oversight are not inconsistent with the Secretary’s statutory authority over commercial space activities.

(c) In making the determination required by subparagraph (b)(3), the Administrator will consider the nature and frequency of launch and reentry activities conducted from the Federal launch or reentry site, coordination between the FAA and the Federal launch or reentry site safety personnel, and the Administrator’s knowledge of the Federal launch or reentry site’s requirements.



Ground Safety — § 450.179(b)

An operator need not comply with ground safety requirements contained in §§ 450.181 through 450.189 if the conditions in § 450.179(b) are met. The FAA preserves its statutory jurisdiction over those ground safety activities that are part of launch and reentry, but recognizes certain Federal processes and procedures as sufficient to meet the FAA's mandate. This responds to the direction of SPD-2, the National Space Council, and the recommendation of the ARC to address duplicative requirements across Federal agencies for commercial space licensing.

§ 450.179(b)

(b) **An operator is not required to comply with §§ 450.181 through 450.189 of this part if:**

- (1) The launch or reentry is being conducted from a Federal launch or reentry site;
- (2) The operator has contracted with the Federal launch or reentry site for the provision of ground safety services and oversight; and
- (3) The Administrator has determined that the Federal launch or reentry site's ground safety processes, requirements, and oversight are not inconsistent with the Secretary's statutory authority over commercial space activities.



Ground Safety — MOA

If a site meets the conditions in §§ 450.179(b) & (c), the FAA will develop Memorandum of Agreement (MOA) with approved site and publish MOA on FAA's website. If these conditions are met, operator can seek FAA permission during pre-application consultation to comply only with ground safety regulations imposed by the Federal site.

For Federal launch or reentry sites or other Federal entities that do not satisfy the conditions in § 450.179(b), the final rule retains the LSSA-like process in accordance with § 450.45(b).

§ 450.179(b) & (c)

(b) An operator is not required to comply with §§ 450.181 through 450.189 of this part if:

- (1) The launch or reentry is being conducted from a Federal launch or reentry site;
- (2) The operator has contracted with the Federal launch or reentry site for the provision of ground safety services and oversight; and
- (3) The Administrator has determined that the Federal launch or reentry site's ground safety processes, requirements, and oversight are not inconsistent with the Secretary's statutory authority over commercial space activities.

(c) In making the determination required by subparagraph (b)(3), the Administrator will consider the nature and frequency of launch and reentry activities conducted from the Federal launch or reentry site, coordination between the FAA and the Federal launch or reentry site safety personnel, and the Administrator's knowledge of the Federal launch or reentry site's requirements.

Separate from part 450, FAA has a **ground safety policy** that establishes FAA's policy applicable to waivers of FAA ground safety requirements for licensed commercial launch and reentry activities at CCAFS, VAFB, KSC, and WFF. Furthermore, FAA prepared a draft launch site safety assessment of NASA KSC ground safety requirements.



Coordination with a Site Operator

In § 450.181, Operators are required to coordinate with site operators to ensure that access to public sites is controlled and prevent unsafe interference of ground hazards. For a launch or reentry conducted from or to an FAA licensed site, an operator is required to coordinate mishap reporting, response, and investigations with the site operator for any mishap during ground activities at the site. Improperly coordinated neighboring operations that occur on or near the launch site have the ability to create hazards to the public.

§ 450.181 Coordination with a Site Operator.

- (a) *General.* For a launch or reentry conducted from or to a Federal launch or reentry site or a site licensed under parts 420 or 433 of this chapter, an operator must coordinate with the site operator to —
- (1) Ensure public access is controlled where and when necessary to protect public safety;
 - (2) Ensure launch or reentry operations are coordinated with other launch and reentry operators and other affected parties to prevent unsafe interference;
 - (3) Designate any ground hazard area that affects the operations of a launch or reentry site; and
 - (4) Ensure a prompt and effective response is undertaken in the event of a mishap that could impact the safety of the public and property.
- (b) *Licensed site operator.* For a launch or reentry conducted from or to a site licensed under parts 420 or 433 of this chapter, an operator must also coordinate with the site operator to establish roles and responsibilities for reporting, responding to, and investigating any mishap during ground activities at the site.
- (c) *Application requirement.* An applicant must describe how it is coordinating with a Federal or licensed launch or reentry site operator in compliance with this section.



Explosive Site Plan

§ 450.183 requires an applicant to include an explosive site plan as part of its vehicle operator license application for a launch or reentry from or to a site exclusive to its own use. This plan would be required to demonstrate compliance with the explosive siting requirements in part 420.

§ 450.183 Explosive Site Plan.

- (a) *Explosive siting requirements.* For a launch or reentry conducted from or to a site exclusive to its own use, an operator must comply with the explosive siting requirements of §§ 420.63, 420.65, 420.66, 420.67, 420.69, and 420.70 of this chapter.
- (b) *Application requirement.* An applicant must submit an explosive site plan in accordance with paragraph (a) of this section.

Explanation and details on how to comply with § 450.183 will be included in AC 450.179-1, “Ground Safety.” Planned issuance is Q3 2021.



Ground Hazard Analysis

§ 450.185 requires an operator to complete a ground hazard analysis that includes an assessment of the launch or reentry vehicle, the launch or reentry integrated systems, ground support equipment, and other site hardware. The analysis must identify hazards; include a risk assessment; and identify and describe mitigations, controls, and provisions for hazard control verification and validation.

Explanation and details on how to comply with § 450.185 will be included in AC 450.179-1, “Ground Safety.” Planned issuance is Q3 2021.

§ 450.185 Ground Hazard Analysis.

An operator must perform and document a ground hazard analysis, and continue to maintain it throughout the lifecycle of the launch or reentry system. The analysis must—

(a) *Hazard identification.* Identify system and operation hazards posed by the vehicle and ground hardware, including site and ground support equipment. Hazards identified must include the following:

(1) **System hazards**, including:

(i) Vehicle over-pressurization; (ii) Sudden energy release, including ordnance actuation; (iii) Ionizing and non-ionizing radiation; (iv) Fire or deflagration; (v) Radioactive materials; (vi) Toxic release; (vii) Cryogenics; (viii) Electrical discharge; and (ix) Structural failure.

(2) **Operation hazards**, including:

(i) Propellant handling and loading; (ii) Transporting of vehicle or vehicle components; (iii) Vehicle testing; and (iv) Vehicle or system activation.



Ground Hazard Analysis

Operator must conduct a risk assessment to evaluate each hazard to determine likelihood and severity of that hazard.

Operator must identify mitigations or controls to eliminate or mitigate severity or likelihood of identified hazards to meet qualitative thresholds of § 450.185(c).

A hazard control is a preventative or mitigation measure that reduces likelihood of the hazard or ameliorates its severity.

§ 450.185 Ground Hazard Analysis.

(b) *Hazard assessment.* Assess each hazard's **likelihood and severity**.

(c) **Risk acceptability criteria.** Ensure that the risk associated with each hazard meets the following criteria:

- (1) The likelihood of any hazardous condition that may cause death or serious injury to the public **must be extremely remote**; and (2) The likelihood of any *hazardous* condition that may cause major damage to property not associated with the launch or reentry **must be remote**.

(d) *Risk mitigation.* Identify and describe the **risk elimination and mitigation measures** required to satisfy paragraph (c) of this section.

(e) **Validation and verification.** Document that the risk elimination and mitigation measures achieve the risk levels of paragraph (c) of this section through validation and verification. Verification includes:

- (1) Analysis; (2) Test; (3) Demonstration; or (4) Inspection.

(f) *Application requirements.* An applicant must submit—

- (1) A description of the methodology used to perform the ground hazard analysis; (2) A list of all systems and operations that may cause a hazard involving the vehicle or any payload; and (3) The ground hazard analysis products of paragraphs (a) through (e) of this section, including data that verifies the risk elimination and mitigation measures.



Q&A



Toxic Hazards Mitigation for Ground Operations

§ 450.35(a) requires prior to application acceptance, a means of compliance must be approved by the Administrator for the following:

- (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.

§ 450.187(a) creates an exception from the toxic release hazard analysis for kerosene-based fuels unless the Administrator determines that an analysis is necessary to protect the public safety. FAA anticipates that such an analysis will be required for uses of kerosene-based fuels that are novel or inconsistent with standard industry practices.

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(a) Applicability.

- (1) Except as specified in paragraph (a)(2), this section applies to any launch or reentry vehicle, including all vehicle components and payloads, that use toxic propellants or other toxic chemicals.
- (2) No toxic release hazard analysis is required for kerosene-based fuels, unless the Administrator determines that an analysis is required to protect public safety.

Although there are similarities, toxic hazards are divided into two sections because ground operations and flight operations have different criteria to establish an acceptable level of safety:
§ 450.139 (*Toxic Hazards for Flight*) &
§ 450.187 (*Toxic Hazards Mitigation for Ground Operations*)



Toxic Hazards Mitigation for Ground Operations

§ 450.187(b), like § 450.139(b), requires an operator to manage the risk of casualties from exposure to toxic release by either containing the hazards or performing a toxic risk assessment.

Explanation and details on how to comply with § 450.187 will be included in AC 450.139-1, “Toxic Hazards Analysis and Thresholds.” Planned issuance is Q3 2021.

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(b) *General.* An operator must—

- (1) Conduct a toxic release hazard analysis in accordance with paragraph (c) of this section;
- (2) Manage the risk of casualties that could arise from the exposure to toxic release through **one of the following means**:
 - (i) **Contain hazards** caused by toxic release in accordance with paragraph (d) of this section; or
 - (ii) **Perform a toxic risk assessment**, in accordance with paragraph (e) of this section, that demonstrates compliance with the risk criteria of § 450.185(c).
- (3) Establish ground hazard controls based on the results of its toxic release hazard analysis and toxic containment or toxic risk assessment for any necessary evacuation of the public from any toxic hazard area.



Toxic Hazards Mitigation for Ground Operations

§ 450.187(d) requires an operator to manage the risk of casualty from the exposure to toxic release either by evacuating, or being prepared to evacuate, the public from a toxic hazard area, or by employing meteorological constraints. In either scenario, the operator would be required to ensure that the public will not be within a toxic area in the event of a worst-case release or maximum credible release scenario.

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(c) *Toxic release hazard analysis.* A toxic release hazard analysis must—

- (1) Account for any toxic release that could occur during nominal or non-nominal launch or reentry ground operations;
- (2) Include a worst-case release scenario analysis or a maximum-credible release scenario analysis for each process that involves a toxic propellant or other chemical;
- (3) Determine if toxic release can occur based on an evaluation of the chemical compositions and quantities of propellants, other chemicals, vehicle materials, and projected combustion products, and the possible toxic release scenarios;
- (4) Account for both normal combustion products and any unreacted propellants and phase change or chemical derivatives of released substances; and
- (5) Account for any operational constraints and emergency procedures that provide protection from toxic release.

(d) *Toxic containment.* An operator using toxic containment must manage the risk of casualty from the exposure to toxic release either by—

- (1) Evacuating, or being prepared to evacuate, the public from any toxic hazard area in the event of a worst-case release or maximum credible release scenario; or
- (2) Employing meteorological constraints to limit a ground operation to times during which prevailing winds and other conditions ensure that the public would not be exposed to toxic concentrations and durations greater than accepted toxic thresholds for acute casualty in the event of a worst-case release or maximum credible release scenario.



Toxic Hazards Mitigation for Ground Operations

§ 450.187(e) contains the requirements for a toxic risk assessment for ground operations. An operator complies with the requirements for a toxic risk assessment by demonstrating no more than an extremely remote likelihood of toxic exposure causing death or serious injury to the public, using toxic concentration and duration thresholds accepted by the Administrator as a means of compliance.

An example of a means of compliance for § 450.187(e)(1) can be found in Acute Exposure Guideline Level 2 (AEGLE-2), Emergency Response Planning Guidelines Level 2 (ERPG-2), or, Short-term Public Emergency Guidance Level (SPEGL)

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(e) *Toxic risk assessment.* An operator using toxic risk assessment must manage the risk from any toxic release hazard and **demonstrate compliance with the criteria in § 450.185(c)**. A toxic risk assessment must—

- (1) Account for airborne concentration and duration thresholds of toxic propellants or other chemicals. For any toxic propellant, other chemicals, or combustion product, an operator must use airborne toxic concentration and duration thresholds identified in a means of compliance accepted by the Administrator;
- (2) Account for physical phenomena expected to influence any toxic concentration and duration in the area surrounding the potential release site;
- (3) Determine a toxic hazard area for each process surrounding the potential release site for each toxic propellant or other chemical based on the amount and toxicity of the propellant or other chemical, the exposure duration, and the meteorological conditions involved;
- (4) Account for all members of the public that may be exposed to the toxic release; and
- (5) Account for any risk mitigation measures applied in the risk assessment.



Toxic Hazards Mitigation for Ground Operations

If a toxic risk assessment is performed, applicant must account for public that may be exposed to airborne concentrations above toxic concentration and duration thresholds, describe any risk mitigations applied in toxic risk assessment, describe the population exposure input data used in accordance with § 450.123 (Population Exposure Analysis), and demonstrate compliance with applicable public risk criteria (for flight, the risk criteria in § 450.101; for ground operations, the risk criteria in § 450.185(c)).

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(f) *Application requirements.* An applicant must submit:

- (1) The identity of the toxic propellant, chemical, or combustion products or derivatives in the possible toxic release;
- (2) The applicant's selected airborne toxic concentration and duration thresholds;
- (3) The meteorological conditions for the atmospheric transport and buoyant cloud rise of any toxic release from its source to downwind receptor locations;
- (4) Characterization of the terrain, as input for modeling the atmospheric transport of a toxic release from its source to downwind receptor locations;
- (5) The identity of the toxic dispersion model used, and any other input data;
- (6) Representative results of an applicant's toxic dispersion modeling to predict concentrations and durations at selected downwind receptor locations, to determine the toxic hazard area for a released quantity of the toxic substance;



Toxic Hazards Mitigation for Ground Operations

If a toxic risk assessment is performed, applicant must account for public that may be exposed to airborne concentrations above toxic concentration and duration thresholds, describe any risk mitigations applied in toxic risk assessment, describe the population exposure input data used in accordance with § 450.123 (Population Exposure Analysis), and demonstrate compliance with applicable public risk criteria (for ground operations, the risk criteria in § 450.185(c)).

§ 450.187 Toxic Hazards Mitigation for Ground Operations.

(f) *Application requirements.* An applicant must submit:

(7) For toxic release hazard analysis in accordance with paragraph (c) of this section:

- (i) A description of the failure modes and associated relative probabilities for potential toxic release scenarios used in the risk evaluation; and
- (ii) The methodology and representative results of an applicant's determination of the worst- case or maximum-credible quantity of any toxic release that might occur during ground operations;

(8) For toxic containment in accordance with paragraph (d) of this section, identify the evacuation plans or meteorological constraints and associated ground hazard controls needed to ensure that the public will not be within any toxic hazard area in the event of a worst-case release or maximum credible release scenario.

(9) For toxic risk assessment in accordance with paragraph (e) of this section:

- (i) A demonstration that the risk criteria in § 450.185(c) will be met;
- (ii) The population characteristics in receptor locations that are identified by toxic dispersion modeling as toxic hazard areas;
- (iii) A description of any risk mitigation measures applied in the toxic risk assessment; and
- (iv) A description of the population exposure input data used in accordance with § 450.123.



Ground Safety Prescribed Hazard Controls

In § 450.189, the FAA requires an operator implement certain prescribed hazard controls during ground operations, in addition to hazard controls derived from ground and toxic hazard analyses.

Explanation and details on how to comply with § 450.189 will be included in AC 450.179-1, “Ground Safety.” Planned issuance is Q3 2021.

§ 450.189 Ground Safety Prescribed Hazard Controls.

(a) *General.* In addition to the hazard controls derived from an operator’s ground hazard analysis and toxic hazard analysis, an operator must comply with paragraphs (b) through (e) of this section.

(b) *Protection of public on the site.* An operator must document a process for protecting members of the public who enter any area under the control of a launch or reentry operator, including:

- (1) Procedures for identifying and tracking the public while on the site; and
- (2) Methods the operator uses to protect the public from hazards in accordance with the ground hazard analysis and toxic hazard analysis.



Ground Safety Prescribed Hazard Controls

These prescribed hazard controls require an operator document how it would protect members of the public who enter areas under the operator's control, and mitigate hazards created by a countdown abort. They also require operator to establish plans for controlling fires and emergency procedures.

§ 450.189 Ground Safety Prescribed Hazard Controls.

(c) *Countdown abort.* Following a countdown abort or recycle operation, an operator must establish, maintain, and perform procedures for controlling hazards related to the vehicle and returning the vehicle, stages, or other flight hardware and site facilities to a safe condition. When a launch vehicle does not liftoff after a command to initiate flight was sent, an operator must—

- (1) Ensure that the vehicle and any payload are in a safe configuration;
- (2) Prohibit entry of the public into any identified hazard areas until the site is returned to a safe condition; and
- (3) Maintain and verify that any flight safety system remains operational until verification that the launch vehicle does not represent a risk of inadvertent flight.

(d) *Fire suppression.* An operator must have reasonable precautions in place to report and control any fire caused by licensed activities.

(e) *Emergency procedures.* An operator must have general emergency procedures that apply to any emergencies not covered by the mishap plan of § 450.173 that may create a hazard to the public.

(f) *Application requirement.* An applicant must submit the process for protecting members of the public who enter any area under the control of a launch or reentry operator in accordance with paragraph (b) of this section.



Part 450 Ground Safety Summary

- Part 431 does not have explicit ground safety requirements, and the ground safety requirements in part 417 are overly prescriptive and onerous.
 - Ground hazard analysis requirements in part 450 strike a balance between the two parts, providing additional guidance to applicants, while at the same time preserving flexibility.
- An operator need not comply with ground safety requirements contained in part 450 if the conditions in § 450.179(b) are met.
 - FAA preserves its statutory jurisdiction over those ground safety activities that are part of launch and reentry, but recognizes certain Federal processes and procedures as sufficient to meet the FAA's mandate.
 - Relieves duplication for Ground Safety at certain federal launch or reentry sites.
- Separate from part 450, FAA has a ground safety policy that establishes FAA's policy applicable to waivers of FAA ground safety requirements for licensed commercial launch and reentry activities at certain Federal ranges.
 - Federal ranges that currently meet the criteria for application of this policy are CCAFS, VAFB, KSC, and WFF.



Part 450 Ground Safety Summary

- Part 450 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 activities occurring between launches of reusable vehicles will not be considered hazardous pre-flight activities if the vehicle is in a safe and dormant state.
- Toxic hazards are divided into two sections (§§ 450.139 & 450.187) because flight and ground operations have different criteria to establish an acceptable level of safety:
 - A toxic risk assessment for flight must demonstrate that the **quantitative** safety criteria (e.g., 1×10^{-4}) in § 450.101, which includes risk posed by toxic release, is met.
 - A toxic risk assessment for ground operations must demonstrate the **qualitative** risk criteria (e.g., extremely remote) in § 450.185(c) will be met.



Q&A





On Break

**Next Session Starts at
2:50 PM EST**

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**Federal Aviation
Administration**

Subpart D – Terms and Conditions of a Vehicle Operator License



Public Safety Responsibility

§ 450.201 consolidates the public safety responsibility requirements in current §§ 417.7 and 431.71(a).

§ 450.201 Public Safety Responsibility.

A licensee is responsible for ensuring public safety and safety of property during the conduct of a licensed launch or reentry.



Compliance with License

§ 450.203 requirement for a licensee to conduct a licensed launch or reentry in accordance with representations made in its license application is the same, in substance, to §§ 417.11(a) and 431.71(b).

§ 450.203 Compliance with License.

A licensee must conduct a licensed launch or reentry in accordance with representations made in its license application, the requirements of subparts C and D of this part, and the terms and conditions contained in the license. A licensee's failure to act in accordance with the representations made in the license application, the requirements of subparts C and D of this part, and the terms and conditions contained in the license, is sufficient basis for the revocation of a license or other appropriate enforcement action.



Financial Responsibility Requirements

§ 450.205 addresses how a licensee is responsible for financial responsibility requirements of part 440.

§ 450.205 consolidates the current financial responsibility requirements in §§ 417.21 and 431.81.

§ 450.205 Financial Responsibility Requirements.

A licensee must comply with financial responsibility requirements as required by part 440 of this chapter and as specified in a license or license order.



Human Spaceflight Requirements

§ 450.207 addresses how a licensee is responsible for human spaceflight requirements in part 460.

§ 450.207 consolidates the human spaceflight requirements in current §§ 415.8, 431.8, and 435.8.

§ 450.207 Human Spaceflight Requirements.

A licensee conducting a launch or reentry with a human being on board the vehicle must comply with human spaceflight requirements as required of part 460 of this chapter and as specified in a license or license order.



Compliance Monitoring

The compliance monitoring requirements of § 450.209 apply to all launch and reentry operations. § 450.209 combines the compliance monitoring requirements of §§ 417.23, 431.83, and 435.51.

Unlike § 450.20(b) and § 417.23, § 431.83 does not require a licensee to provide a console to the FAA for monitoring all the channels on the countdown communication network.

§ 450.209 Compliance Monitoring.

(a) A licensee must allow access by, and cooperate with, Federal officers or employees or other individuals authorized by the FAA to observe any of its activities, or any of its contractors' or subcontractors' activities, associated with the conduct of a licensed launch or reentry.

(b) For each licensed launch or reentry, a licensee must provide the FAA with a console for monitoring the progress of the countdown and communication on all channels of the countdown communications network, unless the licensee has another acceptable means. A licensee must also provide the FAA with the capability to communicate with the mission director designated by § 450.103(a)(1).



Continuing Accuracy of License Application; Application for Modification of License

The FAA clarifies that normal pre-flight testing and refurbishment that are evaluated and accepted during a license application are not considered a material change. The FAA further clarifies that only pre-flight testing and refurbishment that is not evaluated during a licensing process would be considered a material change.

§ 450.211 preserves and consolidates the continuing accuracy requirements in §§ 417.11 and 431.73.

§ 450.211 Continuing Accuracy of License Application; Application for Modification of License.

- (a) A licensee is responsible for the continuing accuracy of representations contained in its application for the entire term of the license.
- (b) After a license has been issued, a licensee must apply to the FAA for modification of the license if—
- (1) The licensee proposes to conduct a launch or reentry in a manner not authorized by the license; or
 - (2) Any representation contained in the license application that is material to public health and safety or the safety of property is no longer accurate and complete or does not reflect the licensee's procedures governing the actual conduct of a launch or reentry. A change is material to public health and safety or the safety of property if it alters or affects—
 - (i) The class of payload; (ii) The type of launch or reentry vehicle; (iii) The type or quantity of hazardous material; (iv) The flight trajectory; (v) The launch site or reentry site or other landing site; or (vi) Any system, policy, procedure, requirement, criteria, or standard that is safety critical.



Continuing Accuracy of License Application; Application for Modification of License

§ 450.211 Continuing Accuracy of License Application; Application for Modification of License.

(c) An application to modify a license must be prepared and submitted in accordance with part 413 of this chapter. If requested during the application process, the FAA may approve an alternate method for requesting license modifications. The licensee must indicate any part of its license or license application that would be changed or affected by a proposed modification.

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

§ 450.211(b) allows an applicant to request approval of an alternate method for requesting license modifications during the application process.



Pre-flight Reporting

The FAA requires a licensee to provide the FAA with the following information prior to each launch or reentry: mission-specific information, FSA products, FSS test data, data required by the FAA to conduct a collision avoidance analysis, and a launch or reentry schedule.

As currently required in §§ 417.17(b)(2) and 431.79(a), an operator is required to provide mission information to the FAA not less than 60 days before each mission conducted under the license. Under part 450, the FAA may also agree to a different time frame in accordance with § 404.15.

§ 450.213 Pre-flight Reporting.

(a) *Reporting method.* A licensee must send the information in this section as an email attachment to ASTOperations@faa.gov, or other method as agreed to by the Administrator in the license.

(b) *Mission information.* A licensee must submit to the FAA the following mission-specific information no less than 60 days before each mission conducted under the license, unless the Administrator agrees to a different time frame in accordance with § 404.15 in the license, except when the information was provided in the license application:

- (1) Payload information in accordance with § 450.43(i); and
- (2) Planned mission information, including the vehicle, launch site, planned flight path, staging and impact locations, each payload delivery point, intended reentry or landing sites including any contingency abort location, and the location of any disposed launch or reentry vehicle stage or component that is deorbited.



Pre-flight Reporting

§ 450.213 Pre-flight Reporting.

(c) *Flight abort and flight safety analysis products.* A licensee must submit to the FAA updated flight abort and flight safety analysis products, using methodologies previously approved by the FAA, for each mission no less than 30 days before flight, unless the Administrator agrees to a different time frame in accordance with § 404.15 in the license.

- (1) A licensee is not required to submit the flight abort and flight safety analysis products if—
 - (i) The analysis submitted in the license application satisfies all the requirements of this section; or
 - (ii) The operator demonstrated during the application process that the analysis does not need to be updated to account for mission-specific factors.
- (2) If a licensee is required to submit the flight abort and flight safety analysis products, the licensee—
 - (i) Must account for vehicle- and mission-specific input data;
 - (ii) Must account for potential variations in input data that may affect any analysis product within the final 30 days before flight;
 - (iii) Must submit the analysis products using the same format and organization used in its license application; and
 - (iv) May not change an analysis product within the final 30 days before flight unless the licensee has a process, approved in the license, for making a change in that period as part of the licensee's flight safety analysis process.



Pre-flight Reporting

The FAA is aware that not all test reports for the FSS, such as end-to-end tests and pre-flight tests, can be delivered 30 days before flight.

§ 450.213(d) allows an operator the flexibility to identify an appropriate time frame in coordination with the FAA.

§ 450.213 Pre-flight Reporting.

(d) *Flight safety system test data.* Any licensee that is required by § 450.101(c) to use a flight safety system to protect public safety must submit to the FAA, or provide the FAA access to, any test reports, in accordance with approved flight safety system test plans, no less than 30 days before flight, unless the Administrator agrees to a different time frame in accordance with § 404.15 in the license. These reports must include:

- (1) A summary of the system, subsystem, and component-level test results, including all test failures and corrective actions implemented;
- (2) A summary of test results demonstrating sufficient margin to predicted operating environments;
- (3) A comparison matrix of the actual qualification and acceptance test levels used for each component in each test compared against the predicted flight levels for each environment, including any test tolerances allowed for each test; and
- (4) A clear identification of any components qualified by similarity analysis or a combination of analysis and test.

(e) *Collision avoidance analysis.* A licensee must submit to a Federal entity identified by the FAA and to the FAA the collision avoidance information in Appendix A to Part 450 in accordance with § 450.169(f).

(f) *Launch or reentry schedule.* A licensee must file a launch or reentry schedule that identifies each review, rehearsal, and safety-critical operation. The schedule must be filed and updated in time to allow FAA personnel to participate in the reviews, rehearsals, and safety-critical operations.



Post-Flight Reporting

§ 450.215 requires an operator to provide the actual trajectory flown by the vehicle and, for an unguided suborbital launch vehicle, the actual impact location of all impacting stages and impacting components, if requested by the FAA.

A 90 day post launch report is required by § 417.25. Part 431 does not require operators to submit a post-flight report, but they are required to ensure that all assumptions and representations made in their application are kept accurate and complete, in accordance with §§ 413.7 & 431.73(b)(2).

§ 450.215 Post-Flight Reporting.

(a) A licensee must submit to the FAA the information in paragraph (b) of this section no later than 90 days after a launch or reentry, unless the Administrator agrees to a different time frame in accordance with § 404.15 of this chapter.

(b) A licensee must send the following information as an email attachment to ASTOperations@faa.gov, or other method as agreed to by the Administrator in the license:

- ➔ (1) Any anomaly that occurred during countdown or flight that is material to public health and safety and the safety of property;
- (2) Any corrective action implemented or to be implemented after the flight due to an anomaly or mishap;
- (3) The number of humans on board the vehicle;
- (4) The actual trajectory flown by the vehicle, if requested by the FAA; and
- (5) For an unguided suborbital launch vehicle, the actual impact location of all impacting stages and impacting components, if requested by the FAA.



Registration of Space Objects

§ 450.217 consolidates the requirements for the registration of space objects that currently reside in §§ 417.19 and 431.85.

§ 450.217 adds a requirement for an operator to provide ownership and country of ownership of the space object.

§ 450.217 Registration of Space Objects.

(a) To assist the U.S. Government in implementing Article IV of the 1975 Convention on Registration of Objects Launched into Outer Space, each licensee must submit to the FAA the information required by paragraph (b) of this section for all objects placed in space by a licensed launch, including a launch vehicle and any components, except any object owned and registered by the U.S. Government.

(b) For each object that must be registered in accordance with this section, not later than 30 days following the conduct of a licensed launch, a licensee must file the following information:

- (1) The international designator of the space object;
- (2) Date and location of launch;
- (3) General function of the space object;
- (4) Final orbital parameters, including:
 - (i) Nodal period;
 - (ii) Inclination;
 - (iii) Apogee;
 - (iv) Perigee; and
- (5) Ownership, and country of ownership, of the space object.

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



Records

§ 450.219 consolidates current record requirements in § 417.15 and 431.77. It requires a licensee to maintain for 3 years all records, data, and other material necessary to verify that a launch or reentry is conducted in accordance with representations contained in the licensee's application, the requirements of part 450 subparts C and D, and the terms and conditions contained in the license.

§ 450.219 Records.

(a) Except as specified in paragraph (b) of this section, a licensee must maintain for 3 years all records, data, and other material necessary to verify that a launch or reentry is conducted in accordance with representations contained in the licensee's application, the requirements of subparts C and D of this part, and the terms and conditions contained in the license.

(b) For an event that meets any of paragraphs (1) through (5) or paragraph (8) of the definition of "mishap" in § 401.7 of this chapter, a licensee must preserve all records related to the event. Records must be retained until completion of any Federal investigation and the FAA advises the licensee that the records need not be retained. The licensee must make all records required to be maintained under the regulations available to Federal officials for inspection and copying.



Q&A





On Break

**Next Session Starts at
3:35 PM EST**

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**Federal Aviation
Administration**

Crosswalk That Compares Part 450 to Legacy Regulations in Parts 415, 417, 431, and 435



Purpose of Crosswalk

- Crosswalk* maps the Streamlined Launch and Reentry Licensing Requirements rule (viz., part 450) to related or similar legacy regulations in parts 415, 417, 431, and 435.
- Crosswalk is intended to assist operators to transition to part 450.
 - Operators are encouraged to examine part 450 regulations to identify areas in which greater flexibility has been provided from more prescriptive requirements under legacy regulations.
 - Many previously submitted materials will satisfy part 450 requirements; however, operators should not assume submission of previous material will in all instances meet new part 450 requirements.

**Crosswalk table is available at*
https://www.faa.gov/space/streamlined_licensing_process/

Live Demo of Crosswalk Table



When Part 450 Becomes Effective

- Legacy operators holding an active license under parts 415/417, 431, and 435:
 - Must 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.
 - Have five years after effective date of part 450 to come into compliance with entirety of part 450.
 - May continue operating under legacy provisions or initiate transition to part 450.
 - May seek a renewal under legacy provisions, but renewal will only be valid for time that remains between time of issuance of renewal and end of five-year period.
 - May modify its legacy license per §§ 417.11 or 431.73; whether new license modifications need to comply with part 450 is subject to FAA approval on a case-by-case basis.
 - FAA will consider extent and complexity of modification, whether licensee would need to modify multiple parts of application, or if license requires significant reevaluation.



When Part 450 Becomes Effective cont'd

- Applicants with an accepted license application awaiting a license determination:
 - May continue to seek a launch or reentry license to operate under parts 415, 417, 431, or 435.
- Prospective applicants in pre-application consultation:
 - May apply for a license to operate under parts 415, 417, 431, or 435 if license application is accepted no later than 90 days after effective date of part 450.
 - May apply for a vehicle operator license under part 450.

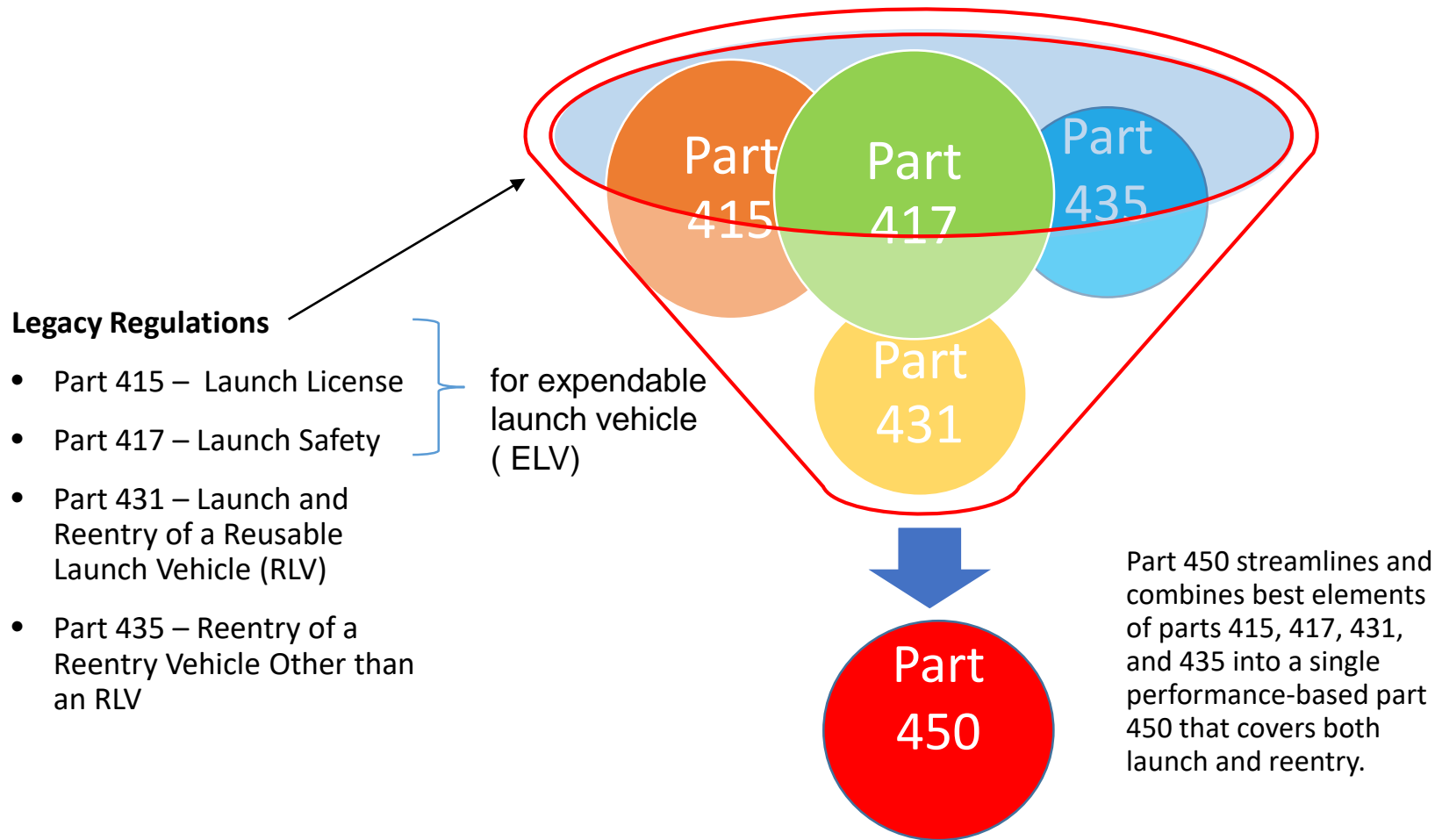


Overall Comparison

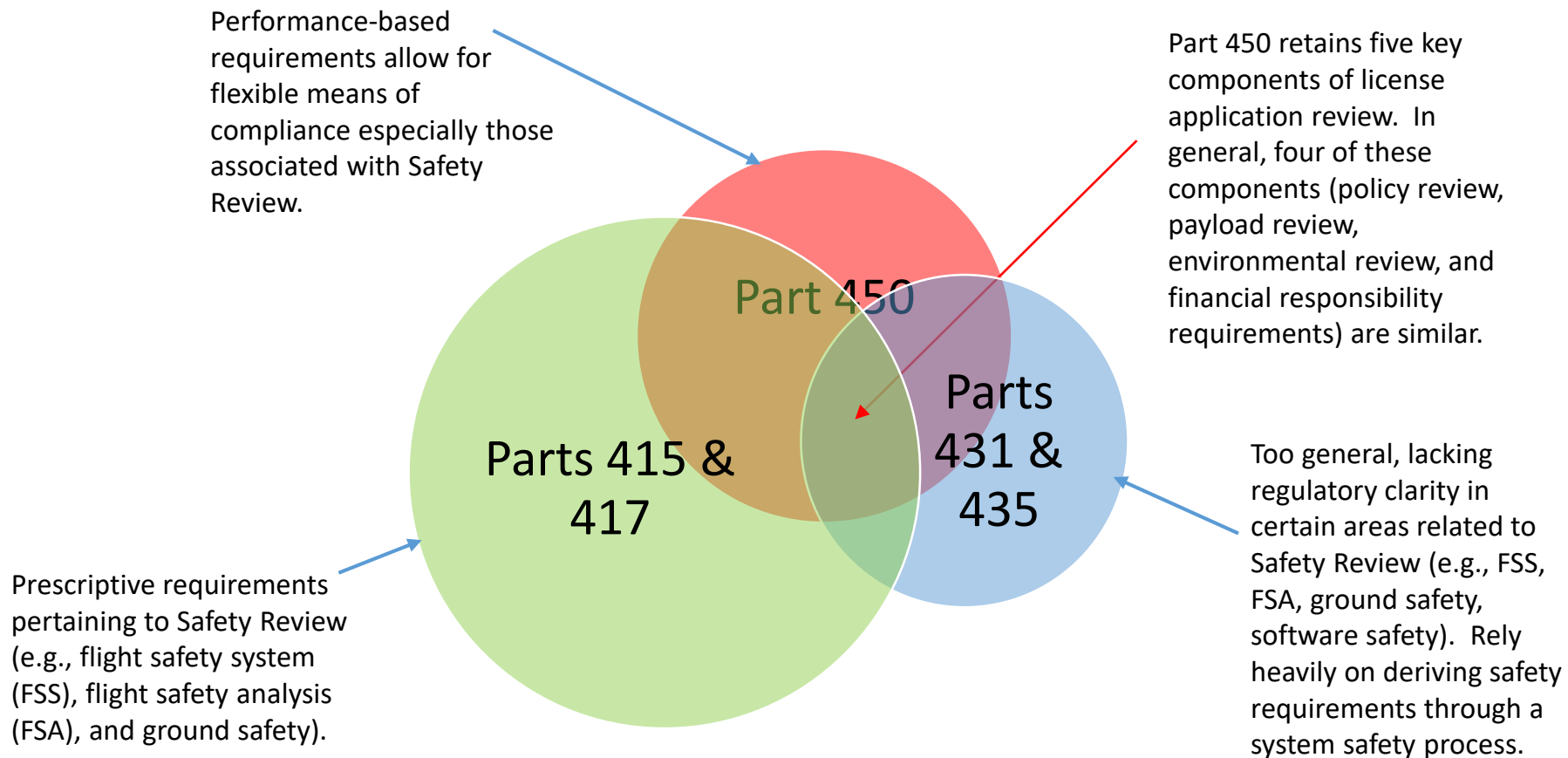
- Performance-based part 450 consolidates, updates, and streamlines requirements currently contained in parts 415 and 417 for the launch of an ELV, in part 431 for launch and reentry of an RLV, and in part 435 for reentry of a reentry vehicle other than an RLV.
- Legacy regulations are based largely on distinction between expendable and reusable launch vehicles.
 - Part 415 and 417 regulations for ELV launches are too prescriptive and are based on Federal launch range standards developed in 1990s.
 - Parts 431 and 435 are primarily process-based, relying on a license applicant to derive safety requirements through a system safety process
 - Regulations in these parts are too general, lacking regulatory clarity in certain areas.
- Part 450 converts many of the legacy prescriptive requirements to more performance-based requirements to allow for flexible means of compliance to accommodate customized operations and evolving technologies.



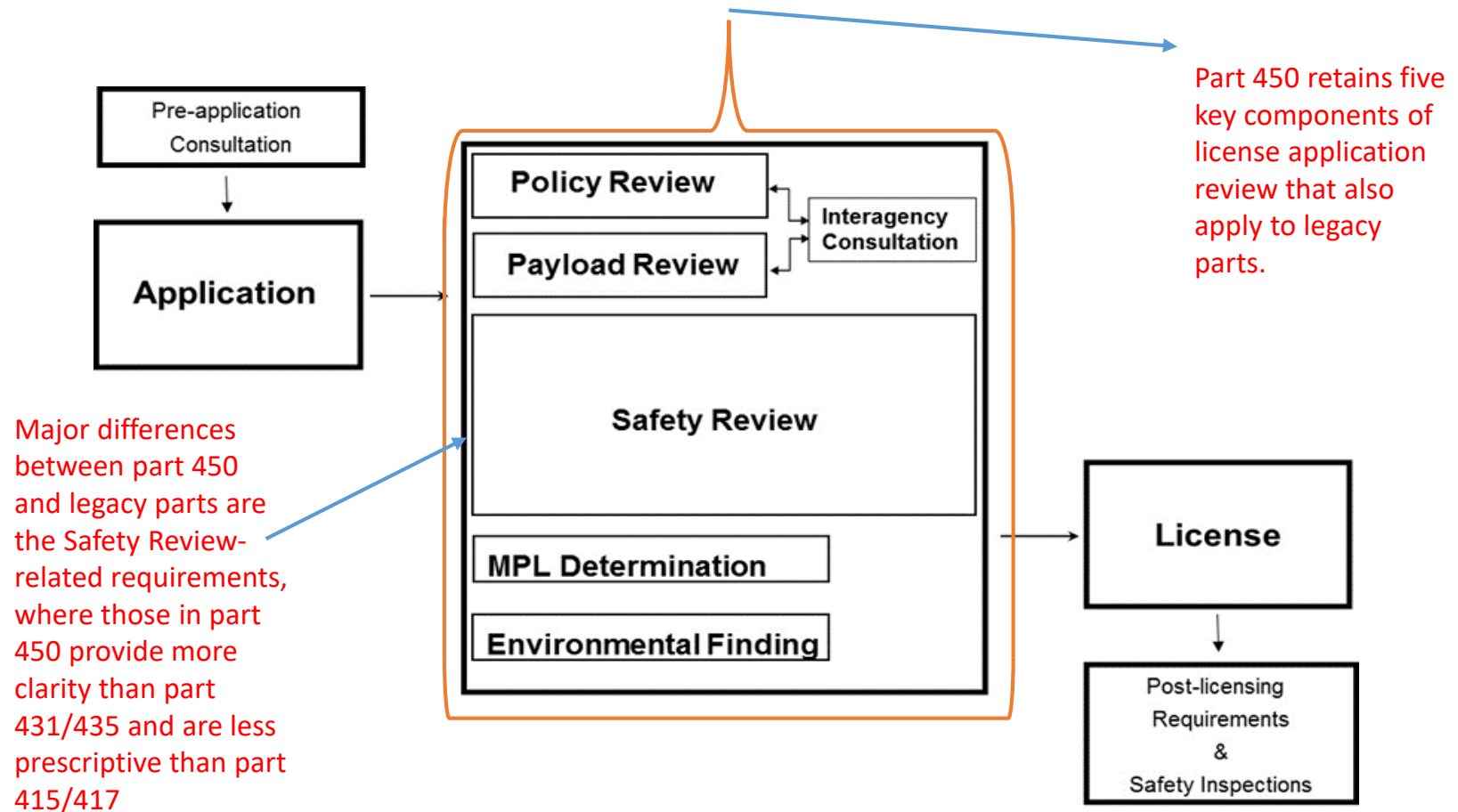
Part 450 Consolidates & Streamlines



Similarities and Differences



Key Components of License Application Review



Overall Comparison

- Part 431 does not contain specificity regarding computing systems, qualification of flight safety systems, acceptable methods for flight safety analysis, and ground safety requirements.
 - At times, FAA used more detailed part 417 requirements to inform parts 431 and 435 or to fill regulatory gaps by adopting part 417 requirements in practice.
- Part 450 incorporates flexibility of parts 431 and 435, but is more explicit in acknowledging acceptability of other hazard control strategies and prescribing certain hazard controls under safety requirements of part 450.
- Part 450 converts many prescriptive requirements of parts 415 and 417 to be more performance-based to allow for flexible means of compliance that accommodate customized operations and evolving technologies.



Crosswalk Flight Safety Analysis Example

Part 417 Subpart C—Flight Safety Analysis

Part 450 Flight Safety Analyses

§ 417.201 Scope and applicability.	→	§ 450.113 Flight Safety Analysis Requirements—Scope.
§ 417.203 Compliance.	→	§ 450.115 Flight Safety Analysis Methods.
§ 417.205 General.	→	§ 450.117 Trajectory Analysis for Normal Flight.
§ 417.207 Trajectory analysis.	→	§ 450.119 Trajectory Analysis for Malfunction Flight.
§ 417.209 Malfunction turn analysis.	→	§ 450.121 Debris Analysis.
§ 417.211 Debris analysis.	→	§ 450.123 Population Exposure Analysis.
§ 417.213 Flight safety limits analysis.	→ §450.108	§ 450.131 Probability of Failure Analysis.
§ 417.215 Straight-up time analysis.	→ §450.108(c)(2)	§ 450.133 Flight Hazard Area Analysis.
§ 417.217 Overflight gate analysis.	→ §450.108(c)(3)	§ 450.135 Debris Risk Analysis.
§ 417.218 Hold-and-resume gate analysis.	→ §§450.108(c)(3)&(4)	§ 450.137 Far-field Overpressure Blast Effects Analysis.
§ 417.219 Data loss flight time and planned safe flight state analyses.	→ §450.108(d)(3)	§ 450.139 Toxic Hazards for Flight
§ 417.221 Time delay analysis.	→ §450.108(d)(4)	
§ 417.223 Flight hazard area analysis.	→	
§ 417.224 Probability of failure analysis.	→	
§ 417.225 Debris risk analysis.	→	
§ 417.227 Toxic release hazard analysis.	→	
§ 417.229 Far-field overpressure blast effects analysis.	→	
§ 417.231 Collision avoidance analysis.	→ §450.169	
§ 417.233 Analysis for an unguided suborbital L/V flown with a wind weighting safety system	→ §450.113	

Parts 431 & 435 lack specificity regarding flight safety analyses.



Crosswalk Safety Criteria Example

Legacy Regulations:

§ 417.107(b) Public risk criteria.

§§ 431.35(a) & (b)
Acceptable reusable launch vehicle mission risk
[refers to § 417.107(b)(1)]

§§ 435.35 Acceptable reusable launch vehicle risk.
[refers to § 417.107(b)(1)]

Launch and Reentry:

- Collective Risk
- Individual Risk

Part 450

§ 450.101 Safety Criteria.

Key provisions 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

Both legacy and part 450 regulations have launch and reentry risk criteria pertaining to collective and individual risks. However, unlike § 450.101, legacy launch and reentry collective risk criteria exclude persons in water-borne vessels. Furthermore, § 450.101 has additional safety criteria (e.g., critical asset) and has separate criteria for NOP as identified above.



Overall Comparison

- Although part 450 may require an operator to conduct of a CEc analysis, which is not currently in parts 415/417, net result from conducting a CEc analysis may be cost savings or less stringent regulatory requirements if analysis shows that an FSS is not needed or one that is less robust than a highly reliable FSS may be adequate.
- Part 450 also 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.
 - Critical assets include property, facilities, or infrastructure necessary to maintain national security, or assured access to space for national priority missions.
 - FAA anticipates that it will perform all critical asset and critical payload risk assessments for commercial space transportation operations involving non-Federal sites.



Flexibilities and Efficiencies Under Part 450

- Vehicle operator license under part 450 may be used to support multiple launches from multiple launch site locations unlike a launch license under part 415/417.
- Applicants may submit an application for a safety review in modules using an incremental review approach approved by the FAA.
- § 404.15 allows an operator to propose reduced document submittal and review period timelines that better suit its operations.
 - Eligible time frames include those for filing a petition for waiver (§ 404.5), demonstration of compliance (§ 440.15), COLA requirements (§ 450.169), pre-flight reporting (§ 450.213), and post-flight reporting (§ 450.215) are listed in Appendix A to part 404.
- Applicants may apply for a safety element approval in conjunction with a vehicle operator license application, making it easier to seek a safety element approval.



Flexibilities and Efficiencies Under Part 450

- Part 450 applies collective and individual risk criteria to people on waterborne vessels, enabling risk management techniques that previously required a waiver.
 - Current practice is to issue waivers to operators as an alternative to scrubbing or delaying a launch or reentry due to waterborne vessels in an area where probability of impact exceeds 1×10^{-5} if collective and individual risk criteria to people on waterborne vessels are met.
- Part 450 carves out neighboring operations personnel (NOP) as a separate category of public subject to a less stringent threshold for risk and financial responsibility (MPL) as compared to other members of the public.
 - NOP would be subject to less stringent individual and collective risk criteria to enable them to remain within safety clear zones and hazardous launch areas during flight as long as their risk did not exceed newly designated thresholds.



Flexibilities and Efficiencies Under Part 450 cont'd

- Part 450 eliminates or modifies requirements for an FSS on some launches by moving from prescriptive and “one-size-fits all” part 417 FSS requirements to performance-based requirements that specify if an FSS is required (§ 450.101 (c)(2) or § 450.101 (c)(3)), and if so, what FSS reliability is needed and when FSS activation (§ 450.108) is required.
 - Part 450 will not require all launch vehicles to have an FSS.
 - Launch vehicles that have a very low probability of multiple casualties even if vehicle control fails will not be required to have as robust an FSS.



Flexibilities and Efficiencies Under Part 450 cont'd

- Efficiencies that may be gained from part 450 include the following:
 - Safety official will need to be in place prior to and throughout any licensed activity, but identifying that individual by name, currently required by § 415.33, is not necessary and not specified in § 450.103, which avoids need to modify a license if name of a safety official were to change.
 - § 450.155 requires an operator to implement procedures to assess readiness to proceed with flight but removes requirements [§§ 417.117(b)(2) & (b)(3)] for a launch safety review no earlier than 15 days before flight and a launch readiness review for flight no earlier than 48 hours before flight.
- § 450.3(b)(1) changes when launch begins by no longer adopting current practice or default that hazardous ground pre-flight operations commence when a launch vehicle or its major components arrive a U.S. launch site.
 - Most prevalent waiver granted to date has been waiver of 14 CFR § 413.3 (b)(1) to obtain a launch license to enable early arrival of flight hardware for preflight ground processing at a U.S. launch site.



Flexibilities and Efficiencies Under Part 450 cont'd

- Part 450 relieves duplication for ground safety at certain federal launch or reentry sites. Under § 450.179 (b), an operator is not required to comply with the ground safety requirements of §§ 450.181 through 450.189 if:
 - Launch or reentry is being conducted from a Federal launch or reentry site;
 - Operator has contracted with the Federal launch or reentry site for ground safety services or oversight; and
 - FAA determined that Federal launch or reentry site's ground safety processes, requirements and oversight are not inconsistent with statutory authority over commercial space activities.



Benefits vs Additional Requirements

Flexibilities and efficiencies that may be acquired under part 450 outweigh a few cases where more documentation may be needed to meet some additional part 450 application requirements, which include the following:

Part 450 Benefits

- More performance based
- Tiered FSS requirements
- Less stringent NOP criteria
- Revised scope of license
- Non-duplication of ground safety at certain federal sites
- Options: alternative time frames, incremental reviews, etc.

*Benefits
outweigh
additional
requirements*

Part 450 Additional Requirements

- Conditional Ec
- Critical assets/critical payloads
- Functional hazard analyses



Crosswalk Summary

- Part 450 streamlines and combines best elements of launch and reentry regulations of parts 415, 417, 431, and 435 into a single performance-based part:
 - Part 431 is not specific enough while parts 415 and 417 are too prescriptive.
 - Part 450 is shorter, less prescriptive, and more performance-based than parts 415 and 417, but it is longer and more specific than parts 431 and 435.
 - Part 450 incorporates traditional hazard control strategies from both part 431 (use of system safety to derive hazard controls) and parts 415 and 417 (use of a flight safety system for flight abort).



Crosswalk Summary

- Many of the current or legacy requirements would serve as a means of compliance to meet performance-based part 450 regulations:
 - FAA anticipates that there would be few, if any, additional requirements that will not be fulfilled by previously submitted information.
 - Although many previously submitted materials will satisfy part 450 requirements, operators should not assume submission of previous material will in all instances meet new part 450 requirements.
- FAA is committed to working with legacy operators to ensure a smooth transition to part 450 by providing pre-application tools, training, advisory circulars, and holding individual sessions to address questions pertaining to unique or specific programs.



Q&A



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