U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Guidance on Submitting a Complete Enough and Complete Application for a Vehicle Operator License

Date: 12-18-2023
Initiated By: AST-1

AC No: 413.11 and 413.13-1

This Advisory Circular (AC) provides guidance on demonstrating compliance with the requirements of completing a license application in accordance with Title 14 of the Code of Federal Regulations (14 CFR) §§ 413.11 and 413.13. It details what constitutes a complete enough submission for application acceptance and a complete submission of an application for a license determination under 14 CFR part 450.

The Federal Aviation Administration (FAA) considers this AC an accepted means of compliance (MOC) for complying with the regulatory requirements of §§ 413.11 and 413.13. This guidance is not legally binding in its own right and will not be relied upon by the FAA as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with the guidance is voluntary only and nonconformity will not affect rights and obligations under existing statutes and regulations.

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.

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1 PURPOSE.

1.1 This Advisory Circular (AC) provides guidance on demonstrating compliance with the requirements of completing a license application in accordance with Title 14 of the Code of Federal Regulations (CFR) §§ 413.11 and 413.13. This document details what constitutes a complete enough submission for application acceptance and a complete submission of an application for a license determination under 14 CFR part 450.

1.1.1 This document is intended as a multi-purpose application checklist for determining the materials necessary for a "complete enough" and "complete" application submission (discussed below). The checklist will indicate application materials that must be included for the FAA to accept an application and begin the 180-day review in accordance with §§ 413.11 and 413.13, respectively. The FAA's acceptance of an application as "complete enough" to begin review does not mean the FAA has determined that the application is complete. The checklist in its entirety constitutes a complete application upon which the FAA can make a final determination. However, once an application is deemed as complete, it does not mean that the FAA has approved or determined the application materials adequately demonstrate compliance. The checklist contains objective criteria to determine whether the application materials for each regulation are complete, posed as a set of objective "yes or no" questions that will facilitate prompt license processing. In some cases, the questions are nearly identical to the application requirements in the regulation; in others, the requirements are parsed in more detail to help applicants provide complete submittals. In addition, a narrative discussion for each application requirement is intended to be helpful for an applicant to consider when preparing its application. These narratives are quite brief; other Advisory Circulars specific to different aspects of the regulation provide much more discussion to help applicants understand and comply with the regulations. The narratives provide beneficial topics to be discussed as part of the pre-application process.

1.1.2 The FAA intends to evaluate license applications in three phases to efficiently process applications. The phases correspond to the logical dependency of the regulation sections (i.e., some sections produce data that is necessary for subsequent sections). The application submissions to be evaluated during Phases 2 and 3 are typically available later in the process as vehicle testing concludes and operational documentation matures closer to flight. The FAA will not begin its evaluation of a phase until all materials identified for that phase are complete. This phased approach is intended to provide greater transparency for the applicant as to the progress of the evaluation. This document explains what is expected during each phase.

1.1.3 Phase 1 requirements include all application submissions necessary for application acceptance, including the FAA's acceptance of the means of compliance (MOC) in accordance with § 450.35. The term "acceptance" is used differently with regard to MOC. FAA acceptance of a MOC is an FAA approval of the MOC rather than acceptance of an application for review. MOC acceptance for the regulations referenced in § 450.35 may take an extended timeframe during pre-application consultation unless the applicant uses a previously accepted MOC. The FAA will only accept an application

when it is complete enough for the FAA to begin its evaluation of the license application in accordance with § 413.11.

1.1.4 Phase 2 requirements should be submitted within 30 days of application acceptance and Phase 3 requirements within 60 days of application acceptance to avoid tolling of the application review period or license denial. At any point in the license review period, the FAA may identify regulatory deficiencies in the application (e.g., if review in a later phase identifies that a previous review was incorrect).

1.1.5 All submitted documents must comply with the requirements in § 450.45(e)(1), should use formatting suitable for technical reports, and should be free from grammatical and cross-referencing errors. All materials should include unambiguous information to track revisions.

1.2 **Level of Imperatives**.

This AC presents one, but not the only, acceptable means of compliance with the associated regulatory requirements. The FAA will consider other means of compliance that an applicant may elect to present. In addition, an operator may tailor the provisions of this AC to meet its unique needs, provided the changes are accepted as a means of compliance by the FAA. Throughout this document, the word "must" characterizes statements that directly follow from regulatory text and therefore reflect regulatory mandates. The word "should" describes a requirement if electing to use this means of compliance; variation from the provisions of this AC is possible, but must satisfy the regulation to constitute an alternative means of compliance. The word "may" describes variations or alternatives allowed within the accepted means of compliance set forth in this AC.

2 APPLICABILITY.

2.1 The guidance in this AC is for launch and reentry vehicle applicants and operators required to comply with 14 CFR part 450, Launch and Reentry License Requirements. The guidance in this AC is for those seeking a launch or reentry vehicle operator license and a licensed operator seeking to renew or modify an existing vehicle operator license.

2.2 The material in this AC is advisory in nature and does not constitute a regulation. This guidance is not legally binding in its own right, and the FAA will not rely upon this guidance as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with this guidance document (as distinct from existing statutes and regulations) is voluntary only, and nonconformity will not affect rights and obligations under existing statutes and regulations.

2.3 The material in this AC does not change or create any additional regulatory requirements, nor does it authorize changes to, or deviations from, existing regulatory requirements.

3 APPLICABLE REGULATIONS AND RELATED DOCUMENTS.

3.1 Applicable United States Code (U.S.C.) Statute.

- 51 U.S.C. Subtitle V, Chapter 509, Commercial Space Launch Activities.

3.2 Related FAA Commercial Space Transportation Regulations.

The following 14 CFR regulations must be accounted for when showing compliance with 14 CFR part 450. The full text of these regulations can be downloaded from the U.S. Government Printing Office e-CFR. A paper copy can be ordered from the Government Printing Office, Superintendent of Documents, Attn: New Orders, P.O. Box 371954, Pittsburgh, PA, 15250-7954.

- Section 401.7, *Definitions.*
- Part 413, *License Application Procedures.*
- Part 440, *Financial Responsibility.*
- Part 450, *Launch and Reentry License Requirements.*
- Part 460, *Human Space Flight Requirements (if applicable).*

Note: FAA Advisory Circulars are available through the FAA website, http://www.faa.gov/.

3.3 Related Industry Documents.

- Department of Defense *Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)*, Instruction Number 5000.61 Change 1, dated October 15, 2018.
- FAA United States Coast Guard Letter of Intent (LOI) Policy Statement. https://www.faa.gov/space/legislationregulationguidance/uscg-letter-intent-loi-policy-statement
- Federal Aviation Administration (FAA), "*Licensing Process*," dated April 6, 2020, available from: https://www.faa.gov/space/streamlined_licensing_process/licensing_process/.
- DOT FAA *Statement of Policy on Waiving Ground Safety Regulations at Cape Canaveral Air Force Station, Vandenberg Air Force Base, Wallops Flight Facility, and Kennedy Space Center*, effective November 3, 2020.
- National Aeronautics and Space Administration (NASA), *NASA Examples of Information to Expedite Review of Commercial Operator Applications to Regulatory Agencies*, dated July 16, 2021, https://www.nasa.gov/recommendations-commercial-space-operators/.
- *Memorandum of Agreement between The Department of the Air Force and the Federal Aviation Administration for Launch and Reentry Activity on Department of the Air Force Ranges and Installation* Agreement Number FAA-DAF-SLR-2021.0

- Risk Committee, Range Safety Group, Range Commanders Council, *Flight Termination Systems Commonality Standard*, RCC 319-19, Aberdeen Test Center, dated June 2019.
- Risk Committee, Range Safety Group, Range Commanders Council, *Common Risk Criteria for National Test Ranges*, RCC 324-11, White Sands, NM dated February 2011.
- Title 49 CFR part 172, (DOT) *Transportation of Hazardous Materials*.

Note: The industry documents referenced in this chapter refer to the current revisions or regulatory authorities' accepted revisions.

4 DEFINITION OF TERMS.

For this AC, the definitions from § 401.7 apply.

5 ACRONYMS.

AC – Advisory Circular

ATO – Air Traffic Organization

CATEX – Categorical Exclusion

CFR – Code of Federal Regulations

CSSI – Computing System Safety Items

DOT – Department of Transportation

EA – Environment Assessment

EIS – Environmental Impact Statement

FAA – Federal Aviation Administration

FSA – Flight Safety Analysis

MOC – Means of Compliance

NASA – National Aeronautics and Space Administration

NM – Nautical miles

NOP – Neighboring Operations Personnel

OMB – Office of Management and Budget

Pc – Probability of Failure

POF – Probability of Failure

RF – Radio Frequency

U.S.C. – United States Code

U.S.G. – United States Government

U.S. – United States

V&V – Validation and Verification

WR – Written Re-evaluation

6 MEANS OF COMPLIANCE.

6.1 Introduction.

6.1.1 A means of compliance (MOC) is the approach used to satisfy a section or subsection of the regulations. Thus, every requirement has a means of compliance. For five topics, the Administrator must accept the MOC prior to an applicant submitting an application. These are listed below, in § 450.35(a), and also referenced within the objective criteria below for each applicable requirement. Because of the complex nature of these requirements, the applicant must submit the MOC for these five topics for FAA acceptance prior to the license application review period. The following means of compliance must be accepted by the Administrator prior to application acceptance:

- § 450.115(b) regarding flight safety analyses;
- § 450.139(e)(1) regarding toxic hazards for flight;
- § 450.145(b) regarding highly reliable flight safety system;
- § 450.163(a)(1) regarding lightning hazard mitigation; and
- § 450.187(e)(1) regarding toxic hazards mitigation for ground operations.

6.1.2 To ensure timely review, applicants proposing to use any means of compliance to satisfy unique safety policies and requirements under § 450.177 should also seek FAA acceptance of their proposed means of compliance prior to submitting their application.

6.1.3 For the purpose of § 450.35(a), the FAA has identified six types of acceptable MOCs:

1. A current Advisory Circular (normally an FAA-approved tailored version),
2. A standard that has been accepted by the FAA, as listed in the *Part 450 Means of Compliance Table*,
3. Services provided by an approved Federal entity per § 450.45(b),
4. A safety element approval per § 450.39,
5. An applicant-specific description of methods that have been approved during pre-application consultation, and
6. For flight safety analysis, the actual mission data being used as “representative” data.

6.1.4 During pre-application consultation, the FAA will work with applicants on compliance planning for the MOC requirements. All publicly available FAA-accepted MOCs are maintained on the FAA website at: https://www.faa.gov/space/streamlinedlicensingprocess/part-450-means-compliance-table/.

6.1.5 The Flight Safety Analysis section of this document includes additional discussion on the MOC for § 450.115(b), especially MOC types 5 and 6.

6.1.6 For all requirements of part 450 not listed in § 450.35(a), an applicant may submit MOCs as part of its application for the FAA to review during the application review period. The FAA determines (1) if the operations represented in the application are consistent with all the conditions relevant to the MOC, and (2) whether the application materials (e.g., data) demonstrate correct implementation of the MOC.

7 SCOPE OF A VEHICLE OPERATOR LICENSE

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
7.1 § 450.3 Scope of a vehicle operator license.	In accordance with § 450.3 Scope of a Vehicle Operator License, the FAA requires an applicant intending to launch from a U.S. launch site to identify pre-and post-flight ground operations such that the FAA is able to determine when the launch operation would begin and end. In §§ 450.3(b)(1) and 450.3(b)(2), the FAA specifies that launch begins under a license with the start of hazardous activities that pose a threat to the public at a U.S. launch site and that for a non-U.S. launch site, launch begins at ignition or at the first movement that initiates flight, whichever occurs earlier. § 450.3(b)(3) describes the requirements for end of launch events as it pertains to orbital and suborbital missions, with and without reentry scenarios. Finally, § 450.3(c) scopes reentry, including activities necessary to return a component to a safe condition on the ground. In its application, § 450.3(d) requires an applicant to identify pre- and post-flight ground operations at a U.S. launch site sufficient for the Administrator to determine the scope of activities authorized under the license. This information is very helpful during pre-application consultation because it circumscribes what needs to be covered in the application. These operations include any operations that are potentially hazardous before any mitigations such as restricting public access. For reentry, the applicant should provide the sequence	For launch from a U.S. site, does the application contain a list of potentially hazardous activities for both pre-flight and post-flight ground operations that are preparing the vehicle for flight? For reentry, does the application contain a list of activities conducted in Earth orbit or outer space to determine reentry readiness? Does the application include a list of post-flight ground activities necessary to return the reentry vehicle, or vehicle component, to a safe condition on the ground after impact or landing?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	when various activities occur on orbit that are prelude to a determination to reenter and activities after landing or impact that are potentially hazardous to the public. Once the FAA and the applicant have a mutual understanding of the applicant's concept of operations, the FAA will determine, using the information provided by the applicant, a starting point for hazardous pre-flight operations. An applicant wishing to deviate from the scope of authorization defined in §§ 450.3(b) or 450.3(c), would discuss the deviation during pre-application consultation.		

8 REQUIREMENTS TO OBTAIN A VEHICLE OPERATOR LICENSE

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
8.1 § 450.41 Policy review and approval.	In accordance with § 450.41 Policy review and approval, a policy approval is issued to an applicant unless the FAA determines that a proposed launch or reentry would jeopardize U.S. national security or foreign policy interests, or international obligations of the United States. In accordance with § 450.41(c), the FAA advises an applicant of any issue raised during a policy review that would impede issuance of a policy approval. To support the applicant's response, the FAA may seek additional information from an applicant in support of interagency consultation to protect U.S. Government interests. The FAA consults with Department of Defense, the Department of State, and other Federal agencies, including the NASA, to address issues associated with an applicant's proposal. During pre-application consultation, the applicant will discuss any unique situations or raise any concerns with the FAA regarding its proposed operations. The flight profile, per (e)(4), needs to be provided in order for other agencies to adequately evaluate the potential for issues. Trajectory ranges should cover the azimuths that are contemplated, relative to each launch or landing site. The regions where normal impacts occur should specify the region of	§ 450.41(e)(1) • Is there a specified vehicle configuration (set of stages/boosters) or a list of configurations? • Is the type of each stage and booster specified? • Is there a model identifier for each configuration? § 450.41(e)(2) • For each stage, is there a description that includes: o Dimensions? o Mass? o Types of propellants, with quantities? o Maximum thrust? § 450.41(e)(3) • Is there a declaration of foreign ownership? § 450.41(e)(4) • Are launch and/or reentry sites specified? • Are contingency abort sites specified, or listed as none?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	ocean, any regions on land or within 200 NM of land, and any regions intersecting foreign territory, including territorial waters.	• Is there a range of flight trajectories defining the extent of the contemplated licensed activity? • If there are contingency sites, are there contingency abort profiles? • Is there a sequence of planned events for each vehicle configuration? • Are there regions defined of where normal impacts or landings may occur? • Is there a list of intermediate orbits that are contemplated for each configuration? • Is there a list of final orbits that are contemplated for each configuration?	
8.2 § 450.43 Payload review and determination.	Per 450.43 Payload review and determination, the FAA issues a favorable payload determination for a launch or reentry to a license applicant or payload owner or operator if an applicant, payload owner, or payload operator has obtained all required licenses, authorizations, and permits and its launch or reentry would not jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States. In § 450.43(a), the FAA clarifies that a payload review is not required to accommodate the situation where there is no payload. Part 450 preserves the ability of payload owners and operators, as well as launch or reentry operators, to request a payload review independent of a launch	• Is there identification of the payload(s) or class of payloads (or specify no payload)? • For payload(s) being launched, is each item of § 450.43(i)(1) answered? • For payload(s) being re-entered, is each item of § 450.43(i)(2) answered? • For unique payloads, is the information provided concerning its intended use sufficient to initiate interagency consultation?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	license application that exists in the current regulations. While the FAA will review all payloads to determine their effect on the safety of launch, the FAA will not make a determination on those aspects of payloads that are subject to regulation by the Federal Communications Commission (FCC) or the Department of Commerce or on payloads owned or operated by the U.S. Government. During pre-application consultation the applicant will discuss the type, class and configuration of payload planned to be flown.		
8.3 § 450.45 Safety review and approval.	In accordance with § 450.45 Safety review and approval, the FAA will issue a safety approval to an applicant if it determines that an applicant can conduct launch or reentry without jeopardizing public health and safety and safety of property. The FAA also notes that an applicant must satisfy the application requirements in § 450.45(e) and subpart C of this part. During pre-application consultation the applicant will discuss its plans for addressing the application requirements. The vehicle description is essential to the development of functional hazard analyses per § 450.107(b) and flight hazard analyses per § 450.109.	§ 450.45(e)(1) General • Is there a glossary? • Is there a list of referenced material? § 450.45(e)(2) Site • Is there a list of launch and reentry sites and contingency abort locations? • For each site/location, o Are the boundaries specified? o Are the launch or landing point locations quantitatively specified? o Is the site operator specified? o Are the facilities for pre-flight operations identified? o Are the facilities for post-flight operations specified? § 450.45(e)(3) Vehicle description	Phase 1; Phase 2-3: Glossary and references, per § 450.45(e)(1), should be updated with subsequent submissions

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		• Does the vehicle description include ("None" may instead be specified where applicable): o Structural characteristics? o Thermal systems? o Pneumatic systems? o Propulsion systems? o Electrical systems? o Avionics and guidance systems? o Propellants? • Is there a reference to how hazardous materials are identified? • For each vehicle configuration specified in § 450.3 Scope, is there either a table of hazardous materials or a statement that none exist? o Does the table(s) include the type of material? o Does the table(s) include the quantities of material? • Are there drawings of each vehicle configuration specified in § 450.3 Scope? • Does the drawing(s) include physical dimensions? • Does the drawing(s) locate (e.g., label in a drawing showing relative position): o Safety critical systems? o Major control systems? o Propulsion systems?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Pressure vessels? ○ Other hardware with hazardous energy or materials (or specify that none exist) • If the rocket is unguided, is there a table or graph of the center of pressure relative to the center of gravity? § 450.45(e)(4) Mission schedule • Is there a generic processing schedule? • Does the schedule include ○ Readiness activities? ○ Safety-critical pre-flight operations? ○ Day-of-flight activities? § 450.45(e)(5) Human space flight • Is there specification as to whether there is a human on board? • If there are humans on board, ○ Are the crew qualifications and training described? ○ Are the crew training devices, maintenance of training records, and training schedule described? ○ Is the environmental control and life support system described? ○ Is the smoke detection and fire suppression system described? ○ Are human factors of the vehicle and operations described?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Is the vehicle's flight test verification program described? ○ Is space flight participant training described? ○ Are the security measures for space flight participant flights described? § 450.45(e)(6) Radionuclides • Is there specification as to whether there are radionuclides on board? • If there are radionuclides, ○ Are the types and quantities identified? ○ Is there a reference list of radionuclide safety documentation? ○ Is there a description of approvals from the Nuclear Regulatory Commission?	
8.4 § 450.47 Environmental review.	The environmental review for license or permit applications must meet the application requirements of the FAA's Commercial Space Transportation Regulations (14 CFR part 400) to enable FAA to meet the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.), the Council on Environmental Quality Regulations (40 CFR Parts 1500 to 1508), and FAA Order 1050.1F, Environmental Impacts: Policies and Procedures. Before the environmental review can begin, an applicant must clearly define their proposal. The proposal should consider environmental	• Is there one of the following: ○ Draft Environmental Assessment (EA), ○ Final Environmental Impact Statement (EIS), ○ Information supporting a written re-evaluation (WR), or ○ Information supporting a categorical exclusion (CATEX)?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	factors that may result in potential construction and operational constraints. Identifying these constraints allows applicants to modify their proposed project before changes or modifications result in substantial delays or costs. The proposed project description will become what is referred to as the Proposed Action in the environmental review.		

9 SYSTEM SAFETY PROGRAM

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
9.1 § 450.103 System safety program.	A documented system safety program establishes and defines pertinent management principles, organizational structures, engineering processes, and safety analysis methodologies meant to ensure public safety is maintained throughout the lifecycle.	Documented system safety program and implementation methods over the lifecycle. § 450.103(a) Safety organization • Is there a description of the safety organization including the roles of "Mission Director", "Safety Official", or other key personnel? • Does it describe lines of communication? • Does it describe approval authority including the manner that safety concerns are addressed? § 450.103(b) Hazard management • Is there a description of the methods to assess the system for hazards? • Does it discuss methods for different phases of the lifecycle? • Does it discuss validating the hazard control strategy determination? • Is there a description of how updates to hazard analyses are communicated through the organization? • Is there a description of how updates to hazard analyses are implemented through the organization? • Does the description identify whether flight hazard analysis may be required?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe

		• If the flight hazard analysis is required, does it discuss tracking of:
		  o Hazards?
		  o Risks?
		  o Mitigation measures?
		  o Verification activities?
		
		§ 450.103(c) Configuration management and control
		• Is there a description of the Configuration management and control process?
		• Does it include safety-critical systems?
		• Does it include safety-critical system documentation?
		• Does it include verification of correctness of versions?
		• Does it include documenting versions for each licensed activity?
		
		§ 450.103(d) Post-flight data review
		• Is there a description of the post-flight data review process?
		• Does it discuss consistency comparison of the post-flight data with:
		  o Hazard control strategy determinations?
		  o Flight hazard analyses?
		  o Flight safety analyses?
		  o Mitigation and hazard control measures?
		• Does it discuss resolution of identified inconsistencies?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe

		• Does it discuss anomaly identification?
		• Does it discuss addressing anomalies with respect to:
		  o Flight hazard analyses?
		  o Flight safety analyses?
		  o Safety-critical systems?	

10 HAZARD CONTROL STRATEGIES.

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe

10.1 § 450.107 Hazard control strategies determination.	The approach to determining and validating hazard control strategies is an iterative process. The functional hazard analysis is utilized to ensure that all potential hazards to the public have a determined hazard control strategy. A functional hazard analysis provides a holistic, systematic approach to identifying potential hazards and supports the validation of adequacy for determined hazard control strategies. If the hazards to the public are potentially mitigated, then the selected strategies are developed, and the supporting data is used as general input for the flight safety analysis. If adequate mitigation is not validated by supporting data, then the hazard control strategy should be revisited. If validation is successful, then the flight safety analysis is used to demonstrate whether the safety criteria are satisfied. If the safety criteria cannot be met, then additional hazard controls must be implemented, in accordance with § 450.107(c).
	
	The identification of what is safety-critical through the functional hazard analysis is essential for determining the scope of §§ 450.141, 450.143, 450.149, 450.151, 450.153, 450.155, 450.157, 450.163, and 450.165.
		• Are phases of flight identified?
		• Do phases cover the entire period:
		  ○ For orbital launch, from liftoff through orbital insertion, and through all component impacts or landings?
		  ○ For suborbital launch, from liftoff through all component impacts or landings?
		  ○ For disposal, from the initiation of the deorbit through final impact?
		  ○ For reentry, from the initiation of the deorbit through all component impacts or landing?
		• Do functional hazard analyses cover every phase of flight?
		• Does each functional hazard analysis account for:
		  ○ Functional failures?
		  ○ Safety-critical-systems?
		  ○ A timeline of safety-critical events?
		• Are there results of the functional hazard analysis (validation of hazard control strategies)?
		• Is there a hazard control strategy identified for each phase of flight?
		• Is each hazard control strategy described?
			Phase 1;
			Phase 2-3 for completion of § 450.107(c) validation effort

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
10.2 § 450.108 Flight abort.	Development of flight safety limits, which is most of this section, is performed in concert with the flight safety analysis. See the introduction to Flight Safety Analysis in this document for more discussion. Flight abort rules are the conditions under which a flight safety system must abort the flight. Some flight abort rules reference flight safety limits. Normally, flight abort rules are provided as a concise set of criteria for a person or computer program to very quickly make a conclusive determination. Flight safety limits are quantitative boundaries, normally based on evaluation of the vehicle state vector (and derived parameters, such as IIP). Normally, flight safety limits are provided in datafiles. "Critical parameters" are those parameters that demonstrate the vehicle is capable of completing safe flight through the upcoming phase of flight. Examples are vehicle thrust and perigee altitude. Commonly, the "list" and the "description" are provided as a table, where the description is more complete and is quite precise.	*This section only applies if flight abort is identified as a hazard control strategy in § 450.107. If it is not, nothing needs to be submitted.* § 450.108(g)(1) Flight abort methods • Does the flight abort methodology reference an accepted means of compliance? § 450.108(g)(2) Evaluation methods & data • Is there a description of how each flight safety limit is evaluated during flight? • Is there a description of how each flight abort rule is implemented during flight? • Are quantitative criteria provided for each flight safety limit for a representative flight? • Are quantitative criteria provided for each parameter in each flight abort rule for a representative flight? • Is there a list of critical parameters used in the flight abort criteria? • Is there a description of each critical parameter?	Phase 2

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		• Is there a description for how values of critical parameters required in paragraphs (c)(3) and (e) of § 450.108 were determined? • Are there quantitative criteria for each critical parameter for a representative flight? § 450.108(g)(3) Graphical depictions • Is there a graphical depiction of each flight safety limit for a representative flight? • Does each graphical depiction include the nominal trajectory? • Does each graphical depiction include the extents of normal flight? • Does each graphical depiction include limits of a useful mission trajectories? • Does each map include uncontrolled area boundaries together with the launch or landing point? § 450.108(g)(4) Available data • Is there a clear and complete narrative description of vehicle data available to evaluate flight abort rules?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
10.3 § 450.109 Flight Hazard Analysis	Flight hazard analysis may be utilized as a hazard control strategy but may also be mandated by § 450.107(c) A flight hazard analysis identifies key system design and operation data, documents the overall system safety risk to the public, and determines the necessary hazard controls (mitigations) to ensure the residual risk meets acceptable criteria. The flight hazard analysis should be performed early in system development and operation conceptualization to define the system safety risk to the public in order to positively influence design and operation decisions. AC 450.103-1, *System Safety Program,* provides guidance on severity categories and likelihood levels in Table 3 and Table 4 of Appendix A, including acceptable criteria for "extremely remote."	*This section only applies if flight hazard analysis is identified as a hazard control strategy in § 450.107 OR if the exception per § 450.143(a)(2) is being applied. If it is not, nothing needs to be submitted.* • Is there a description of the flight hazard analysis methodology for the lifecycle? • Does the flight hazard analysis identify hazards? • Is there a failure mode identified for each hazard? • Does the analysis methodology consider hazards from: o Vehicle operation, including staging and release? o System, subsystem, and component failures or faults? o Software operations? o Environmental conditions? o Human factors? o Design inadequacies? o Procedure deficiencies? o Functional and physical interfaces between subsystems, including any vehicle payload? o Reuse of components or systems?	Phase 1; Phase 2-3 for completion of § 450.109(b)(5) validation effort

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Interactions of the above? • For each hazard, is there identification of: ○ Likelihood? ○ Severity? • Is there a definition of what constitutes "extremely remote" likelihood? • For every hazard with a severity of death or serious injury to the public, is the mitigated likelihood "extremely remote"? • Are risk elimination and mitigation measures identified and described? • Are verification methods for risk elimination and mitigation measures identified and described? • Is there documentation of verification and validation achieving the risk levels above? • Is traceability demonstrated in the hazard analysis data: ○ For each hazard is there at least one failure? ○ For each hazard, is there as least one mitigation? ○ For each failure, is there at least one cause? ○ For each cause, is there at least one mitigation?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ For each mitigation, is there at least one verification? ○ For each mitigation, is there a risk assessment? • Is there documentation of the techniques for identifying new hazards? • Does the documentation include criteria for identification of new hazards?	
10.4 § 450.110 Physical containment.	Physical containment is a hazard control strategy described in § 450.110. The focus in pre-app is on the methods used to demonstrate that the launch vehicle does not have sufficient energy for any hazards associated with its flight to reach outside the flight hazard area. FAA reviews the proposed means of compliance in pre-app to confirm that the methodologies will result in compliance with the regulation.	*This section only applies if physical containment is identified as a hazard control strategy in § 450.107. If it is not, nothing needs to be submitted.* § 450.110(c)(1) Extent of hazard • Is the method for determining maximum range of the vehicle described? • Is the size of the hazard area around an impact discussed? § 450.110(c)(2) Clearance • Are the methods for clearing flight hazard areas of the public documented? • Is the potential for critical assets within the flight hazard areas discussed?	Phase 2

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
10.5 § 450.111 Wind weighting.	Wind weighting is a hazard control strategy described in § 450.111. The focus in pre-app is to identify a means of compliance for the wind weighting analysis methods, including the method and schedule of determining wind speed and wind direction for each altitude layer. FAA reviews the proposed means of compliance in pre-app to confirm that the methodologies will result in compliance with the regulation.	*This section only applies if wind weighting is identified as a hazard control strategy in 450.107. If it is not, nothing needs to be submitted.* § 450.110(e)(1) Methods • Are the methods of performing wind weighting to determine launcher (e.g., launch rail) parameters documented? • Is the method for determining wind as a function of altitude documented? • Is there a schedule for making wind measurements? § 450.110(e)(2) System • Is there a description of the wind weighting safety system? • Does the description include equipment? • Is there a wind weighting analysis for a representative flight? • Does it include launch areas winds? • Are there samples of wind weighting output?	Phase 2

11 FLIGHT SAFETY ANALYSIS.

11.1.1 Flight Safety Analysis (FSA) consists of sections §§ 450.113 through 450.139. Sections 450.113 and 450.115 provide general requirements that apply to each of the sub-analyses, which are discussed in §§ 450.117 through 450.139. Pursuant to § 450.35(a)(1), a means of compliance must be accepted by the Administrator for § 450.115(b)(1) prior to application acceptance.

11.1.2 Note that § 450.115(b) is a requirement on the level of fidelity of the applicant's FSA method. The FSA method is the accumulation of the methods for each sub-analysis (§§ 450.117 through 137), as well as flight abort (§ 450.108). Thus, the FSA MOC needs to cover every sub-analysis. However, the FAA does not require that the same MOC type (see the types of acceptable MOC discussed in the Means of Compliance section of this document) be used for each sub-analysis. Instead, the applicant should specify which of the MOCs is being used for each of the requirements. For example, when operating from a Federal Range, it is common to use Federal Entity Services for most of the sub-analyses, and an applicant-specific method for the sub-analyses that the Federal Range does not perform.

11.1.3 The FSA method must apply for the entire scope of the analysis in accordance with § 450.115(a).[1] Applicants should consider performing preliminary functional hazard analyses prior to submitting their FSA method for review since the system safety process identifies "reasonably foreseeable events and failures" that ultimately determine the proper scope of the FSA method under § 450.115(a). For this reason, applicants are encouraged to include any preliminary functional hazard analyses with their FSA methodology documentation to facilitate the FAA's review of their FSA method.

11.2 FSA Application Requirements.

11.2.1 Each of the FSA sub-analysis sections contains application requirements. These application requirements may be considered as three categories: methodology, narratives, and data for a representative analysis, as discussed below.

11.2.2 The first type of application requirement includes those that begin with the words **"a description of the methods**" which refer to § 450.115(c). An applicant-specific MOC for FSA (type 5 in in the Means of Compliance section of this document) for a regulation section is an FAA-approved methodology. Thus, if an applicant is submitting a new methodology which will be used as a MOC for any of the flight safety analysis requirements, they will be focal points for pre-application conversations. See below for guidelines for a complete methodology description.

[1] § 450.115(a) provides essential context for understanding § 450.115(b).

11.2.3 The second type of application requirements are **narrative descriptions**. There are only a few requirements of this type (e.g., § 450.119(c)(3)). Advisory Circulars provide guidance of satisfactory versions of these. It is important that the narrative cover all phases of flight.

11.2.4 The third type of application requirement is **representative data**, obtained by performing an FSA for a representative operation. A representative operation is one that is covered by the scope of the vehicle operator license (§ 450.3). It should be appropriate to all vehicle configurations (see § 450.45). For example, if solid rocket boosters are part of one configuration, the representative analysis should include them. The analysis must cover all phases of flight as required by § 450.113. The representative analysis should result in satisfying the safety criteria in § 450.101, in order to demonstrate that the methods have sufficient fidelity to be appropriate for the license, per § 450.115(b)(1). This analysis process is then performed throughout the lifecycle of all proposed operations, for all phases of flight, to demonstrate compliance with the safety criteria for each operation are met at the time of the launch commit decision. The application materials should be of sufficient detail for evaluating the safety criteria for all proposed operations within the scope of license.

11.3 FSA Methodology Description.

11.3.1 There are three general aspects to determining completeness for a methodology: content, rigor, and depth. The content must 1) address each element of the regulations for the subject sub-analysis (e.g., constraints, objectives, and application requirements) with a scope and level of fidelity in accordance with § 450.115(a) and (b), and 2) cover each element of § 450.115(c). The level of fidelity means the exactness to which the approach reflects the actual physical world–a higher level of fidelity has less uncertainty and/or bias. The content should also describe the intended usage and limitations for each proposed method. The rigor of the description should ensure that the logic is clear, and discussions (especially of processes) are definitive; equations and flowcharts are often helpful to clarify. A knowledgeable reader should be able to read a methodology and produce nearly the same answer for the same vehicle, provided they had access to the raw data. current ACs and other previously approved methodologies provide specific guidelines for satisfactory content, rigor, and depth for a valid methodology description.

Note: Some sections of ACs implicitly rely on long-established Federal Range precedent as rationale, so therefore have less detailed derivation and/or justification).

11.3.2 Pre-application conversations on the proposed method for FSA, particularly for novel operations and new methodologies, are an efficient means to reach a mutual understanding of the appropriate content, rigor, and depth. Pre-application conversations on the “ground rules and assumptions” used in a proposed FSA methodology should address each of the requirements of § 450.115(c) over the lifecycle of the proposed license activities. For example, the input data and assumptions used for some FSA methods, such as the trajectory analysis for normal flight, naturally evolve given higher uncertainties prior to the first flight. If an applicant proposes multiple flights, the application, per § 450.103(e)(2), must include a summary of the processes

and products identified in the system safety program that enable FSA method updates to comply with the post-flight data requirements in § 450.103(d). Since the nature of the methodology updates often depend on the specifics of the data or anomalies identified during the post-flight data review, the applicant should consider defining a process that involves the FAA in evaluating proposed FSA methodology updates[2] based on post-flight data. For example, a complete submission may include a post-flight data review process with an objective to identify any element of the flight safety analysis content, rigor, or depth that should be updated given the post-flight evidence. Such a post-flight data review process may involve the FAA in discussions intended to gain mutual understanding of any updates to the ground rules and assumptions appropriate for future flights based on the specifics of the data or anomalies identified during the post-flight data review.

11.3.3 The following provides additional guidance regarding the requirements of § 450.115(c):

1. *The scientific principles and statistical methods used*;

   This is the data, including reference data, and mathematics that are used to describe the physical phenomena and the associated uncertainties. Modeling should be based on established physics, standard statistical methods, and/or empirical data. References to appropriate literature should be provided. Scientific principles refer to knowledge based on the scientific method, such as that established in the fields of physics, chemistry, and engineering. An analysis based on non-scientific principles, such as astrology, would not be consistent with this standard.

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

2. *All assumptions and their justifications*;

   There are two types of assumptions in a methodology: 1) the scope of scenarios for which the methodology is intended to apply (and not apply), and 2) the physical phenomena that are relevant to the modeling. These assumptions should be stated clearly at relevant points within the narrative. Key assumptions should also be summarized separately, such as the assumptions on the scope of applicability of the method.

3. *The rationale for the level of fidelity*;

   The applicant should discuss the fidelity of the approach and explain how this was determined. Fidelity means the degree of exactness of the approach relative to the actual physical world, so this usually involves a discussion of the biases and uncertainties associated with the method (ideally quantitative). A key aspect of part 450 is that the fidelity of the analysis only needs to be sufficient to demonstrate compliance with the safety criteria, accounting for uncertainty; see § 450.115(b).

[2] An application for a license modification would be required if this is significant update (material change).

4. *The evidence for validation and verification (V&V) required by § 450.101(g)*;

   Department of Defense Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A) Instruction Number 5000.61 Change 1, dated October 15, 2018, provides a good overview of V&V for modeling and simulation. The rigor of V&V depends on the level of criticality of the model (so independent V&V is not usually necessary); see also § 450.143 and associated guidance. An appraisal of the software development process (e.g., comparison to the CMMI best practices), is an effective way of demonstrating ongoing V&V. The V&V discussion should also consider processes, particularly those that must happen in a short time frame, such as during the countdown to an operation.

5. *The extent to which the benchmark conditions are comparable to the foreseeable conditions of the intended operations.*

   Benchmark conditions are situations where the modeling approach has been compared to empirical data and/or other modeling approaches. These should be compared to the intended scope of the methodology, discussing the regimes where the model is closer to and further from the benchmarks.

6. *The extent to which risk mitigations were accounted for in the analyses.*

   This describes how mitigations (e.g., flight safety system, hazard areas, trajectory limits) are incorporated in the analysis process. Mitigations are those described in the functional hazard analysis.

11.3.4 It is helpful if a complete methodology description includes an overview discussion guiding the reader to where each required element may be found. It is usually convenient for sub-analysis descriptions to be separate documents, and often, even within a regulation section, there may be multiple methodology documents. For example, § 450.121 includes breakup and debris analysis; the methodologies for determining breakup criteria (structural limits), debris catalog, and debris propagation/dispersion are often separate documents. Many descriptions may reference a common document, such as a software development plan to discuss how software implementations undergo verification per § 450.115(c)(4).

11.3.5 In accordance with § 450.35(a)(1), the FAA will only accept an application that uses previously accepted flight safety analysis methodologies for all sub-analyses for all phases of flight. A compliance matrix is a helpful approach to demonstrate compliance with this requirement.

11.4 FSA MOC for a Single Planned Flight Profile.

11.4.1 Scoping the initial FSA MOC using a single planned flight profile may reduce the initial effort for an applicant for their first operations because the level of rigor of the methodology description may be significantly lower. This occurs because it significantly limits the scope of the FAA's evaluation of compliance of the methodology description with § 450.115(b) and § 450.101(g). This approach may be useful to applicants who only need a single flight profile for first flights of a new vehicle in development, but it is not intended for long term operational needs. Each new mission profile requires a license modification and subsequent FAA review. This approach is only a viable path for situations where collective risk is significantly below the safety criteria and mitigations can include larger operational restrictions (e.g., larger hazard areas). It is generally not suitable to optimize operational constraints for a frequent operational cadence.

11.4.2 To utilize this approach, an applicant may choose to scope their methodology and data to a single planned flight profile instead of requesting that a methodology be approved for variety of flight profiles and operations. The applicant should discuss the suitability of this approach with the FAA during pre-application consultations. The application should state that:

- The data in application submissions are for the actual planned flight profile rather than just "representative" data.
- The risk analysis is applicable to all foreseeable conditions within the launch commit criteria, in accordance with § 450.135(a)(1) and § 450.137(a)(1).

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
11.5 § 450.115 Flight safety analysis methods.	This requirement is referenced by each flight safety analysis section as part of the methodology descriptions, which are a Means of Compliance.	Prior to application submission
11.6 § 450.117 Trajectory analysis for normal flight.	§ 450.117(d)(1) Vehicle's flight behavior methods • Does the normal trajectory analysis methodology reference an accepted means of compliance? § 450.117(d)(2) Quantitative input data • Is there normal trajectory analysis input data for all phases of flight? • Does the normal trajectory analysis input data include uncertainties? § 450.117(d)(3) Atmospheric conditions • Does the normal trajectory analysis atmospheric data account for all phases of flight? • Is there a definition of the worst atmospheric conditions under which flight will be attempted, such as a table of criteria? • Is there a description of how atmospheric conditions will be evaluated prior to initiating the operation? • Is there a description of how uncertainty in the atmospheric conditions will be evaluated prior to initiating the operation? § 450.117(d)(4) Nominal flight trajectory analysis outputs **for a representative flight** • Does the normal trajectory data account for all phases of flight? • Does the normal trajectory data include position, velocity, and orientation for each second of flight? • Is there a nominal trajectory?	Phase 1

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	• Is there a set of trajectories (normally at least four) that characterize variability in the intended trajectory based on conditions known prior to initiation? • Is there a set of trajectories (normally hundreds) that characterize how the actual trajectory could differ from the intended trajectory due to random uncertainties?	
11.7 § 450.119 Trajectory analysis for malfunction flight.	§ 450.119(c)(1) Vehicle's flight behavior methods • Does the malfunction trajectory analysis methodology reference an accepted means of compliance? § 450.119(c)(2) Limits of useful mission methods • Do the limits of a useful mission determination methodology reference an accepted means of compliance? § 450.119(c)(3) Malfunction flight behavior • Does the malfunction trajectory analysis input data account for all phases of flight? • Is there a list of each cause of malfunction flight considered? • Is there a list of each type of malfunction flight for which malfunction flight behavior was characterized? • Is there a quantitative description of the parameters with a significant influence on the vehicle's malfunction behavior? • Does the quantitative description of the malfunction flight parameters include uncertainties? • Does the quantitative description cover each type of malfunction flight characterized? **Note**: A quantitative description of a parameter specifies the numerical values. A quantitative description of an uncertain parameter should be in the form of a distribution with its numerical parameters specified (e.g., mean and standard deviation for a normal distribution).	Phase 1

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	§ 450.119(c)(4) Malfunction flight trajectory analysis outputs **for a representative flight** • For each phase of flight, are there sets of trajectories (normally a few sets of hundreds or more, depending on the failure mode, phase of flight, and resolution required) for different types of malfunction flight? • Do the malfunction trajectories contain position and velocity as a function of flight time? • Is the probability of each set of trajectories that characterizes a type of malfunction flight specified? • Is there a set of trajectories that characterizes the limits of a useful mission? (This set normally contains at least six trajectories).	
11.8 § 450.121 Debris analysis.	§ 450.121(d)(1) Hazardous scenarios • Does the description of hazardous scenarios account for all phases of flight? • Does the description of hazardous scenarios include the event sequence for multiple causes of vehicle breakup and intact impact? § 450.121(d)(2) Breakup analysis methods • Does the methodology reference an accepted means of compliance for breakup criteria (structural limits) analysis? • Does the methodology reference an accepted means of compliance for breakup debris analysis? • Does the methodology reference an accepted means of compliance for impact analyses (when propellant or other hazardous substances are present at impact)? § 450.121(d)(3) Methods for dispersions • Does the methodology reference an accepted means of compliance for computing debris impact dispersions?	Phase 1

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	§ 450.121(d)(4) Atmospheric data • Is there a narrative description of the atmospheric data used? • Does the description include references to specific data sources? • Does the description account for all phases of flight? • Does the description identify the data elements used, including wind uncertainty? § 450.121(d)(5) Output debris data **for a representative flight** • Does the debris data cover all hazardous scenarios for each phase of flight? • Does the debris data include physical characteristics of debris (size, mass)? • Does the debris data include aerodynamic characteristics of debris (ballistic coefficient with uncertainty, lift uncertainty, breakup-induced velocity)? • Does the debris data include harmful characteristics (including explosives or toxics)?	
11.9 § 450.123 Population exposure analysis.	§ 450.123(c)(1) Exposure input data methods • Does the methodology reference an accepted means of compliance for determining population exposure regions, characterized by fidelity and resolution required? • Is there a methodology associated with each identified region? • Does each identified methodology reference an accepted means of compliance for developing population exposure data? § 450.123(c)(2) Population exposure data **for a representative flight** • Is there a demonstration that the region covered by the population exposure data is sufficient? • Does the population exposure data include population as a function of geographic location? • Is the population data in tabular form (normally should be machine readable)?	Phase 2

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
11.10 § 450.131 Probability of failure analysis.	§ 450.131(f)(1) Probability of failure (POF) analysis methods • Does the methodology reference an accepted means of compliance for probability of failure development? § 450.131(f)(2) Failure probability data **for a representative flight** • Does the POF data account for all phases of flight? • Is there tabular (quantitative) data on the predicted failure rate for multiple failure modes for each phase of flight? • Are their graph(s) of the predicted failure rate for each failure mode for each phase of flight? • Is there tabular (quantitative) data of the cumulative failure probability for each foreseeable failure mode for each phase of flight? • Are their graph(s) of the cumulative failure probability for each failure mode for each phase of flight?	Phase 2
11.11 § 450.133 Flight hazard area analysis.	§ 450.133(e)(1) Vehicle's flight behavior methods • Does the methodology reference an accepted means of compliance for flight hazard area analysis? § 450.133(e)(2) Flight hazard area analysis results **for a representative flight** • Are there geographic coordinates that define the boundaries of all hazard areas? • Are there contours that demonstrate 97 percent probability of containment for debris resulting from normal flight events capable of causing a casualty? **Note:** Contours, in this section, means a set of geographic coordinates defining an isopleth, normally rendered on a map. • Are there individual probability of casualty contours for unsheltered people? • Do the unsheltered probability of casualty contours specify 1E-5 and 1E-6 levels?	Phase 3

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	• Are there probability of casualty-producing impact contours for persons on a waterborne vessel? • Do the waterborne vessel probability of impact contours specify 1E-5 and 1E-6 levels? • Are there probability of casualty-producing impact contours for persons on an aircraft? • Do the aircraft probability of impact contours specify 1E-6 and 1E-7 levels?	
11.12 § 450.135 Debris risk analysis.	§ 450.135(c)(1) Compliance methods • Does the methodology reference an accepted means of compliance for debris risk analysis? § 450.135(c)(2) Atmospheric data • Is there a description of atmospheric data used as input for the debris risk analysis? **Note:** Normally this is the same as the data used for debris analysis, § 450.121(d)(4), and that could be referenced here. § 450.135(c)(3) Unsheltered casualty area • Is there an effective unsheltered casualty area for all fragment classes for all phases of flight? § 450.135(c)(4) Sheltered casualty area • Is there an effective casualty area for all phases of flight for all fragment classes for: o One or more types of buildings? o One or more types of ground vehicles? o One or more types of waterborne vessels? o One or more types of aircraft? § 450.135(c)(5) Debris risk analysis outputs for a representative flight, with both representative and worst-case conditions under which an operation might be attempted.	Phase 3

Section	Objective Criteria to Determine if the Application is Complete	Timeframe

	• Is there a total collective casualty expectation?
	• Is there a total collective casualty expectation?
	  o Is there a collective risk contribution for (at minimum) the top ten population centers?
	  o Is there a list of all centers with collective risk exceeding 1% of 2×10^{-4} expected casualties for all neighboring operations personnel (NOPs)?
	  o Is there a list of all centers with collective risk exceeding 1% of 1×10^{-4} expected casualties for all members of the public (excluding [NOPs])?
	• Individual risk
	  o Are the ten population centers with the highest maximum individual risks identified?
	  o Is there a list of all centers that exceed 10% of 1×10^{-5} probability of casualty for any neighboring operations personnel?
	  o Is there a list of all centers that exceed 10% of 1×10^{-6} probability of casualty for any member of the public (excluding NOPs)?
	• Conditional risk
	  o Is there a list of the conditional collective casualty expectation results for each failure mode for each significant period of flight (e.g., 1s intervals)?
	  o Are all of the outputs required by 450.135(c)(5) provided for two cases, one labeled “representative” and one labeled “worst foreseeable”?	

11.13 § 450.137 Far-field overpressure blast effects analysis.	§ 450.137(c)(1) Population center, terrain, etc. description • Is there a description of the population centers used as input that addresses the requirement in 450.137(b)(3)? • Is there a description of the terrain used as input? **Note:** This is usually a narrative along with digital data.	Phase 1: § 450.137(c)(2) Phase 2: § 450.137(c)(1) § 450.137(c)(3)

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	§ 450.137(c)(2) Probability pairs methods • Does methodology reference an accepted means of compliance for computing yield probability pairs? • Is there a set of yield-probability pairs? § 450.137(c)(3) Peak incident overpressure methods • Does the methodology reference an accepted means of compliance for computing peak incident overpressure? • Are sample calculations included for a representative range of foreseeable meteorological conditions, yields, and population centers? § 450.137(c)(4) Window breakage methods • Does the methodology reference an accepted means of compliance for computing the probability of window breakage? • Is there tabular data for the probability of window breakage as a function of the peak incident overpressure? • Are there graphs of the probability of window breakage as a function of the peak incident overpressure? • Does the probability of window breakage data cover a representative range of window types? • Does the probability of window breakage data cover a representative range of building types? • Does the probability of window breakage data cover a representative range of yields? § 450.137(c)(5) Individual probability of casualty (Pc) methods • Does the methodology reference an accepted means of compliance for computing the Pc for a representative individual? • Is the Pc for a representative individual as a function of location relative to the window and peak incident overpressure?	§ 450.137(c)(4) § 450.137(c)(8) Phase 3: § 450.137(c)(5) § 450.137(c)(6) § 450.137(c)(7)

Section	Objective Criteria to Determine if the Application is Complete	Timeframe
	• Does the Pc account for a representative range of window types? • Does the Pc account for a representative range of building types? • Does the Pc account for a representative range of yields? § 450.137(c)(6) Exposed persons data • Is there tabular/graphic data showing the hypothetical location of any NOPs that could be exposed to Pc $\geq 1 \times 10^{-5}$? (or a statement that there are no NOPs at the site) • Is there tabular/graphic data showing the hypothetical location of any other member of the public that could be exposed to Pc $\geq 1 \times 10^{-6}$? • In lieu of the tabular/graphic data on the hypothetical location of member of the public, are there tabular/graphic data on the actual location where members of the public (both NOPs and otherwise) would be subject to the maximum individual risks under the worst-case conditions when an operation might be attempted? § 450.137(c)(7) Max expected casualties • Does the application identify a maximum expected casualties that could result from far-field overpressure hazards? § 450.137(c)(8) Meteorological measurements • Is there a description of meteorological measurements used as input including the temporal and spatial resolution?	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
11.14 § 450.139 Toxic hazards for flight.	Prior to application acceptance, a means of compliance for § 450.139 must be accepted. Hazards associated with toxics utilized during licensed flight must be properly managed and compliance demonstrated with criteria in § 450.101.	§ 450.139(e)(1) • Does the methodology reference an accepted means of compliance for toxic risk analysis? § 450.139(f)(1) • Is a reference for what constitutes a toxic substance identified? • Are possible toxic release sources identified from: o Propellants? o Chemicals? o Combustion products? o Derivatives? § 450.139(f)(2) • Is there a list of toxic concentration and duration thresholds? § 450.139(f)(3) • Are meteorological conditions provided? § 450.139(f)(4) • Is a characterization of terrain provided? § 450.139(f)(5) • Is the toxic dispersion modeled identified? • Is other input data to the toxic model provided? § 450.139(f)(6) • Are representative results of the toxic analysis provided? • Do the results include toxic concentrations and durations?	Phase 1: § 450.139(e)(1) § 450.139(f)(1) § 450.139(f)(2) § 450.139(f)(7) Phase 2: § 450.139(f)(3) § 450.139(f)(4) § 450.139(f)(5) Phase 3: § 450.139(f)(6) § 450.139(f)(8)

		§ 450.139(f)(7) • Are failure modes and probabilities of toxic scenarios provided? • Are representative results of a worst-case toxic release provided? § 450.139(f)(8) • Is the use of a containment or risk assessment approach specified? • If a containment approach is used: o Is there a description of evacuation plans? o Is there a description of meteorological constraints and associated launch commit criteria? • If a risk assessment approach is used: o Is there a demonstration of compliance with safety criteria? o Is population data provided? o Is there a description of risk mitigations?	

12 PRESCRIBED HAZARD CONTROLS FOR SAFETY-CRITICAL SYSTEMS

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
12.1 § 450.141 Computing systems.	In pre-application, FAA reviews documentation to define an agreed set of computing system safety items, assess the criticality of each computing system safety item, and evaluate the development processes for the computing system safety items to verify sufficient rigor. The identification and assessment of computing system safety items (CSSI) is accomplished through § 450.107 functional hazard analysis, flight hazard analysis, and/or other software safety analysis. With respect to "evidence", this means artifacts of the development process, such as design documents, test reports, etc.	§ 450.141(d)(1) • Is there a list of computing system safety items (CSSI)? • Is there a description of how severity is determined? • Is there a description of how degree of control is determined? • Is the degree of control specified for each CSSI? • Is the severity of outcome specified for each CSSI? • Are criticality levels defined? • Is the level of criticality specified for each CSSI? § 450.141(d)(2) • Are there safety requirements for each CSSI? • Is a description of the approach for identifying safety requirements included? • Is a description of the approach for evaluating each safety requirement included? § 450.141(d)(3) Is there documentation of: • Responsibilities for tasks associated with CSSIs?	Phase 1: § 450.141(d)(1) § 450.141(d)(3) Phase 2: § 450.141(d)(2) Phase 3: § 450.141(d)(4) § 450.141(d)(5)

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		• Processes for internal review and approval of CSSIs? • Processes to ensure development personnel are trained, qualified, and capable of performing their role? • Processes that trace requirements to verification and validation evidence? • Processes for configuration management? • Processes for testing? • Reuse policies? • Third-party product use policies? § 450.141(d)(4) • Is there evidence of the development process being executed for each CSSI? § 450.141(d)(5) • Is there evidence for verification of implementation of each safety requirement identified for each CSSI?	
12.2 § 450.143 Safety-critical system design, test, and documentation.	The robustness of safety-critical systems must be demonstrated via compliance to the design, test, and documentation requirements of § 450.143. Safety-critical systems of flight systems are primarily identified via § 450.107 functional hazard analysis. Additional "safety-critical	§ 450.143(f)(1) Safety-critical systems • Is there a list of safety-critical systems? • Is there a description of each safety-critical system? § 450.143(f)(2) Drawings • Are there drawings and/or schematics that include every safety-critical system?	Phase 1; Phase 2-4 for completion qualification and acceptance with results / data and resolution of findings

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	system" designations may be determined via § 450.109 flight hazard analysis, flight safety analysis, § 450.185 ground hazard analysis, or other system safety analyses. Safety-critical systems may be excluded per § 450.143(a)(2).	§ 450.143(f)(3) Operating environments, for each safety-critical system identified in (f)(1): • Is there a summary of the analysis approach to determine the predicted operating environments? • Does each summary discuss how the duration of associated testing is determined? • Does each summary discuss how service-life is determined? § 450.143(f)(4) Validation • Is there a description of method(s) used to validate the predicted operating environments? § 450.143(f)(5) Aging • Is there a description of instrumentation or inspection processes to monitor aging of each safety-critical system? § 450.143(f)(6) • Are there criteria and procedures for disposal or refurbishment for service life extension of safety-critical system components? § 450.143(f)(7) • Is there a description of the standards used for different phases of the system lifecycle? Normally this is a list of documents with a summary description and how they are applied to the system lifecycle.	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
12.3 § 450.145 Highly reliable flight safety system.	Part § 450.35(a) requires that a means of compliance must be accepted by the Administrator for the § 450.145(b) Highly reliable Flight Safety System prior to application acceptance. The flight safety system includes the Flight Termination System and the Range Tracking System. FAA regulations identify RCC 319 and RCC 324 as a means of compliance accepted by the Administrator for § 450.145 Highly Reliable FSS.	Is there an accepted Means of Compliance specified? *This is normally a mature draft of tailored versions of RCC 319 and 324.* § 450.145(d)(1) • Is there a description of the flight safety system? • Does the description include: o Flight safety system component list, including vendor and heritage (if any)? o Function(s) of each component? o Operational scenario(s), including launch locations or Ranges? • Is there a method for predicting the environments for each operational scenario and mission phase? § 450.145(d)(2) • Is there a flight safety system design, including top level block diagrams and schematics? • Do the diagrams include: o Subsystems? o Interconnections between systems? § 450.145(d)(3) • Is there a list and schedule for submitting the analyses and documentation required to support the reliability and confidence of a highly reliable flight safety system? • If using a tailored RCC 319, does this list include: o Flight safety system report?	Phase 1: MOC § 450.145(d)(1) § 450.145(d)(2) § 450.145(d)(3) Phase 2: § 450.145(d)(4) § 450.145(d)(5) Phase 3: § 450.145(d)(6)

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Component preliminary and critical design reviews? ○ Reliability analysis? ○ Bent pin analysis? ○ Single point failure analysis? ○ Fratricide analysis? ○ RF link and radiation analysis? ○ Sneak circuit analysis? ○ Power budget analysis? ○ Breakup analysis? ○ Command and auto destruct timing analysis? ○ Qualification by similarity analysis? ○ Software & firmware analysis? § 450.145(d)(4) • Is there a schedule for submitting procedures for validating tracking data? § 450.145(d)(5) • Is there a list and schedule for submitting the qualification and acceptance test plans and procedures? • Is there a schedule for conducting approved test procedures? § 450.145(d)(6) • Is there a monitoring plan for operating environments? If using a tailored RCC 319 and the system is intended for reuse on multiple flights, does the plan include a discussion of assessment of component life remaining?	

13 OTHER PRESCRIBED HAZARD CONTROLS

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe

13.1 § 450.147 Agreements.	The FAA requires documentation of written agreements between the operator and applicable outside entities. The entities include three types: site operators, entities as identified as needed to control hazard areas (per § 450.161), and entities providing emergency response.
	
	These agreements need not be signed at the time the application materials for this requirement are submitted. The agreements should be ready for signature and available for the FAA to request. If operating from a site that holds an existing agreement covering vehicle operations, that agreement may be used in lieu of developing a new agreement.
	
	With respect to the U.S. Coast Guard, a letter of intent is sufficient as an agreement, per the FAA *United States Coast Guard Letter of Intent (LOI) Policy Statement*. https://www.faa.gov/space/legislationregulationguidance/uscg-letter-intent-loi-policy-statement
		• Is there a list of agreements?
		• Is there a description of each agreement?
		• Are there effective dates for each agreement?
		• Does the list include agreements with:
		  ○ Site operator(s) for each launch or reentry site or a statement that the applicant is the site operator?
		  ○ Maritime authority(ies) for Issuance of Notice to Mariners or a statement that no water areas will be affected?
		  ○ Air navigation authority(ies) for Issuance of Notices to Air Missions [formerly Airmen]?
		  ○ Entity(ies) providing emergency response services?
			Phase 2

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
13.2 § 450.149 Safety-critical personnel qualifications.	The performance-based requirement set forth in § 450.149 allows operators to document and describe how it will satisfy the personnel qualification program requirements and identify by position those individuals who implement the program. During pre-application consultation the applicant will discuss and identify the expected safety-critical tasks and safety-critical personnel qualifications, including training. The discussion will involve internal training and currency requirements, completion standards, or any other means of demonstrating compliance with the regulation. The applicant will be informed that the FAA may request and review documentation or observe activities while on site to verify compliance.	§ 450.149(b)(1) • Is there a list of safety-critical tasks (per § 450.107) that qualified personnel must perform? § 450.149(b)(2) • Is there a description of requirements for training for each identified task? • Is there a currency requirement (or specified as none) for each identified task? • Is there a description of capability (e.g., physical, medical) requirements for each identified task? § 450.149(b)(3) • Is there a description of the process for tracking currency?	Phase 1: Preliminary submission Phase 3: Final submission
13.3 § 450.151 Work shift and rest requirements.	The performance-based requirement set forth in § 450.151 allows operators to take into account factors affecting crew rest and adopt mitigations and procedures unique to their launch operation. During pre-application consultation the applicant will be asked to discuss work shift and rest requirements, and the plan for implementing rest requirements that ensure safety critical personnel are physically and mentally capable of	§ 450.151(c) • Is there a set of rest rules for safety-critical personnel? • Do the rules include: o The duration of the work shift? o A process for extending a work shift? o A maximum allowable length of extension of a work shift?	Phase 1: Preliminary submission Phase 3: Final submission

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	performing assigned tasks. The applicant will be informed that FAA may request and review documentation or observe activities while on site to verify compliance. **Note:** Safety-critical personnel may be determined via association with safety-critical systems (identified via § 450.107 functional hazard analysis), § 450.109 flight hazard analysis, flight safety analysis, § 450.185 ground hazard analysis, or other safety analyses.	○ The number of consecutive work shift days allowed? • Do the rules include a minimum period of rest required: ○ Between work shifts? ○ Prior to flight countdown work shift? ○ After the maximum number of work shift days allowed? • Do the rules include a description of the approval process for any deviation from the rest requirements?	
13.4 § 450.153 Radio frequency management.	Radio frequency (RF) management is a prescribed hazard control that ensures that the applicant has a plan to ensure RF interference does not adversely affect public safety and that the operator appropriately communicates frequency usage to key impacted stakeholders of the spectrum. If launching from an accepted Federal range the applicant will meet the § 450.153(a)(2) requirement by following current range process. **Note:** Safety-critical systems of flight systems are primarily identified via § 450.107 functional hazard analysis. Additional "safety-critical system" designations may be determined via § 450.109 flight hazard analysis, flight safety	• Is there a means of compliance (MOC) specified? • If operating from a Federal range, where the range has been accepted per § 450.45(b) for RF management, the agreement with the site, per § 450.147, specifying responsibility should be specified as the MOC for § 450.153(a)(2). • If utilizing § 417.111(f) as an MOC, is there a description of how the RFs will be coordinated with site operator(s) and/or government authorities, per § 450.145(b)(2)? • If utilizing another MOC: ○ Is there a description of the procedures to ensure RF	Phase 1: MOC Phase 3: 145(b)(2)

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	analysis, § 450.185 ground hazard analysis, or other system safety analyses.	interference does not affect performance of safety-critical systems? o Does the description include a discussion of each flight safety system and safety-critical system? o Is there a description of how the RFs will be coordinated with site operator(s) and/or government authorities, per § 450.145(b)(2)?	
13.5 § 450.155 Readiness.	An operator must conduct a readiness review(s) for flight, including a determination to proceed. During pre-application consultation the applicant will be asked to discuss its procedures and processes that will be used to assess readiness to proceed with the flight of a launch or reentry vehicle. The applicant will be informed that FAA may request and review documentation or observe activities while on site to verify compliance. **Note:** Safety-critical systems are identified via § 450.107 functional hazard analysis. Additional "safety-critical" designations may be determined via association with safety-critical systems, § 450.109 flight hazard analysis, flight safety analysis, § 450.185 ground hazard analysis, or other safety analyses.	§ 450.155(b)(1) Procedures • Is there a description of procedures used to assess readiness to proceed with flight? • Does the description of procedures include the readiness of: o The vehicle? o Each launch, reentry, and landing site(s)? o Contingency abort sites, if any? o Safety-critical personnel? o Safety-critical systems? o Safety-critical software? o Safety-critical procedures? o Safety-critical equipment? o Safety-critical property? o Safety-critical services? • Does the description include readiness to implement the mishap plan?	Phase 1: Preliminary submission Phase 3: Final submission

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		§ 450.155(b)(2) Criteria • Is there a description of the criteria for establishing readiness? • Are there readiness criteria for: o The vehicle? o Each launch, reentry, and landing site(s)? o Contingency abort sites, if any? o Safety-critical personnel? o Safety-critical systems? o Safety-critical software? o Safety-critical procedures? o Safety-critical equipment? o Safety-critical property? o Safety-critical services?	
13.6 § 450.161 Control of hazard areas.	In accordance with § 450.161, the launch or reentry operator must perform surveillance sufficient to verify or update the assumptions, input data, and results of the flight safety analyses. Flight hazard areas are defined in accordance with § 450.133 and § 450.139(b)(3). 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. During pre-application consultation, the applicant is encouraged to discuss and describe its plan for the control of hazard areas, including publication and verification.	§ 450.161(a) Control and Surveillance • Is there a description of how day-of-flight control of hazard areas will be performed for: o Land? o Water? o Airspace? • Is there a description of how day-of-flight surveillance of hazard areas will be performed for: o Land? o Water? o Airspace? • Is there a description of the process to verify that the control and hazard	Phase 1: Preliminary submission Phase 2: Final submission

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	An example of means of compliance for § 450.161 can be found in AC 450.161-1, "Surveillance and Publication of Hazard Areas".	plans are consistent with the flight commit criteria? § 450.161(b) Warnings • Is there a description of how hazard areas will be publicized for: o Land? o Water? o Airspace? § 450.161(c) Toxics • Is there a description of how flight commit criteria will be established due to the potential for toxic hazards? (or a statement that there are no toxic hazards).	
13.7 § 450.163 Lightning hazard mitigation.	This regulation allows two options: 1. Mitigating the potential for lightning strikes or initiation 2. Design of the vehicle to protect safety-critical systems from the effects of lightning. The first option requires per § 450.35(a) an accepted means of compliance prior to application acceptance. The second option would include documentation of the methods and standards applied to the design. **Note**: Safety-critical systems are identified via § 450.107 functional hazard analysis.	• If the flight commit criteria are being used as mitigation: o Is an accepted means of compliance for determining flight commit criteria based on lighting specified? o Are representative flight commit criteria regarding lightning provided? • If lighting protection is used: o Is there documentation of the methods to protect all safety-critical systems? o Does the documentation include a discussion of: ▪ Direct lighting strikes? ▪ Nearby discharge?	Phase 1: Preliminary submission Phase 3: Final submission

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
13.8 § 450.165 Flight commit criteria.	Flight commit criteria are essential for ensuring that the assumptions underlying the safety analyses are valid. Flight commit criteria are dependent on some products of the analysis process, and thus specific criteria may change for different operations during a license. However, each vehicle should have a template for flight commit criteria and a process for updating specific values. Clarity of flight commit criteria is also critical so there is no ambiguity in the decision process. § 450.165(a) lists seven specific topics that must be considered for inclusion in the criteria. There are two options for submission: 1. Template + example: a template of flight commit criteria covering all the topics in § 450.165(a) which are relevant. The template should have placeholders for values determined for each operation and a specific reference to the source of each value. The material should also include an associated example with values assigned to placeholders. 2. A complete static list of flight commit criteria which may not be changed without a license modification, covering all the topics in the § 450.165(a) that are relevant. **Note:** Safety-critical systems of flight systems are primarily identified via	• Is there a list of flight commit criteria, or a template list? • Do the criteria include the following: o Surveillance of any region of land, sea, or air? o Monitoring of any meteorological condition? o Launch or reentry window for the purpose of collision avoidance? o Confirmation that any safety-critical system is ready for flight? o Confirmation from the FAA regarding risk to critical assets? o For any reentry vehicle, status of safety-critical systems? o Any other hazard controls (or a statement that there are none)? • If a template is submitted: o Is there a specific reference to the source of the value for each placeholder in the template? o Is there an example complete list as would be used for an operation?	Phase 1: Preliminary submission Phase 3: Final submission

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	§ 450.107 functional hazard analysis. Additional "safety-critical system" designations may be determined via § 450.109 flight hazard analysis, flight safety analysis, § 450.185 ground hazard analysis, or other system safety analyses.		
13.9 § 450.167 Tracking.	The system used to track the vehicle is required to provide data to determine the actual impact locations of all stages and components, and to obtain vehicle performance data for comparison with the pre-flight performance predictions. The FAA intended the requirements to capture current practice. During pre-application consultation the applicant will discuss and describe the method or system used to meet the tracking requirements. Means of compliance for § 450.167 are AC 450.167-1 and RCC 324-11.	• Is there a description of a method used for tracking? • Does the method discuss measuring and recording in real-time? • Does the method discuss recording position and velocity with respect to time? • Is there a description of systems used for tracking?	Phase 2
13.10 § 450.171 Safety at end of launch.	To address Safety at the End of Launch the FAA imposed § 450.171 to provide requirements for the prevention of creating orbital debris, with which an applicant would be required to demonstrate compliance in its application. During pre-application consultation the applicant will discuss and describe its plans to demonstrate compliance to mitigate orbital debris generated from vehicle stages or components that reach earth orbit.	• Is there a description of how safety at the end of launch will be ensured? • Does the description include a discussion of the prevention of unplanned physical contact between: o The vehicle and any of its components? o The vehicle and the payload? • Is there a list of potential residual energy sources?	Phase 2

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	A means of compliance for § 450.171 is the Inter-Agency Space Debris Coordination Committee IADC-02-01: IADC Space Debris Mitigation Guidelines or the U.S. Government Orbital Debris Mitigation Standard Practices	• Is there a discussion of the process for: o Depleting residual fuel? o Leaving all fuel line valves open? o Venting each pressurized system? o Discharging all batteries? o Removing other sources of energy, if any?	
13.11 § 450.173 Mishap plan–reporting, response, and investigation requirements.	In accordance with 14 CFR § 450.173(h), an applicant must submit a mishap plan, or other written means, containing processes and procedures for reporting, responding to, and investigating a mishap in accordance with § 450.173(b) through (g). During pre-application, FAA will work with an applicant to ensure the processes and procedures outlined in an applicant's mishap plan contain sufficient detail to allow for FAA evaluation and approval, and for the applicant to implement the plan in the event of a mishap. This consultation will include guidance and lessons learned based on previous mishaps. To aid the applicant in developing their mishap plan, the FAA published AC 450.173-1 Mishap Plan – Reporting, Response, and Investigation Requirements. To facilitate review of a mishap plan, applicants should identify whether the mishap plan is applicable to a single launch	• Is there a mishap plan or other written documentation of the response to a mishap? • Does the documentation include a description of: o Responsibilities of personnel? o Personnel reporting responsibilities? o Allocation of roles/responsibilities between the site operator and launch operator? o Reporting timelines? o Special reporting for fatalities or serious injuries? o The contents of the preliminary mishap report? o Evacuation plans? o Fire extinguishing plans? o Hazard area surveillance? o Securing impact areas? o Disposal of hazardous materials? o Controlling hazards at the site?	Phase 3

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	vehicle type, configuration, location, or applicable to multiple vehicles and locations. **Note***:* For plans applicable to multiple vehicles or locations, the FAA may require additional information to verify the satisfaction of applicable requirements for all vehicle types and locations.	○ Controlling hazards at the impact areas? ○ Preserving data? ○ Preserving physical evidence? ○ Agreements with government authorities regarding mishaps? ○ Agreements with emergency response services regarding mishaps? • Is there a documentation of mishap investigation process? • Does the process discuss: ○ Investigation of root causes? ○ Reporting results to the FAA? ○ Implementation of measures to avoid recurrence? • Is there a discussion of records preservation methods? • Is there a discussion of records retention conditions? • Is there a discussion of records access to FAA officials?	
13.12 § 450.175 Test-induced damage.	This section applies to license applicants or operators seeking an optional test-induced damage exception under 14 CFR § 450.175. This regulation only applies if there is a test event that caused damage and the operator wishes to apply for an exception. This is more common as a license modification than during the initial license phase. The FAA will consider test failures and	• Is there a document containing: ○ Test objectives? ○ Test limits? ○ Expected outcomes? ○ Potential risks, including the applicant's best understanding of the uncertainties in environments, test limits, or system performance?	Prior to planned test activity

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	damage covered by this section, including damage to ground support equipment, ground support systems, and flight hardware, as test-induced damage and not a mishap, so long as the failure falls within the pre-coordinated scope and FAA-approved testing profile. Any mishap resulting in a serious injury or fatality, damage to property not associated with the licensed activity, or hazardous debris leaving the pre-defined hazard area, will be treated as a mishap and not test-induced damage, and will be subject to the reporting, response, and investigation requirements of 14 CFR § 450.173. A license applicant or operator must coordinate potential test-induced damage exception 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.	○ Applicable procedures? ○ Expected time and duration of the test?	
13.13 § 450.177 Unique safety policies, requirements, and practices.	The FAA expects that advances in technology and implementation of innovations by launch and reentry operators will likely introduce new and unforeseen public safety considerations. In this case, the FAA must work with operators on a case-by-case basis to identify and mitigate any unique hazards posed to	• Are unique hazards identified, or specified as none? • If unique hazards are identified: ○ Have safety policy, requirements, or practices been included in the application? ○ Is there documentation of demonstration that public health and safety is protected with respect to each hazard?	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
	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. However, during pre-application consultation the FAA will inquire and afford the applicant the opportunity to discuss and identify any unique safety policies, requirements, and practices pertaining to its operations.	○ Is there documentation of demonstration of compliance with each policy, requirement, or practice developed in response to this hazard?	

14 GROUND SAFETY

14.1.1 Ground Safety consists of sections §§ 450.179 through 450.189. Section 450.179 provides general requirements for demonstrating compliance to ground safety requirements discussed in §§ 450.181 through 450.189. Section 450.179(a) requires an operator at a U.S. launch or reentry site to protect the public and property from adverse effects of hazardous operations and systems during licensed ground activities. Section 450.179(b) does not require an operator to comply with ground safety requirements discussed in §§ 450.181 through 450.189 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.

14.1.2 In the case of § 450.179(b)(3), the FAA has published: (1) the "*Ground Safety Policy,* dated 3 Nov 2020", which discusses FAA rationale for acceptance of ground safety processes, requirements, and oversight at Cape Canaveral Air Force Station, Vandenberg Air Force Base, Wallops Flight Facility, and Kennedy Space Center, and (2) FAA-DAF-SLR-2021.01, which documents a Memorandum of Agreement for launch and reentry activity at Department of the Air Force Ranges and Installations.

14.1.3 If required by § 450.179(a), an operator will need to document and demonstrate compliance with §§ 450.181 through 450.189 by coordination with a site operator (450.181), an explosive site plan (450.183), ground hazard analysis (450.185), toxic hazard mitigations for ground operations (450.187), and ground safety prescribed hazard controls (450.189).

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
14.2 § 450.179 Ground safety – general.	At a U.S. launch or reentry site, the public and property must be protected from adverse effects of licensed ground operations via either: (1) demonstrated compliance to the requirements of §§ 450.181 through 450.189, or (2) § 450.179(b) exception.	• If an applicant proposes to use § 450.179(b) exception, the FAA requests a copy of the written agreement in accordance with § 450.147(d)(2). • Is there a description and copy of the written agreement with the Federal launch or reentry site for the provision of ground safety services and oversight in section § 450.147?	Phase 1
14.3 § 450.181 Coordination with a site operator.	Site coordination requirements for a launch or reentry conducted from or to a Federal launch or reentry site or a site licensed under part 420 or 433 of this chapter. This section applies when the launch or reentry operator is NOT the site operator. It is possible that multiple sites could be involved, such as a launch from one site and landing at another.	• Is there a description of coordination with each site? • Does the description include the following topics: o Control of public access? o Coordination with other site users? o Designation of ground hazard areas? o Mishap response affecting the public? • For non-Federal sites, is there a description of ground mishap response coordination? • Does the description include roles and responsibilities?	Phase 1
14.4 § 450.183 Explosive site plan.	Explosive siting requirements for a launch or reentry conducted from or to a site exclusive to its own use.	• Is there an explosive site plan and supporting data, addressing: o Separation distance requirements for handling division 1.1 and 1.3 explosives. o Separation distance requirements for storage of hydrogen peroxide, hydrazine, and liquid hydrogen and any incompatible energetic liquids stored within an intraline distance.	Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Separation distance requirements for handling incompatible energetic liquids that are co-located. ○ Separation distance requirements for co-location of division 1.1 and 1.3 explosives with liquid propellants? ○ Separation distance measurement requirements?	
14.5 § 450.185 Ground hazard analysis	A ground hazard analysis identifies key integrated system design and operation data, documents the overall ground safety risk to the public, and determines the necessary hazard controls (mitigations) to ensure the residual risk meets acceptable criteria. The ground hazard analysis should be performed early in system development and operation conceptualization to define the ground safety risk to the public in order to positively influence design and operation decisions. AC 450.103-1, *System Safety Program*, provides guidance on severity categories and likelihood levels in Table 3 and Table 4 of Appendix A, including acceptable	• Is there a description of the ground hazard analysis methodology for the lifecycle? • Does the ground hazard analysis identify hazards, including system and operation hazards? • For each hazard, is there identification of: ○ Likelihood? ○ Severity? ○ Is there definition of what constitutes "extremely remote" and "remote" likelihood? • For every hazard with a severity of "death or serious injury", is the mitigated likelihood "extremely remote"? • For every hazard with a severity of "major damage to property not associated with the launch or reentry", is the mitigated likelihood "remote"? • Are risk elimination and mitigation measures identified and described? • Are verification methods for risk elimination and mitigation measures identified and described?	Phase 1; Phase 2-3 for completion of § 450.185(e) validation effort

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe

	criteria for "remote," and "extremely remote."	• Is there documentation of verification and validation achieving the risk level above?
		• Is traceability demonstrated in the ground hazard analysis data:
		  ○ For each hazard is there at least one failure?
		  ○ For each hazard, is there as least one mitigation?
		  ○ For each failure, is there at least one cause?
		  ○ For each cause, is there at least one mitigation?
		  ○ For each mitigation, is there at least one verification?
		• For each mitigation, is there a risk assessment?	

14.6 § 450.187 Toxic hazards mitigation for ground operations.	Prior to application acceptance, a means of compliance for § 450.187 must be accepted.
	
	Hazards associated with toxics utilized during licensed ground operations must be properly managed and compliance demonstrated with criteria in § 450.185(c).
		§ 450.187(e)(1)
		• Does the methodology reference an accepted means of compliance for toxic risk analysis?
		
		§ 450.187(f)(1)
		• Is a reference list of toxic substances identified?
		• Are possible toxic release sources identified from:
		  ○ Propellants?
		  ○ Chemicals?
		  ○ Combustion products?
		  ○ Derivatives?
			Phase 1

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		§ 450.187(f)(2) • Is there a list of toxic concentration and duration thresholds? § 450.187(f)(3) • Are meteorological conditions provided? § 450.187(f)(4) • Is a characterization of terrain provided? § 450.187(f)(5) • Is the toxic dispersion modeled identified? • Is other input data to the toxic model provided? § 450.187(f)(6) • Are representative results of the toxic analysis provided? • Do the results include toxic concentrations and durations? § 450.187(f)(7) • Are failure modes and probabilities of toxic scenarios provided? • Are representative results of a worst-case toxic release provided? § 450.187(f)(8) • Is the use of a containment or risk assessment approach specified? • If a containment approach is used:	

Section	Narrative	Objective Criteria to Determine if the Application is Complete	Timeframe
		○ Is there a description of evacuation plans? ○ Is there a description of meteorological constraints and associated ground hazard controls? • If a risk assessment approach is used: ○ Is there a demonstration of compliance with safety criteria? ○ Is population data provided? ○ Is there a description of risk mitigations?	
14.7 § 450.189 Ground safety prescribed hazard controls.	Prescribed hazard controls ensure adequate mitigation for unique ground safety items associated with protecting public and property.	• Are processes and methods documented for protecting members of the public who enter any area under the control of a launch or reentry operator? • Are there procedures for identifying and tracking the public while on the site? • Are mitigations implemented identified by the ground hazard analysis and toxic hazard analysis?	Phase 1

OMB Control Number: 2120-0746
Expiration Date: 11/30/2024

Advisory Circular Feedback Form

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If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) emailing this form to 9-AST-ASZ210-Directives@faa.gov, or (2) faxing it to (202) 267-5450.

Subject: (insert AC title/number here) Date: Click here to enter text.

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph Click here to enter text. on page Click here to enter text..

☐ Recommend paragraph Click here to enter text. on page Click here to enter text. be changed as follows:

Click here to enter text.

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

Click here to enter text.

☐ Other comments:

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☐ I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____