



**Federal Aviation
Administration**

The Office of Commercial Space Transportation

Safety Management System Manual

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Signature Page

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Date

Document Change Record

Version	Date	Description
1.0	September 2007	Initial Release
1.1	April 2011	Added organizational update with new roles. Added discussion of other FAA LOBs SMS with planned interoperability with SMS Committee in accordance with FAA flight plan, updated safety policy discussion.
1.2	September 2012	Updated references including Explosive Siting rule.
1.3	September 2013	Added organizational update with new roles. Updated references including Tethered Vehicle Rule and FAA Safety Management System Guidance.
1.4	September 2014	Updated planned enhancement activities including maximum probable loss. Updated references.
1.5	April 2015	Added Description of Change record. Numerous editorial changes. Incorporated P-011: Pre-Application Consultation Process, Version 1.0, March 2015, procedural document.
2.0	December 2015	Comprehensive rewrite to improve clarity and consistency.
2.1	September 2022	Updated to reflect AST reorganization, renaming of Standard Operating Procedures, Safety Philosophy, and enhancements to SMS.

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I. Introduction

1. Scope.

- a. The Office of Commercial Space Transportation (AST) serves to protect the public health and safety, the safety of property, and the national security and foreign policy interests of the United States during commercial launch and reentry activities, and to encourage, facilitate, and promote US commercial space transportation.
- b. AST achieves the public safety¹ aspects of its mission through the application of a regulatory framework for commercial space transportation and through safety promotion activities, which together make up AST's safety management system (SMS).
- c. The AST SMS reflects an integrated framework of formalized roles, responsibilities, accountabilities, policies, and procedures that are used to manage safety in the course of AST's day to day operations. In the event of a conflict between this document and the foundational documents that comprise the elements of AST's SMS (i.e., AST's governing statutes, regulations, orders, policies and procedures, etc.), the contents of those documents take precedence over this manual.
- d. This document seeks to outline AST's current SMS implementation, as well as AST's approach to continuously improving and refining the SMS. It fulfills the requirements of FAA Order 8000.369(Series), *Safety Management System*.
- e. This document does not address occupational health and safety considerations for AST personnel or facilities.

2. Audience. All AST personnel (management and staff).

3. Structure. This document is organized to address each of the four components of AST's SMS: safety policy, safety risk management, safety assurance, and safety promotion.

II. AST Safety Philosophy

This section describes AST's safety philosophy with guidance included to elaborate and provide clarity.¹

1. Public Safety – Top Priority

AST's top priority is public safety² when licensing and regulating commercial space launch and reentry operations.

- a. Public safety is the driving force and ultimate determinant in AST licensing. AST will not review and approve a license, license modification, or waiver request if it is submitted in a timeframe (e.g., close to flight) that doesn't provide adequate time for AST evaluation.
 - AST will not make or issue a license determination if a safety evaluation is not complete.

¹ Special or unique situations may require additional AST management direction or guidance.

² For the purpose of this document, the term public safety refers to the safety of people and property not involved with an FAA licensed or permitted launch or reentry operation.

- AST strives to be responsive, but it will take the required time necessary to evaluate an application thoroughly and not cut corners to rush a safety evaluation.
 - AST may prioritize an application evaluation based on factors that consider mission criticality and support public or national interests of the United States (e.g., mission involving NASA crew or cargo to the ISS or related to national security).
- b. While keeping public safety at the forefront, AST strives to provide commercial space transportation operators with maximum flexibility to innovate by regulating launch and reentry operations only to the extent necessary.
- Per 51 U.S.C. § 50901(7), the FAA is to regulate commercial space transportation operations only to the extent necessary to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States.
 - AST’s regulatory requirements are focused on public safety, not mission assurance, and do not ensure the public faces no risk at all. However, they are intended to ensure that adverse public consequences remain rare events and that the public safety risks are a small fraction of the background risks accepted by the public in the course of normal day-to-day activities (e.g. the risk posed by cars and trucks to pedestrians).³
- c. A waiver to a safety requirement may be granted when AST determines that the waiver is in the public interest and will not jeopardize public health and safety,⁴ the safety of property, or any national security or foreign policy interest of the United States.
- d. A disciplined evaluation process is essential to avoid making a rash or arbitrary decision based on insufficient analysis or “gut-reaction,” which could lead to serious consequences.
- On the other extreme, overthinking or overanalyzing a situation, or “paralysis by analysis” may be counterproductive, leading to indecisiveness or diverting resources from other critical areas.
 - AST staff are expected to follow standard operating procedures (SOP) when conducting an evaluation or consult with AST management for direction or guidance if an SOP may not be applicable or needs revision.

2. Human Space Flight – Occupant Safety

AST is currently statutorily limited in regulating occupant safety, but is committed in its statutory mission to encourage, facilitate, and promote the continuous improvement of the safety of commercial human space flight (HSF) through: research and development; issuing safety guidance and recommended practices; and planning for a future regulatory framework that provides some protection to occupants while not stifling the industry.

³ This has been an AST policy goal for more than 20 years. See page 19605 of Federal Register, Vol. 64, No. 76, 21 April 21, 1999. AST’s current individual and collective risk limits are less than 0.5% and 0.05% of the annual risk U.S. pedestrians accept, respectively.

⁴ An aspect of risk management applied to the regulation and general safety management of various industries, is to set the acceptability criteria for routine operational risks below the level that would be acceptable in usual circumstances on a short-term basis. Under certain conditions, waivers including those pertaining to pre-defined risk criteria, which continue to evolve, have been granted by AST when risks to the public remain sufficiently mitigated to be a small fraction of background risks and are consistent with the goal that adverse public consequences remain rare events.

- a. AST is prohibited from issuing any regulations governing the design or operation of a launch vehicle intended to protect the health and safety of crew and space flight participants unless there was a death, serious injury, or close call. The original prohibition or moratorium expired in 2012, but Congress extended it twice, to 2015 and then again to October 2023.
- b. As noted in 51 U.S.C. § 50901, space transportation is inherently risky and regulatory standards must evolve as the industry matures, so that regulations neither stifle technology development nor expose crew, government astronauts, or space flight participants to avoidable risks as the public comes to expect greater safety for crew, government astronauts, and space flight participants from the industry.

3. Raising/Reporting Safety Concerns and Being Proactive

Safety is everyone's responsibility. All AST personnel are accountable and empowered to raise safety issues or concerns without fear of reprisal, propose solutions, and seek ways to proactively enhance safety.

AST is committed to a workplace with a safety culture where employees at each level are engaged, and their inputs are valued such that they may raise or report safety concerns without fear of reprisal and recommend solutions to resolve them. Safety issues or concerns may be associated with risk to the public due to proposed launch or reentry operations, or they may pertain to the health and safety of AST personnel such as safety inspectors when performing their duties.

- a. Diversity of opinions, dissenting opinions, and healthy debate from all members of the organization help enable management to make informed decisions.
- b. Establishing safety procedures and policies and providing safety training and tools help reinforce AST's commitment and advocacy of safety at the management and staff level and ensure consistency between AST's safety philosophy and values.
- c. At the end of the decision-making process, management, after considering all viewpoints or opinions makes an informed decision or determination; however, management decisions and determinations are not required to be unanimity based.
 - Once a decision is made by management, it becomes the official FAA position on the matter and should be consistently communicated to avoid conflicting or confusing messages. The decision stands unless new information arises in the future that warrants the decision to be reassessed or changed by management.

4. Safety Inspections and Operator Responsibility

AST exercises a proactive and risk-based safety inspection approach to monitor operator compliance with the terms and conditions of a license and determine if operations are conducted according to the representations in a license application. An operator is ultimately responsible for ensuring regulatory compliance and public safety and safety of property.

- a. AST safety inspectors take a proactive approach, which includes explaining regulatory issues, informing operators early to avoid potential noncompliance, and cautioning operators on the spot when witnessing potential issues to return the operator back into compliance soonest (e.g., verbal counseling).
- b. AST safety inspectors are proactive and, while not required, may inform operators of any observed potential violation(s) or non-compliance(s) prior to or during an operation. Further, it is not the responsibility of the FAA safety inspector to correct or propose a remedy to a potential violation or noncompliance prior to or during an operation because it is the operator's responsibility to fully

comply with legal and regulatory requirements for launch or reentry. Further, an operator must know, without FAA intervention, when it should stand down (e.g. postpone a launch, stop the launch count, etc.), and if an operation would lead to a noncompliance with any commercial space transportation statute or regulations, its license orders, or representations made in its license application.

- c. AST uses a risk-based approach to determine the timing and level of a safety inspection, which includes deciding if it should be conducted onsite, remotely, or via data review. In general, an onsite and full inspection is conducted for launch operations that pose moderate to high risk due to a new or less experienced operator, significant first-flight hardware/process/event, or involves return to flight after a safety-critical related mishap.⁵ Spot inspections may be conducted for routine operations after an operator has demonstrated a disciplined and consistent pattern of conducting safe launch operations in compliance with its license and regulations. In addition, a launch site with limited or no launch operations from that site may not warrant an onsite inspection on an annual basis.

5. Compliance and Enforcement

The primary objective of AST's compliance and enforcement program is to promote compliance with statutory and regulatory requirements. The top priority is to protect the public and property, and bring the licensed/permitted organization back into compliance as quickly as possible through a range of options.

- a. A range of options for addressing noncompliance include educational and remedial training efforts, compliance actions, administrative actions in the form of a Letter of Correction or Warning Notice, as well as enforcement actions such as an operational stand-down, civil penalties, license/permit suspensions, and indefinite suspension of license/permit pending compliance, license/permit revocations, injunctions, and referrals for criminal prosecution. A formal enforcement action, such as a civil penalty, may not be the most appropriate or effective means. AST requiring an operator to stand down from flight until an investigation is completed to enable an operator to identify and address the cause of the noncompliance to prevent recurrence may also achieve the desired results. However, intentional or reckless deviations from regulatory standards or unwillingness or inability to comply in most cases will require formal enforcement actions such as a civil penalty or suspending/revoking a license.
- b. Operators have the responsibility for regulatory compliance and must monitor their own performance. Therefore, voluntary disclosure reporting serves an important role in achieving compliance and improving commercial space safety. AST is working with industry through the Commercial Space Transportation Advisory Committee (COMSTAC) and the ASTM F47 Standards Committee to establish the basis for a voluntary disclosure reporting system.

III. Safety Policy

1. AST's authorizing legislation is the foundation of AST's safety policy.

- a. The purposes of the Commercial Space Launch Act of 1984, as amended (CSLA), are, in part, to:
 - i. Provide that AST, by delegation, is to oversee and coordinate the conduct of commercial

⁵ A safety-critical related mishap may involve a malfunction of a safety-critical system or failure of the operator's safety organization, safety operations, or safety procedures.

- launch and reentry operations, issue permits and commercial licenses and transfer commercial licenses authorizing those operations, and protect public health and safety, safety of property, and national security and foreign policy interests of the United States; and
- ii. Facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities.⁶
- b. The Secretary of Transportation, and by delegation the FAA and AST, are authorized to issue regulations “only to the extent necessary... to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States,” and to carry out the requirements of the CSLA under the Secretary’s general authority to prescribe regulations under 49 USC §322(a).
 - c. In amending the CSLA in 2004, Congress enacted a moratorium (Learning Period) prohibiting the FAA from issuing regulations that protect occupant safety.⁷ In crafting the moratorium and the “learning period” that it represents for industry, Congress also tasked the FAA to encourage, facilitate, and promote the continuous improvement of the safety of launch vehicles designed to carry humans. The learning period expires in October of 2023.
 - d. Title 14, Chapter III of the Code of Federal Regulations (CFR) implements the CSLA mandates by defining the regulatory lifecycle, specifying the procedures and public safety requirements for each regulatory phase, and establishing the associated public risk thresholds for commercial space activities.
 - e. The CSLA and the commercial space transportation regulations form the foundation of AST’s SMS by providing a systematic approach to identifying, assessing, and controlling risks associated with commercial space transportation operations.
- 2. AST is committed to implementing, operating, maintaining, and continuously improving the AST SMS.**
- a. The Associate Administrator for Commercial Space Transportation (AST-1) is committed to implementing and operating AST’s SMS as the accountable executive.
 - b. AST’s management is committed to, and will continue to provide resources for, the implementation, operation, and continuous improvement of the AST SMS.
 - c. AST’s management is held accountable by AST-1 for:
 - i. Implementing, operating, integrating, and continuously improving the AST SMS,
 - ii. Communicating the requirements of the AST SMS to AST staff, and

⁶ 51 USC §50901(b)(3) and (4).

⁷ 51 USC §50905(c) identifies specific exceptions to the moratorium. In 2015, Congress extended the moratorium until October 1, 2023.

- iii. Overseeing the staff's compliance with the AST SMS.
 - d. AST's progress in implementing and executing its SMS is reported to AST's management during appropriate management review meetings.
- 3. **AST is committed to complying with applicable statutes and applying the regulatory requirements. The AST SMS does not replace or change AST's statutory or regulatory responsibilities.**
- 4. **AST is committed to managing safety risk.**
 - a. AST bases safety decisions on safety risk assessments conducted using formal, disciplined, and documented processes. These processes are defined by the commercial space transportation regulations, their associated guidance and policies, and AST's internal procedures documents and work guides.
 - b. Within AST, information resulting from safety risk analyses is communicated in an objective and unbiased manner to decision makers.
 - c. Decision makers, in turn, provide objective and unbiased feedback to the technical staff responsible for safety risk analyses regarding both process improvement and the technical merit of the analyses.
 - d. AST manages safety risk by applying, monitoring, and enforcing safety risk controls and continuously evaluating the adequacy of those controls.
- 5. **AST's management promotes a positive organizational safety culture.**
 - a. AST's management promotes an environment of open communication, mutual trust, and active engagement with all stakeholders.
 - b. AST's management recognizes the vital importance of AST's staff development, and strives to deliver training that enables the staff to grow professionally, meet their responsibilities, and to implement and maintain the AST SMS.
 - c. AST's management encourages staff to identify and report potential safety issues and concerns related to their job responsibilities.
 - i. AST's operational process and procedures documents outline a number of means for staff to identify and address potential safety issues and concerns while performing their assigned duties. These documents also outline ways for staff to raise potential safety issues or concerns to management for resolution.
 - ii. AST's management encourages employees to identify and resolve potential safety issues or concerns in accordance with procedures.
 - iii. Staff may utilize any voluntary reporting or disclosure programs available to FAA employees.

- iv. AST's management does not punish staff for identifying or raising potential safety issues or concerns, nor does raising potential safety issues or concerns affect personnel decisions in any way.⁸
 - v. AST's management encourages staff to propose solutions to potential safety issues or concerns and make suggestions for safety improvements, whenever possible.
 - d. AST's management reviews potential safety issues and concerns that are raised to management by staff, determines what action is appropriate, and ensures timely resolution of all validated safety issues or concerns.
- 6. AST upholds the FAA's standards for acceptable behavior.**
- a. AST's management recognizes the impact of employee behavior on safety and the implementation and operation of the AST SMS.
 - b. AST requires all employees to comply with the standards of conduct contained in:
 - i. FAA Order 3750.7 (Series), *Ethical Conduct and Financial Disclosure*, and
 - ii. *The FAA Human Resource Policy Manual (HRPM)*.
 - c. AST's management does not tolerate willful violations of laws, regulations, policies, or the standards of conduct in the *HRPM* and FAA Order 3750.7 (Series). Such actions and behavior are not protected under any voluntary employee reporting program.
 - d. AST employees must meet the responsibilities described in their position descriptions with respect to protecting public safety.
 - e. All AST employees should note that under the provisions of FAA Order 2300.2 (Series), *Employee Indemnification Policy and Procedures*, and Public Law 100-223, the FAA Administrator may only protect FAA employees from personal liability arising from their conduct when their acts are determined to be within the scope of their official duties.
 - f. All AST employees are legally obligated to protect classified, sensitive unclassified, and proprietary data.
- 7. The safety responsibilities and accountabilities of AST's management and staff are clearly defined.**
- a. AST-1 has the ultimate responsibility and is the accountable executive for the safety oversight of commercial space transportation as delegated by the FAA Administrator.
 - b. Any management official designated by AST's management must:
 - i. Ensure the establishment, implementation, and maintenance of processes, procedures, and tools necessary for the AST SMS, and

⁸ AST's management will address unacceptable behavior, however, even when the issue was voluntarily reported. Refer to item 6 for standards of acceptable behavior.

- ii. Provide status reports, as requested, to AST's management regarding the implementation and management of the AST SMS.
- c. AST's staff are responsible for operating and supporting the SMS by adhering to FAA and AST policies, procedures, and guidance in the execution of their duties.

8. SMS Manager General Responsibilities

- a. The SMS manager is the responsible individual and focal point for the development and maintenance of an effective safety management system. General responsibilities include:
 - i. Managing the coordinated development and support of the FAA's SMS framework, as well as AST's SMS Manual and associated training.
 - ii. Creating a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures.
 - iii. Serve as the designated representative for AST the FAA SMS Committee
 - iv. Utilizing and ensuring the 4 pillars of SMS are working in unison in AST.
 - v. Maturing and growing the SMS program.
 - vi. Actively seeking information on new ways of conducting SMS operations.
 - vii. Continuously evaluating the organizational health and welcoming new and innovative ideas.

9. AST's leadership has implemented an integrated organizational structure and operational processes that align with and support the commercial space transportation regulatory framework. Table 1 lists the primary safety responsibilities of each of AST's component organizations as they relate to AST's SMS.

Table 1: Summary of SMS Responsibilities for AST's Component Organizations

Safety Authorization Division (ASA-100)

- Develop, manage, and execute a comprehensive licensing and evaluation program to review and authorize applications for commercial space transportation launches, reentries, and the operation of launch and reentry sites in accordance with FAA regulations and the CSLA;
- Coordinate the evaluation of requests for relief to the specific regulatory provisions for authorized commercial space transportation activities, consistent with FAA regulations and the CSLA;
- Manage the Pre-Application Consultation process with potential applicants for FAA commercial space transportation authorizations;
- Develop, manage, and execute a comprehensive safety approval program in accordance with FAA regulations and the CSLA;
- Coordinate AST communications flow with operators⁹ to ensure a consistent, efficient, and effective flow of information; and

⁹ The term operator is sometimes used in this document to refer to all of the entities subject to commercial space transportation regulations, including potential applicants, applicants, and entities that hold AST-issued authorizations₁₁

- Develop, manage and execute the Environmental Compliance functions in support of the licensing and permitting processes.

Safety Analysis Division (ASA-200)

- Review and conduct qualitative and quantitative safety assessments as necessary to support AST evaluations of applications for authorization of launches, reentries, and spaceports;
- Develop and maintain AST's suite of safety analysis tools; and
- Review and approve ground rules and assumptions for safety analyses and maximum probable loss determinations.

Safety Assurance Division (ASA-300)

- Oversee FAA licensed and permitted activities involving the launch or reentry of expendable and reusable launch vehicles (to include safety approvals) and the operation of FAA-licensed launch and reentry sites to ensure compliance with FAA regulations;
- Maintain and coordinate safety inspector training qualifications;
- Develop, manage, and maintain a mishap response coordination program; and
- Execute appropriate enforcement actions.

Space Policy Division (ASZ-200)

- Develop, manage, and execute a comprehensive regulatory and guidance program in accordance with the CSLA;
- Support the commercial space transportation industry's development of voluntary consensus standards to promote the safety of human space flight;
- Manage the coordinated development and support of the FAA's SMS framework, as well as AST's SMS manual and associated training;
- Promote US policy and the commercial space transportation regulatory framework internationally; Promote US safety policy through interagency coordination.
- Manage Government partnerships for commercial space transportation authorizations

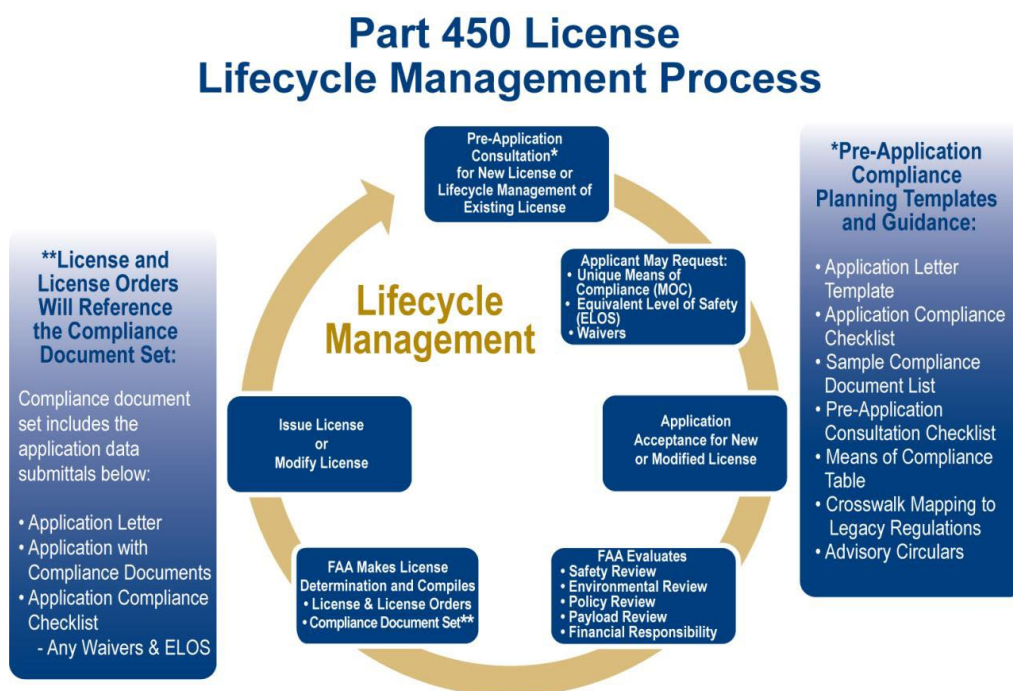
Space Innovation Division (ASZ-300)

- Manage the coordinated planning and execution of AST's research and development portfolio.
- Develop safety promotion programs including AST specific SMS education in coordination with the SMS manager to instill and maintain a strong safety culture within AST.

IV. Safety Risk Management

1. AST applies a safety risk management framework through the commercial space transportation regulations and AST’s processes.
 - a. Per FAA Order 8000.373 (Series), *Federal Aviation Administration Compliance Philosophy*, “The aviation and aerospace communities have a statutory obligation to comply with established regulatory standards. This obligation includes a duty to develop and use processes and procedures that will prevent deviation from regulatory standards.”
 - b. AST ultimately evaluates each application’s demonstration of public safety through compliance with the applicable regulations using a risk-informed process that accounts for the hazards and the environment in which the operation will occur.
2. The commercial space transportation regulations provide a comprehensive lifecycle framework for commercial space safety risk management, as illustrated in Figure 1.

Figure 1: The Commercial Space Transportation License Lifecycle Management Process



3. 14 CFR Chapter III contains the regulations that apply to all phases of the commercial space transportation regulatory lifecycle.
 - a. The regulations in this chapter stipulate the process for rulemaking, the requirements for pre-application consultation and application submission, the criteria for application evaluation, and the standards for monitoring commercial space operations.

It is important to note that the regulations comprise a *minimum* set of safety requirements governing commercial space operations. AST may not compel an operator to exceed the safety

requirements set forth in the commercial space transportation regulations. Operators may exceed these minimum safety standards at their discretion, but they have no obligation to do so.

- b. A commercial space operator is responsible for ensuring the safe conduct of an FAA-authorized operation and for ensuring public safety and the safety of property at all times during the conduct of an authorized operation.

4. AST issues non-binding guidance to assist applicants and potential applicants in understanding and complying with the commercial space transportation regulations.

- a. An advisory circular is a type of guidance that offers a means but not the only means of complying with a specific regulation.
- b. Guidelines are a type of guidance that provides explanatory information or clarifies an FAA policy or regulation.
- c. A handbook is a type of guidance that provides detailed instructions as to how to perform a particular task.
- d. A sample application is guidance in the form of a completed application intended to help applicants develop applications that meet AST's standards for acceptance.
- e. While not guidance per se, legal interpretations issued by the FAA's Office of Chief Counsel address specific legal issues pertaining to the regulatory framework and have precedential effect.

5. AST's process and procedures documents provide instructions for staff in meeting their responsibilities and top-level expectations.

- a. *Pre-Application Consultation Process* defines the procedures for pre-application consultation. Per this process, the purpose of pre-application consultation is for the applicant and the FAA to discuss and resolve potential issues relevant to the FAA's licensing or permitting decision prior to formal application submission.
- b. *License and Permit Application Reviews and Issuance Procedures* describes AST's procedures for the evaluation of an application for a license, permit, or approval. Through the application evaluation and authorization determination processes, AST determines whether and under what terms and conditions an applicant may conduct commercial space operations.
- c. *Safety Inspection Processes and Procedures, Safety Inspector Training & Certification Program, and Safety Inspector Roles & Responsibilities* contain AST's procedures for conducting inspections and other oversight activities for commercial space operations. The purpose of inspections and oversight activities is to monitor and enforce compliance with requirements and authorizations issued by AST.

6. AST uses processes for assessing and controlling risks that are objective, transparent, and open to all AST employees.

- a. AST's procedures highlight the means for any AST employee to raise potential safety issues or concerns.
- b. AST uses technical review board (TRB) meetings to assess, discuss, and make decisions regarding the development, application, and adequacy of AST's policies and regulations as they relate to potential safety issues and evaluations. AST documents the results of TRB meetings and makes them available to AST's staff for review.
- c. AST uses management review board (MRB) meetings to make decisions regarding the issuance of authorizations. All AST employees are invited to attend and raise issues or concerns at MRB meetings. The results of MRB meetings are documented and made available to AST's staff.

V. Safety Assurance

1. **AST requires a potential applicant to participate in pre-application consultation in accordance with the commercial space transportation regulations. This process is described in *Pre-Application Consultation Process*.**
 - a. Pre-application consultation enables a commercial space operator to obtain a clear understanding of the safety regulations and of the FAA's expectations for the operator.
 - b. Pre-application consultation also improves the operator's ability to provide the correct safety information in an initial application submission, which streamlines the evaluation process.
2. **AST conducts application evaluations to determine whether a license or permit should be issued in accordance with *License and Permit Application Reviews and Issuance Procedures*. The key components of the application evaluation process include the following:**
 - a. AST conducts policy and payload reviews to determine whether a proposed launch and payload present any issues affecting US national security or foreign policy interests, public health and safety, safety of property, or international obligations of the United States.
 - b. AST makes a financial responsibility determination, which is a calculation of the minimum amount of insurance required of a launch or reentry operator to compensate the maximum probable loss from claims by third parties and the US Government for damage or loss to government property.
 - c. AST conducts an environmental review to determine the potential environmental impact of commercial space operations because the issuance of an authorization is considered to be a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act.
 - d. AST conducts a safety review to determine whether an applicant can safely conduct a launch or reentry without jeopardizing the health and safety and the safety of property of those not involved with the mission.

- i. Because the operator is responsible for public safety, it is important that the applicant demonstrate an understanding of the hazards involved and document how the operations will be performed safely.
 - ii. There are a number of technical analyses, some quantitative and some qualitative, that the applicant may perform in order to demonstrate that its launch or reentry operations will not pose unacceptable risk to the public.
 - iii. The quantitative analyses tend to focus on the reliability and functions of critical safety systems, the hazards associated with the hardware, and the risk those hazards pose to public property and individuals near the launch site and along the flight path.
 - iv. The qualitative analyses focus on the organizational attributes of the applicant, such as launch safety policies and procedures, and communications, as well as those aspects of system safety assessments that do not lend themselves to quantified analysis.
- 3. AST monitors FAA-regulated operations to verify compliance with the Federal statutes, applicable regulations, the terms and conditions of the authorization, and the representations made in an operator's application. AST maintains and improves the application of risk controls through the following elements of AST's safety inspection program:**
- a. AST manages and communicates changes to internal procedures to staff through the following procedures documents.
 - i. *Safety Inspection Processes and Procedures* explains the overall AST safety inspection tasks, processes, and rationale. These comprehensive written procedures provide a documented instruction guide allowing safety inspectors to provide a consistent, common approach for safety assurance.
 - ii. *Safety Inspector Roles & Responsibilities* defines the roles and expectations for an AST safety inspector.
 - iii. *Safety Inspection Standardization and Evaluation (Stan/Eval) Program* governs the process to independently evaluate safety inspector performance, ensure a uniform application of procedures, ensure the proper implementation and evaluation of training, and evaluate the effectiveness of the safety inspection program as it pertains to the AST safety inspection mission and individual safety inspector duties.
 - b. Safety inspector training is key to an AST safety inspector's ability to provide the proper level of safety assurance.
 - i. The *Safety Inspector Training & Certification Program* internal procedures outline the standard training requirements and certification process for safety inspectors. All AST safety inspectors require certification and FAA credentials prior to independently conducting inspections. The certification and credentialing of AST safety inspectors follows FAA Order 8800.1(Series), *Commercial Space Transportation Safety Inspector Credential Program*.

- ii. *Safety Inspector Training for Non-Licensed/Permitted Activities* provides guidance for the use of non-licensed/permitted operations to supplement the AST safety inspector training process. These training procedures aid in providing a consistent safety assurance approach.
- c. The safety inspection process employs the use of a safety inspection plan (SIP), which guides an AST safety inspector in the verification process for a given operation through a series of checklist items. *Safety Inspection Processes and Procedures* outline the process for the development, configuration control, and modification of SIPs.
- d. ASA-300 conducts a safety inspection pre-brief prior to each safety inspection.
 - i. Safety inspectors discuss applicable public safety issues from past safety inspections as well as new specific issues for inspection or verification.
 - ii. This activity ensures all support personnel obtain a clear understanding of the public safety areas requiring verification during an FAA regulated operation in order to provide the appropriate level of safety assurance.
- e. ASA-300 conducts a safety inspection “hot wash” following each safety inspection. Safety inspectors discuss the applicable public safety issues observed, identify required corrective actions or follow-up actions, and share lessons learned for modifications to current procedures or regulations to improve safety assurance.
- f. Documenting and implementing lessons learned allows AST to improve its ability to maintain and increase safety assurance processes.
 - i. The hot wash meeting provides immediate lessons learned information to all AST divisions.
 - ii. ASA-300 documents and distributes all lessons learned via an annual report that includes recommended process modifications, identified regulatory errors, regulatory requirements which are incapable of supporting operational concepts and recommended changes, waivers and equivalent levels of safety granted, compliance and enforcement issues, mishap response lessons learned, annual metrics information, and required training modifications.
- g. ASA-300 prepares white papers to address more specific systemic safety issues discovered through the safety inspection process.
- h. Enforcement.
 - i. The *Compliance & Enforcement Program* internal procedures provide a written, standardized approach to the compliance and enforcement process. These procedures reflect the standard FAA practices reflected in FAA Order 2150.3(Series), *FAA Compliance & Enforcement Program* and train AST safety inspectors on the associated background and implementation.
 - ii. The AST compliance and enforcement process, which follows FAA Order 8000.373(Series), *Federal Aviation Administration Compliance Philosophy*, returns commercial space operators to a state of acceptable safe practices and compliance with FAA regulations, thereby

maintaining the expected level of safety assurance.

- i. Mishap Response. *Mishap Response Program* provides a written, standardized approach for AST to properly and consistently respond to mishaps, monitor mishap investigations, interface with stakeholders, and close out the FAA's investigation process through the anomaly review board process. These processes aid AST's ability to maintain or improve the level of safety assurance.
 - j. Situational Awareness. ASA-300 shares all safety inspection results and compliance actions by notifying all AST staff of noncompliance notifications, safety inspection reports, and related safety inspection documents. This process provides situational awareness on all related public safety issues associated with a given safety inspection campaign.
- 4. Each division of AST conducts periodic operational reviews to document lessons learned from operations and identify potential improvements in the regulatory framework or internal policies or procedures. Division managers are responsible for assimilating lessons learned into operational policies and procedures and implementing improvements to divisional processes. AST uses MRB and TRB meetings to consider potential changes to the regulatory framework or changes to policies and procedures that affect multiple divisions.**

VI. Safety Promotion

- 1. AST's mandate to encourage, facilitate, and promote US commercial space transportation is complementary to its regulatory mission to ensure the protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch or reentry activities. The commercial space transportation industry, and particularly that sector of the industry seeking to provide human space transportation, will not grow unless it is safe.**
- 2. AST strives to ensure that commercial space regulations and associated policies keep pace with the technological and operational developments in the commercial space transportation industry. Furthermore, AST strives to provide operators with sufficient guidance to understand and comply with the regulations.**
 - a. AST continuously assesses the effectiveness of commercial space transportation regulations, identifies changes to regulations that will improve the effectiveness and efficiency of the regulatory framework, and prioritizes the implementation of changes based on their projected impact.
 - i. AST strives to provide commercial space transportation operators with maximum flexibility to innovate and minimizes the regulatory burden on operators by establishing, where possible, a performance-based regulatory framework and by regulating only to the extent necessary to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States.
 - b. AST seeks to develop and implement common regulatory standards with Federal ranges—or standards that are functionally equivalent to the ranges' standards—to minimize the burden on commercial space operators while fulfilling AST's safety oversight responsibilities and making commercial space transportation operations more attractive to Federal customers.
 - c. AST provides guidance to operators—through direct engagement with industry stakeholders, posting items to the AST Web site, and publishing notices in the *Federal Register*—to assist them in complying with the commercial space transportation regulations. AST periodically assesses its

guidance to ensure that it clearly, comprehensively, and succinctly addresses regulatory issues, remains consistent with the regulations and with AST's policies and procedures, and promotes feasible approaches to compliance that minimize the burden on the operator.

- 3. AST promotes compliance with the regulations by applying the regulatory framework consistently and efficiently, and by conducting oversight in a collaborative and transparent manner.**
 - a. AST has implemented management practices and operating procedures designed to allocate resources and apply regulatory standards consistently and fairly among operators and operations.
 - i. AST exercises regulatory oversight consistently, fairly, and in a manner that respects individual companies' goals and objectives within the commercial space regulatory framework and AST's resource constraints.
 - ii. By computing realistic maximum probable loss values, AST limits Federal liability while requiring applicants to purchase only the minimum amount of insurance necessary.
 - b. AST strives to foster a culture of compliance among operators by conducting its oversight role in a collaborative and transparent manner.
 - i. AST takes a proactive approach to engaging with operators by educating them on the regulatory process, defining AST's responsibilities and expectations for operators, identifying potential regulatory issues as early as possible, providing guidance, and indicating potential means of complying with regulatory requirements.
 - (1) AST assists potential applicants in identifying and finding means of resolving potential safety issues early in the regulatory lifecycle to minimize the number and cost of subsequent safety mitigations required to comply with the regulations.
 - (2) AST provides assistance to applicants on methods for conducting safety analyses that are compliant with the regulatory requirements and facilitates their access to Government-developed analytical tools.
 - (3) AST's safety inspectors alert operators to potential violations as early as possible so that operators can correct or avoid instances of non-compliance and minimize disruptions to operations.
 - (4) Safety inspectors inform operators of the potential consequences of violations should an operator continue in an unadvised, non-compliant approach. This promotes safety and avoids needless enforcement action.
 - c. AST educates Federal partners on the commercial space regulatory framework to promote compliance and make commercial space transportation operations more attractive to Federal partners.
- 4. AST continually seeks to improve the practices, methods, and tools used to integrate commercial space launches and reentries into the National Airspace System (NAS) to enable safe, efficient, and flexible launch and reentry windows while minimizing disruption to other NAS users.**

- a. AST educates commercial space operators on the NAS and how space operations affect other NAS users.
 - b. AST acts as a liaison to the Air Traffic Organization (ATO) and the Airports Organization (ARP) on behalf of applicants and operators to facilitate agreement on the use of airspace and other NAS assets during commercial space transportation operations as well as on the establishment of commercial launch and reentry sites at operational airports.
 - c. AST supports airspace coordination and provides guidance during the planning and conduct of launch and reentry operations to facilitate safe operations.
 - d. AST leads the research of new technologies and systems to better integrate launch and reentry operations into NAS automation and decision support tools.
 - e. AST collaborates with air traffic personnel and operators to develop optimal operational hazard areas and reduce buffers to the minimum size necessary to achieve public safety objectives.
- 5. To promote the development of safe commercial space transportation technologies, systems, processes, and services, and reduce business risk for operators, AST evaluates applications for new commercial space transportation products and services and, as appropriate, issues safety approvals, policy determinations, and payload determinations.**
- 6. AST plans and executes its research and development program to address critical needs and emerging concepts.**
- a. AST conducts research into subject areas that are likely to have a significant impact on the future safety of the commercial space transportation industry. These areas include safe and efficient integration of increased commercial space launch and reentry activity into the NAS, advanced safety assessment methods, advanced vehicle safety technologies and methodologies, and human space flight safety and physiology factors.
 - b. AST compiles and analyzes data about the global commercial space transportation industry to identify trends and developments relevant to the US commercial space transportation industry.
- 7. AST promotes safety and the growth of the US commercial space industry by promoting the US regulatory framework internationally and working with international partners to harmonize regulatory standards.**
- 8. AST maintains recommended practices for human space flight occupant safety and supports the development of voluntary consensus standards for vehicles designed to carry humans.**
- 9. AST facilitates a robust informed consent regime so that potential space flight participants can fully understand the risks of space flight.**
- 10. Subject to available funding, AST may issue commercial space transportation infrastructure grants to promote the growth and safety of the commercial space transportation industry.**
- a. For example, AST has previously provided grants for:
 - i. Dedicated fire trucks at the Mojave Air & Space Port,

- ii. A security system at the Mid-Atlantic Regional Spaceport, and
- iii. The installation of automated weather observing systems at Spaceport America.

VII. Future Initiatives

1. **The timing and pace of the development and implementation of future initiatives will depend on several factors, including industry feedback on these concepts, and the resources available to both AST and industry stakeholders to support these initiatives.**
2. **Priority for future safety initiatives will focus on Congress’s direction to “encourage, facilitate and promote the continuous improvement of the safety of launch vehicles designed to carry humans,” recognizing the ongoing moratorium (Learning Period) that limits AST’s authority to issue regulations to protect occupants of space flight vehicles.**
3. **AST will strive to develop and implement a voluntary safety data reporting and analysis program in partnership with the commercial space industry.**
 - a. Recognizing the profound impact that voluntary safety data sharing has had on aviation safety, the FAA believes that facilitating an appropriate framework for voluntary safety data sharing can also bring significant continuous safety improvements to the emerging commercial human space flight operations.
 - b. Several challenges will need to be addressed in order to implement such a program, and it may take years to address them. These challenges include:
 - i. De-identification and protection of proprietary data. While the numbers of commercial space operators and operations conducted in the nascent space transportation industry remain low, it will be difficult to implement a data-sharing program that adequately preserves the anonymity of reporting operators;
 - ii. Creating a non-punitive environment for voluntary disclosure of safety information. As was the case with commercial aviation, legislative protections may be required to fully implement the non-punitive environment needed to support this type of program and the sharing of this type of information with the FAA and others in the industry; and
 - iii. Ensuring the availability of data mining and analysis tools to proactively identify emerging safety issues and lessons learned.
 - c. In advance of establishing an industry-wide data-sharing framework, AST will encourage commercial space operators to implement internal, company-sponsored safety management systems that leverage non-punitive voluntary reporting by flight crews and operational staff, along with the collection and analysis of detailed operational data. AST intends to provide guidance to operators as necessary. AST will also promote the creation of cooperative safety reporting programs that are analogous to the Flight Operations Quality Assurance (FOQA) and Aviation Safety Action Programs (ASAPs) successfully used by individual operators in the aviation industry.
 - i. FOQA-type programs enable operators and regulators to reduce or eliminate safety risks by collecting and aggregating data from each flight, and then analyzing it to identify issues and

trends that might only be evident over several flights.

- ii. ASAPs rely primarily on individuals to identify confusion, errors, or other similar issues that could lead to safety consequences.

4. Consensus Standards.

- a. Any regulatory agency overseeing a dynamic industry such as commercial space transportation will have a difficult time keeping pace using traditional regulatory approaches. One avenue available to AST is to take advantage of voluntary consensus standards to complement, augment, or, in some instances, replace regulations.
- b. Voluntary consensus standards can be developed by the industry and AST to serve as a means of compliance to AST public safety requirements. Voluntary consensus standards can also help to improve the safety of occupants of commercial spacecraft, although not regulated directly by AST.
- c. AST is working with ASTM and other voluntary consensus standards organizations to help create a standards roadmap or framework to support industry's development of voluntary consensus standards.
- d. AST will actively support industry development of individual voluntary consensus standards by being members of the standards development team, and will accept standards that follow established guidelines for voluntary consensus standards development.

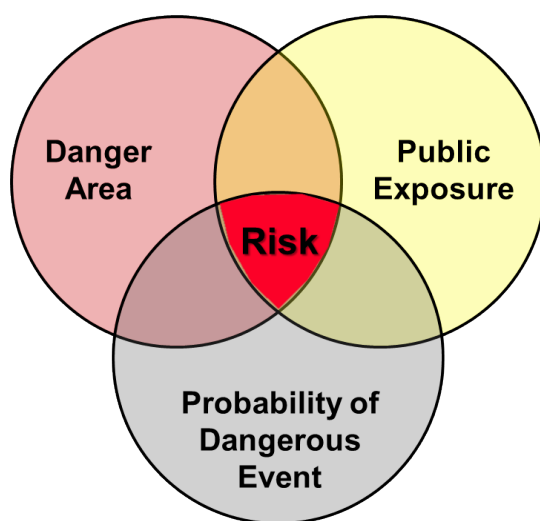
Appendix A: Public Safety during Commercial Space Operations

AST is statutorily directed to regulate commercial space transportation “only to the extent necessary...to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States.”¹⁰ This appendix explains the philosophy behind safety risk management and the key elements of AST’s approach to risk management.

The FAA was granted the authority to regulate commercial space transportation after the US Government had completed thousands of launches without any public casualties. However, the adverse public consequences suffered as a result of launch failures in other countries confirm that orbital launches are potentially very dangerous (i.e., space launches are capable of producing high public consequence events).

The fundamentals of public risk management are the same across all industries. Risk management involves a logical and systematic process to identify hazards and control the risk they pose. Hazard identification uses data on the planned performance and potential malfunctions to identify scenarios that could threaten the public. Risk controls for any scenario must address at least one of three key elements of risk, illustrated in Figure A1: (1) the probability of a dangerous event (such as a rocket crash), (2) the size of the danger area (such as the area destroyed by a rocket crash), and (3) the nature of the public exposure (such as the population density and sheltering provided in an area where a rocket could crash). Thus, public risks reflect the possibility of dangerous events that could produce serious public consequences.

Figure A-1: Key Elements of Risk



To illustrate these concepts, consider for example, that the public risk from an intact rocket impact may be controlled by reducing the probability of an intact impact, reducing the area destroyed by the impact

¹⁰ Congress found that “space transportation is inherently risky,” and simultaneously declared that “the goal of opening space to the American people and their private commercial, scientific, and cultural enterprises should guide Federal space investments, policies, and regulations.” Thus, Congress directed the Department of Transportation to encourage, facilitate, and promote the commercial space transportation industry, while regulating commercial space transportation activities “only to the extent necessary” to protect against risks that “jeopardize the public health and safety.”

(e.g. by ensuring the propellants are dispersed before impact), or by evacuating the public from the area that could be hit. As a result, there are a number of ways to potentially mitigate risk, and the level of effort required to demonstrate appropriate risk management is naturally linked to the size and complexity of the system, as well as the nature of the public exposure.

AST seeks to maintain a level of public safety where adverse public consequences remain rare events. AST enforces well-defined regulatory risk acceptance criteria that are grounded in the comprehensive set of public safety requirements that were initially developed and implemented by US Government agencies like the US Air Force and NASA, and that are supported by multiple lines of logic. Building upon this experience and approach, the FAA has implemented a comprehensive and interdependent set of public safety regulations that include specific operating requirements, specific safety requirements for critical systems, and the application of a public risk management process that uses quantitative analyses. A primary purpose of the public risk management process applied to launch and reentry is to facilitate informed decisions regarding the operating parameters and vehicle design features that are necessary to limit the predicted public risks to pre-defined criteria. It is important to understand that this is fundamentally different from defining operating parameters or design features that promote mission assurance, i.e., preventing vehicle failures.

One fundamental tenet of risk management is that acceptable risk levels are set with an understanding of the consequences of a hazard and the likelihood of its occurrence. While the consequences of the hazards of commercial space transportation operations are significant, the acceptable risk levels are typically only a small fraction of the “normal background risk...accepted in the course of normal day-to-day activities.”¹¹ AST’s risk limits equate to less than 1% of the annual risk accepted by US pedestrians.¹² The risk criteria set by AST in the commercial space regulations for licensed operations are the same for each mission.

These limits were set as a means to collectively manage the risk for the preponderance of current and expected future operations, consistent with the goal that adverse public events remain rare.

Another aspect of risk management, however—which is also applied to both the regulation and general safety management of various industries—is to set the acceptability criteria for routine operational risks below the levels that would be acceptable in usual circumstances on a short-term basis. For aviation risk management, the FAA has identified risk-informed Continued Airworthiness Assessment Methodologies (CAAM) that include short-term acceptable risks that are orders of magnitude greater than long-term acceptable risk levels.¹³ Thus, the FAA has officially adopted an aviation risk management approach where acceptability criteria are more restrictive than may be acceptable in unusual circumstances or on a short term basis. Note that the FAA’s use of quantitative risk analysis results is also consistent with the risk-informed approach to regulatory decision-making adopted by the Nuclear Regulatory Commission (NRC). In 1999, the NRC wrote that “a ‘risk-informed’ approach to regulatory decision-making represents a philosophy whereby risk insights are considered together with other factors to establish

¹¹ See page 19605 of Federal Register, Vol. 64, No. 76, 21 April 21, 1999.

¹² See Wilde P., “Public Risk Criteria and Rationale for Commercial Launch and Reentry,” 5th IAASS Conference, Versailles, France, October 2011.

¹³ Federal Aviation Administration, *Continued Airworthiness Assessments of Powerplant and Auxiliary Power Unit Installations of Transport Category Airplanes*, Advisory Circular 39-8, 8 September 2003.

¹⁰ Nuclear Regulatory Commission, *Risk-Informed and Performance-Based Regulation*. 1 March 1999, Web. 16 December 2015, <http://www.nrc.gov/reading-rm/doc-collections/commission/srm/1998/1998-144srm.pdf>

requirements that better focus licensee and regulatory attention on design and operational issues commensurate with their importance to public health and safety.”¹⁰ AST recognizes these standard risk management practices that are in use elsewhere within the US government. AST also recognizes that due to the other safety constraints imposed by the comprehensive commercial space transportation regulations, there are instances where, due to the unique circumstances of certain operations, the predefined risk criteria can be deviated from on a temporary basis without jeopardizing the public health and safety, or the safety of property. The unblemished public safety record of US space operations includes some instances where waivers were issued for a variety of requirements, including the predefined criteria for acceptable public risks. In this context, AST ultimately evaluates what is necessary to protect the public on a case-by-case basis using a risk-informed process to systematically identify, reduce, monitor, and ensure that any public risks are reasonable given the nature of the benefits provided to the public from that enterprise.

Appendix B: Referenced Documents

This appendix contains a list of the latest versions of documents referenced in the *SMS Manual*. Future amendments to these documents will be considered equally applicable.

FAA Order 2150.3B, *FAA Compliance & Enforcement Program*, CHG 10, 30 October 2015.

FAA Order 2300.2A, *Employee Indemnification Policy and Procedures*, 22 October 1993.

FAA Order 3750.7A, *Ethical Conduct and Financial Disclosure*, 24 October 2011.

FAA Order 8000.369A, *Safety Management System*, 8 May 2013.

FAA Order 8000.373, *Federal Aviation Administration Compliance Philosophy*, 26 June 2015.

FAA Order 8800.1A, *Commercial Space Transportation Safety Inspector Credential Program*, 7 April 2014.

Commercial Space Transportation Licensing Regulations, 64 Fed. Reg. 76, 21 April 1999.

Airport and Airway Safety and Capacity Expansion Act of 1987, Public Law 100-223, 101 Stat. 1486-1535, 30 December 1987.

Commercial Space Transportation, Federal Aviation Administration, Department of Transportation, 14 CFR Chapter III.

Federal Aviation Administration, Office of Commercial Space Transportation, *Mishap Response Program*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Compliance & Enforcement Program*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Pre- Application Consultation Process*.

Federal Aviation Administration, Office of Commercial Space Transportation, *License and Permit Application Reviews and Issuance Procedures*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspection Processes and Procedures*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspector Training & Certification Program*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspector Roles & Responsibilities*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspection Standardization and Evaluation (Stan/Eval) Program*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspector Training & Certification Program*.

Federal Aviation Administration, Office of Commercial Space Transportation, *Safety Inspector Training for Non-Licensed/Permitted Activities*.

Standards of Conduct, *FAA Human Resource Policy Manual (HRPM)*, ER-4.1.

Wilde P., “Public Risk Criteria and Rationale for Commercial Launch and Reentry.” 5th IAASS Conference, Versailles, France, October 2011. Conference Presentation.