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LOCKHEED MARTIN

Elaine David
Senior Director, Trade and Regulatory Affairs
Washington Operations

April 23, 2001

127094

Docket Management System
U.S. Department of Transportation
Room Plaza 401
400 Seventh Street, SW
Washington, D.C. 20590-0001

FAA-00-7953-17

Re: Notice of Proposed Rulemaking on Licensing and Safety Requirements for Launch (Docket Number FAA-2000-7953; Notice No. 00-10)

To Whom It May Concern:

On behalf of Lockheed Martin Astronautics, The Boeing Company, Orbital Sciences Corporation, Sea Launch Company, L.L.C. and International Launch Services, I am enclosing two copies each of comments prepared in response to the Federal Aviation Administration ("FAA") Notice of Proposed Rulemaking ("NPRM") on Licensing and Safety Requirements for Launch, published in the *Federal Register* at 65 Fed. Reg. 63,922 on October 25, 2000; and a letter dated April 23, 2001, signed on behalf of the five companies joining in submission of the comments. I also am enclosing five additional copies of this letter to be date stamped and returned to our waiting messenger as proof of filing.

Please feel free to contact me if you have any questions or need additional information.

Sincerely,

Elaine David

Elaine David

DC1:#8061817v1

April 23, 2001

Ms. Patricia G. Smith
Associate Administrator for
Commercial Space Transportation
Federal Aviation Administration
Room 331, AST-1
800 Independence Avenue, SW
Washington, DC 20591

Re: Notice of Proposed Rulemaking on Licensing and Safety Requirements for Launch
(Docket No. FAA 2000-7953; Notice No. 00-10)

Dear Ms. Smith:

The attached is submitted on behalf of the undersigned companies in response to the above-referenced Notice of Proposed Rulemaking (NPRM) published by the Federal Aviation Administration (FAA) in the Federal Register on October 25, 2000. This joint response is comprised of two volumes, the first of which is an Executive Summary highlighting our major concerns and recommendations, and the second of which is a detailed line-by-line review of the NPRM including our proposed changes and supporting rationale. Additionally, a proprietary Cost Impact Analysis has been submitted under separate cover by each of the undersigned companies pertaining to their respective launch vehicle programs.

We wish to emphasize that we continue to support the FAA's mission of ensuring public safety and acknowledge its statutory authority for regulating commercial launch activities conducted from both federal and non-federal ranges. To that end, we offer our expertise to the FAA in its effort to develop a regulatory framework that strikes a proper balance between ensuring public safety and fostering the competitiveness of the U.S. launch industry.

Upon conclusion of a comprehensive review of the proposed regulations, it is our considered opinion that implementation of final regulations as written in the NPRM will have a profound adverse effect on both the operational and financial aspects of launch activities conducted by our respective companies. The anticipated cost of compliance with the regulations as drafted will place our continued viability in the launch services arena at risk. In addition to substantive cost concerns, we believe the NPRM proposes significant changes to a proven and robust safety process and does so with no corresponding benefit to public safety. We believe this was not the intent of the FAA and respectfully submit that the FAA's responsibilities can be fulfilled more effectively with an alternative approach to that presented in the NPRM.

We also believe that our submission of this joint response will be of benefit and assistance to the FAA by providing particular insight into the basis for our concerns and recommendations, because it represents the collective views of a majority of domestic launch operators, large and small, and is based on the context of our collective experience gained in launch operations over the past four decades at both federal and non-federal ranges. Moreover, it is our collective view that the changes to, and phased approach to implementation of, these regulations outlined in our comments and recommendations will allow the FAA to achieve its objectives of maintaining public safety while promoting the health of the U.S. launch industry through the development of a regulatory environment conducive to these goals.

We are committed to working with the FAA to achieve these objectives and look forward to a continued dialogue on this subject through the auspices of the Commercial Space Transportation Advisory Committee (COMSTAC) and other means as may be deemed appropriate.

Sincerely,

G. Thomas Marsh
President
Lockheed Martin Astronautics

for Gale Schluter
Vice President and General Manager
Expendable Launch Systems
The Boeing Company

Ronald J. Grabe
Executive Vice President and General Manager
Launch Systems Group
Orbital Sciences Corporation

Will Trafton
President and General Manager
Sea Launch Company, L.L.C.

Mark Albrecht
President
International Launch Services

cc: Mr. Ronald Gress, FAA/AST-200
Ms. Laura Montgomery, FAA/AGC-200
Mr. Michael Dook , FAA/AST-200

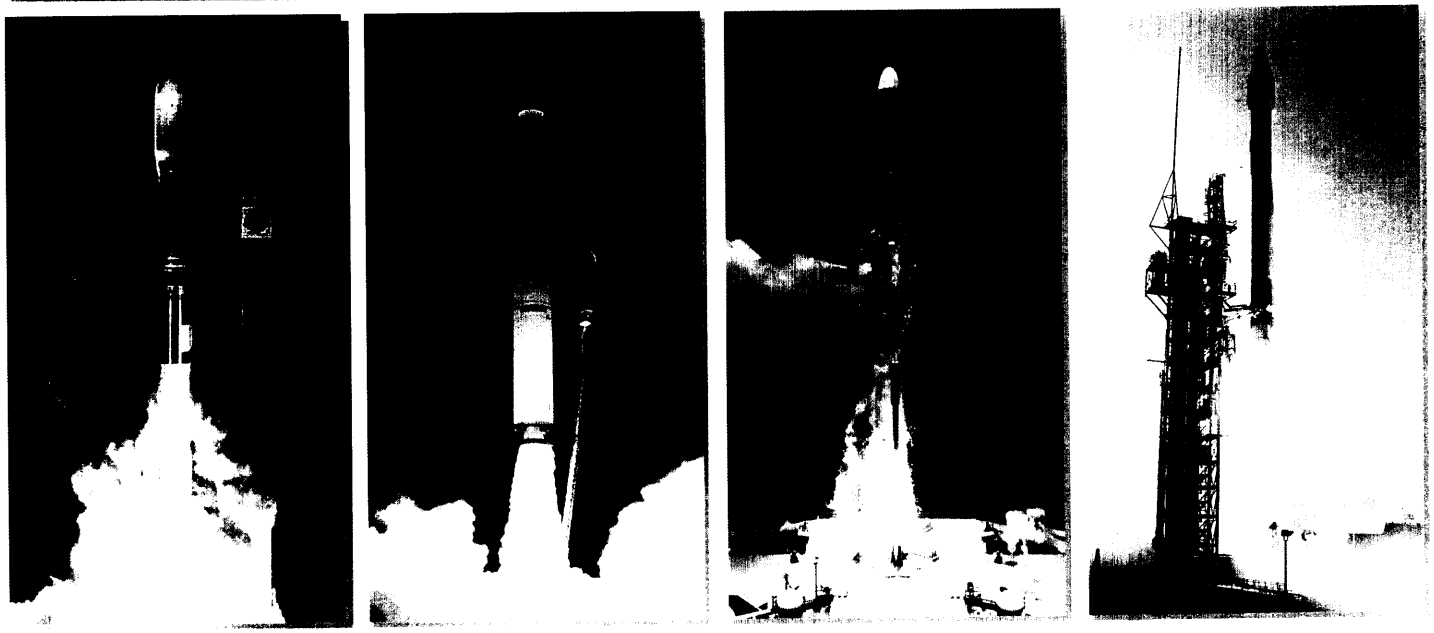
Volume I

Executive Summary

April 23, 2001

Consolidated Industry Response to FAA NPRM, Licensing and Safety Requirements for Launch, October 25, 2000

Docket Number FAA 2000-7953



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Consolidated Industry Response

Volume I: Executive Summary

FAA NPRM
Licensing and Safety Requirements for Launch
October 25, 2000
Docket Number FAA 2000-7953

The Boeing Company

International Launch Services

Lockheed Martin Corporation

Orbital Sciences Corporation

Sea Launch Company

Preface

We, the undersigned members of the United States launch industry (Lockheed Martin Corporation, The Boeing Company, Orbital Sciences Corporation, Sea Launch and International Launch Services, Inc.) have reviewed the Federal Aviation Administration's ("FAA") Notice of Proposed Rulemaking on Licensing and Safety Requirements for Launch, Docket No. FAA 2000-7953 dated October 25, 2000 ("NPRM"). We, as well as other entities experienced in the launch business with whom we have consulted, believe that this NPRM, if published as a final rule, will have a significant, adverse financial and operational effect on launch operations in the United States.

We set forth our assessment of the NPRM's impact neither lightly nor without due consideration. Our collective view, however, is that the impact of implementing this NPRM will be significant and adverse. Of primary concern is the anticipated cost of compliance with the NPRM as drafted, which we collectively assert will undermine our competitiveness in the world market to the point of jeopardizing our continued viability. Our preliminary estimates indicate a collective impact to our respective companies on *a rough order of magnitude ranging from $500 million to $1 billion* over a period of five years. Moreover, the burdens and competitive disadvantages this NPRM would impose on the U.S. commercial launch services industry (the "Industry") are unnecessary in that they are:

1. Not statutorily mandated;

2. Inconsistent with the Commercial Space Launch Act's ("CSLA") finding that private sector launches and associated services should be regulated only to the extent necessary to protect, among other things, the public health and safety;[1] and

3. Would not enhance the safety launch operations, as the NPRM is not directed towards addressing deficiencies in current safety standards or requirements or the failure of the Industry to maintain a high level of assurance of public safety.

Considering that: (1) the FAA has the statutory flexibility to accept the assistance of other executive agencies in fulfilling its obligations under the CSLA;[2] (2) the Air Force's (*i.e.*, another executive agency's) launch range safety requirements are comprehensive, efficiently and effectively implemented, familiar to the Industry and applicable to both government and commercial launches; and (3) the Industry, which is subject to the Air Force's standards at the Federal Ranges, has an impeccable safety record, adoption of this NPRM is neither necessary nor appropriate.

We strongly believe that the FAA's position, as articulated in the NPRM, is contrary to our long-held and unchallenged understanding of the statutory framework under which the FAA operates. Under the CSLA, the FAA is tasked with encouraging, facilitating and promoting commercial space launches by the private sector.[3] In carrying out this mission, the FAA is directed to establish a streamlined regime for the licensing and regulation of commercial launch operators. To that end, in its wisdom, with enactment of the CSLA, the Congress

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1 Commercial Space Launch Act of 1984, as amended, 49 U.S.C. §§ 70101(a)((7)(2000).

2 CSLA at § 70103(c).

3 CSLA at § 70103(b)(1).

conferred on the Department of Transportation ("DoT") the authority to establish the universe of licensing requirements. This includes the discretion to determine how those requirements must be met and which executive agency is best suited to promulgate and enforce them. In this regard, the FAA has the flexibility under the CSLA to develop and issue its own rules, incorporate the rules or requirements of other executive agencies into its own rules, or allow compliance with other executive agencies' rules and requirements to satisfy the FAA's rules.

Historically, DoT – most recently through the FAA – has employed each of these three approaches available to it, as set forth above, prudently and generally successfully in accordance with the discretion it has had, and continues to have, under the CSLA to do so.[4] The FAA has endorsed and adopted wholesale as part of its licensing requirements the range safety regime administered by the Air Force (*i.e.*, EWR 127-1) to apply to commercial launch operations at the Federal Ranges. The FAA and its predecessor office within the Office of the Secretary of Transportation also promulgated its own regulations. The availability of these options to establish the definitive set of requirements for commercial launch activities, and the flexibility of tailoring or selecting among them, is extremely successful as evidenced by the Industry's outstanding safety record. Moreover, implementation of this approach has been critical to the Industry's ability to address and manage the tremendous technical risks inherent in this business and the unyielding competition from foreign launch service providers. Therefore, we respectfully submit that, if the FAA were to codify the proposed rules set forth in the NPRM – because they would not provide the Industry with any improvement in streamlining the existing approach to licensing and regulation, would unduly and unnecessarily increase the regulatory burden on launch operators and would not commensurately enhance public safety -- the FAA would be in conflict with its mandate under the CSLA.

Our consolidated response to the NPRM consists of this volume and its accompanying technical volume. It is intended to provide a detailed compilation of relevant data, information and insights to support our conclusions in this matter. Our principal goals are to offer comments to the FAA that are useful and productive and help to achieve a final rule that meets the needs of the FAA, the Industry and the public.

Over the past forty years, the Industry has demonstrated an exemplary public safety record. During this period, the Industry has worked closely with the Federal Ranges to develop and implement systems that ensure that the public is never exposed to an unacceptable risk arising from launch processing or launch operations. All members of the Industry, including the undersigned entities, have been active participants in this effort.

We acknowledge that we have not always agreed with the Federal Ranges' approach to the imposition of certain range safety requirements, particularly when those requirements took the form of design solutions. We appreciate, however, that the Federal Ranges (through their safety officers) strive to interpret the requirements in a manner that meets the objectives and intent of the requirements without creating undue hardship for the Industry. The Federal Ranges' approach allows for flexibility in choosing and developing appropriate and cost-effective methods to meet those requirements. Within this framework, we have established positive working relationships, understandings and approaches that have resulted in the current high level of public safety that is maintained by the Industry and the ranges at the relevant launch sites.

Likewise, the designs and operations used in launch processing and launches are a product of mutual agreements reached over the years between each member of the Industry and the affected Federal Ranges. These agreements afford each launch operator the requisite flexibility needed to account for individual variations in launch vehicles and launch programs without compromising public safety. The outstanding safety record of the Industry is testament to the success of this arrangement. Consequently, we respectfully question the need to upend or alter this successful and productive arrangement, particularly in light of the fact that the FAA is not legally compelled to do so. To the contrary, the FAA is well within its statutory mandate when it accepts the regulatory regime of another executive agency, in this case the Air Force, in fulfilling its obligation to safeguard public safety.

Clearly, we support the FAA in its mission of ensuring public safety, along with its continuing efforts and successes in carrying on the traditions and underlying processes that have shaped the industries under its jurisdiction, including the U.S. launch industry, into one of the safest industries in the world. As stated above, one of our primary goals in offering these consolidated comments is to assist the FAA in achieving its mission. In addition, we offer our experiences and expertise in helping to strike the requisite balance between the need to ensure public safety and maintaining the exemplary safety record of the U.S. launch industry with the need to maintain the competitiveness of the U.S. launch industry in the global market.

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[4] For example, the FAA allows the rules administered by the Occupational Safety and Health Administration to regulate worker safety for those engaged in commercial launch operations.

Contents

Introduction

This consolidated submission is based upon both our independent and collective assessments of the NPRM. It seeks to set forth our positions on those issues of common concern in a manner that will prove helpful and productive for the FAA during its review of the NPRM.

Outline Of Submission

This submission is divided into two volumes: Volume I contains our overall, broader comments on the NPRM and our assessment of its impact on the Industry. Volume II features a more detailed discussion of the text set forth in the NPRM, and includes our proposed alternatives to the terms and approaches offered therein. Separate submissions, to be made by each of the undersigned companies individually, will address the analysis undertaken by each company as to the NPRM's cost and other impacts on that company.

We hope that our submission, which is based upon our review of the NPRM in the context of the individual and collective experiences we have acquired over the past forty years, will provide the FAA with an important insight and understanding into our concerns and recommendations.

General Overview

Each of us has provided launch services for both commercial and government customers for many years. As companies with considerable engineering, design and launch processing expertise, we, are in close coordination with the respective range safety offices on both the Eastern and Western Ranges. Through this coordination and our risk analyses, we have been instrumental in identifying the safety hazards and public safety risks associated with launches from those ranges as well as the ranges at Kwajalein, NASA Wallops Flight Facility, White Sands and Kodiak, Alaska. Our expertise and relationship with the Federal Ranges has significantly contributed to the safety of U.S. launch programs overall.

At the same time, the commercial launch industry as a whole has become global and increasingly competitive. The commercial viability of the various members of the Industry now relies upon the ability to compete aggressively with non-US launch services providers and operators, such as Arianespace. The Industry is already under significant pressure from international competition. Additional regulatory burdens that could affect the Industry adversely should be carefully weighed against the benefits of such burdens.

It is thus with respect for and sensitivity to the complexities involved in balancing the need to ensure public safety with the need to maintain the competitiveness of the Industry that we have identified, in this consolidated response, the following issues arising under the NPRM that we believe require modification and/or clarification. We collectively maintain that full and due consideration must be given to these concerns, to forge an effective and acceptable means of striking the requisite balance:

1. The need for transparency in terms of what set (and what kind) of safety requirements will apply, which agency will have responsibility for administering and applying those requirements and how the new requirements specifically will impact existing programs.

2. The need for consistency in how the established safety requirements will apply with regard to a particular launch vehicle launching from a specific launch site, with clarity provided for how differences in programs and vehicles will be adequately and reasonably addressed in licensing, operational and procedural contexts.

3. The need for predictability with respect to what will be required of launch operators to comply with the technical, procedural and financial requirements sought to be imposed.

4. The need to maintain operational and technical flexibility in conducting launch operations, while concurrently ensuring the public's safety.

5. The need to conduct realistic assessments on the cost impact on the Industry of changes to current safety standards, and to seek Industry's input on these assessments.

6. The need to avoid an undue and unnecessary level of detail in applicable regulations and regulatory oversight, particularly where there is no corresponding enhancement of public safety.

7. The need to assure the Industry that our extensive expertise and experience in the launch business will be given due consideration, especially in the absence of any evidence that the Industry has failed to adequately address and meet the need to ensure public safety.

After thoroughly reviewing the NPRM, we have concluded, individually and collectively, that the NPRM does not adequately address any of the above-listed concerns. Set forth below is a discussion of the issues that are of common concern to the drafters of this submission. As noted earlier, a more detailed discussion of the specific terms set forth in the NPRM are addressed in Volume II of this consolidated submission.

Current Relationship With The Federal Ranges

Given the maturity of the Industry, a brief note on the background and context of the processes and practices currently in place for the management and application of safety requirements at federal launch ranges (the "Ranges") is warranted. The Industry and the Ranges have worked together over the past forty years to assure public safety at the Ranges. During that time, the safety requirements for design and operations relating to launch processing and launches have evolved and improved. Lessons learned from hundreds of launches and the development of new technologies have helped to establish a useful and manageable level of safety standards and the means to implement corresponding safety requirements.

The Industry and the Ranges, working closely over many years as partners, have developed a positive and mutually beneficial relationship. This relationship ensures public safety while providing sufficient flexibility to accommodate various launch systems. Moreover, it maintains public safety without placing undue hardships on launch operators or adversely impacting the often-aggressive schedules and cost considerations that the competitiveness of the market demands.

We cannot overemphasize the criticality to the Industry of the relationship between the Industry and the Ranges – a relationship which took over forty years to establish and refine to its current efficiencies. It is imperative that Industry's relationship with the Ranges, or an equivalent relationship with another executive agency, be maintained, without interruption, to ensure not only public safety but also the viability of the Industry.

Discussion of Significant Issues

During our overall assessment of the NPRM, we attempted to identify those areas that raised the most significant concerns. While many of these concerns also will be reflected in the comments addressing the issues set forth in Volume II of this submission, which addresses the specific terms of the NPRM, the issues listed below are those that we believe are echoed throughout the NPRM and, as such, will have to be addressed on a broader level.

I. Competing Safety Requirements on the Federal Ranges

If the NPRM is implemented as drafted, launch operators on Federal Ranges will be required to demonstrate compliance with two sets of requirements overseen and administered by two separate and independent governmental oversight agencies -- the Federal Ranges and the FAA. This would be a cumbersome arrangement that inevitably would lead to costly and duplicative safety efforts with no appreciable increase in public safety. Moreover, it would create a situation in which two sets of safety requirements would apply to a single launch vehicle launching off a single pad, and where the safety requirements to assure public safety are different for commercial and government launches. A more effective and efficient method to continue ensuring public safety would be to designate a single government agency with oversight responsibility. This agency, in consultation with other interested federal agencies, would be tasked with implementing the requirements for ensuring public safety set forth in one comprehensive document including clearly identified processes. Such processes would allow for a sufficient amount of flexibility in application of the requirements without compromising public safety. This type of structure would ensure that public safety standards are implemented clearly, consistently and predictably, and certified as safe in a commercially viable manner.

Currently, technical safety certification for launch processing and launches from Federal Ranges is performed by the Ranges themselves, in close coordination with the launch operator. Preliminary analysis of the structure and implementation of the safety certification process set forth in the NPRM raises two major concerns:

1. Who is the technical safety certification authority for launch processing and launch operations with whom the launch operators will directly interface?

2. Which document takes precedence for safety compliance if and when the NPRM becomes law?

As noted previously, for the past forty years the Industry has worked very closely with the Ranges on implementing the applicable requirements. This task has been accomplished in a manner that ensures that public safety standards are either met or exceeded. As also discussed above, the exemplary safety record is the product of a process and relationship that has evolved over many years and with the full and complete cooperation and coordination of the Ranges and the Industry.

The Industry's current and historical experience with regard to safety certification has been to work directly with the Ranges in certifying launch systems as safe for processing and launch from the Ranges. Likewise, the Ranges are present and available on a real-time basis to address and resolve issues relating to fulfillment of public safety requirements. The Ranges have consistently executed their role in a manner that avoided imposing undue hardship on the Industry. The processes currently in place are mature, conservative, flexible, effective and proven.

If the NPRM is implemented as presented, ambiguities are created as to *which* agency will serve as the technical

safety certification interface for launch processing and launches following the promulgation of the NPRM as a final rule.[5]

If the Ranges recede from their present role and the primary responsibility for dealing with safety certification at the Ranges is transferred to the FAA, we believe strongly in the need for a clear and well-thought out transition plan. Such a plan would take into account the complexities and inherent difficulties involved in replacement of the Ranges by the FAA as the prime technical interface on safety certification issues. In addition, the plan must allow for a reasonable time period in which to execute the transition smoothly. The close working relationships between the Industry and the Ranges, which require intense involvement and direct interfaces on an ongoing basis, often in real-time, must also be taken into account. Clarification of this point is critical to the Industry due to its impact on daily operations and schedules and the need for consistency, transparency and predictability in adequately addressing safety certification matters for all affected launch programs.

With regard to the precedence of documented requirements, for now we anticipate that, if the NPRM is promulgated as drafted, for some period after the publication of the new FAA regulations, EWR 127-1 (as well as its current means and methodology of implementation and application) would remain in effect. The NPRM states that, in the event of a conflict between these two documents, *"FAA requirements will govern licensed launch operations."* [6] As a practical matter, however, the need to resolve any potential conflicts or ambiguities arising from the dual application of different sets of safety requirements will require discussion and negotiation. Such a process demands a reasonable amount of time to reach resolution of such issues to preserve the continuity of existing programs and commitments.

As the NPRM would affect only commercial launches (and ERW 127-1 would continue to apply to all launches), we also are concerned that the rules for government launches will be significantly different from the rules for commercial launches. We are concerned that these disparate approaches, which would apply to launch services providers operating the same classes of launch vehicles for commercial and government launches, will prove inefficient, unduly burdensome and will not enhance public safety.

In summary, our review of the NPRM indicates that the ambiguities and potential conflicts created by implementing two sets of safety requirements at the same time will, at a minimum, prove unduly burdensome. Moreover, since the FAA's proposed safety requirements are significantly more conservative than those of the Ranges in several areas (*viz.*, design, testing, analysis and operations), such dual implementation will prove extremely costly to implement. Lack of clarity with regard to the FAA's intended means and methodology of application and implementation will also inevitably impose delays in operational activities and scheduling. The changes, differences and potential conflicts in the approaches between the two sets of safety requirements will thus have significantly adverse cost and schedule effects on the Industry. Requiring launch operators who launch a mix of government and commercial payloads from the same launch facility to comply with a dual/parallel set of launch safety requirements introduces a need to create and maintain two costly separate sets of analyses, documentation, operational procedures and launch approval processes to meet the separate requirements. All of this results in imposing additional costs, delays and burdens on the launch operator, *with no commensurate increase in public safety.*

In a world market that is already extremely competitive, the requirement to satisfy additional requirements as well as the potential need to redesign current vehicles to meet the new requirements set forth in the NPRM will indisputably result in a significant and adverse cost impact to the Industry. Given the Industry's need to respond to the increasingly aggressive competition posed by foreign launch providers in a global market of increased supply and decreased demand, the imposition of additional costs, operational burdens and delays on the Industry will ultimately result in a reduction in the Industry's market share. This is an outcome which gives rise to grave concern, particularly where the costly effects of meeting the new requirements will not offer any enhanced protection to the public than what currently is being achieved.

II. Loss of Operational Flexibility (Highly Detailed Safety Requirements Implemented and Administered as Law)

Over the years, range safety officers and launch operators have worked together in developing flexible and responsive approaches to the implementation of safety requirements. These approaches both protect the public and support aggressive launch schedules. If the detailed requirements of the NPRM are adopted as drafted, we believe that this critical flexibility in the implementation of safety requirements will be significantly limited. Although the NPRM allows launch operators to demonstrate the adequacy of alternative approaches to compliance, we are concerned that the process could be unduly burdensome

[5] The NPRM makes brief mention of the FAA's proposal for supplanting the Ranges' implementation and certification process, but fails to specifically address how the transition of certification responsibility from the Ranges to the FAA will be executed.

[6] NPRM Preamble, Section II, p. 63925.

and time-consuming. Worse, the process ultimately could compromise our achievements in meeting aggressive launch schedules – a national as well as commercial imperative – without improving public safety.

The Industry is deeply concerned about the loss of operational flexibility that would occur if the NPRM were promulgated as drafted, due to the implementation of the safety requirements as *legal* requirements rather than technical guidance. This concern is heightened by the combination of this change in status with the extraordinary level of detail of those requirements (which is discussed in further detail in Section IV). The significant change in status of these two aspects on the proposed requirements will adversely impact the Industry's ability to demonstrate, in a timely and cost-effective manner, how alternative means of implementation (or design solutions) can be equally sufficient to protect public safety.

Unlike a final rule, EWR 127-1 does not have the status of law. *The flexibility of this range safety requirements document is readily apparent by virtue of the fact that there is no single vehicle design that strictly complies with the letter of all applicable EWR 127-1 safety requirements.* This variation in application, however, is consistent in its achievement of the primary objective of meeting or exceeding public safety standards. The inherent flexibility of the range safety requirements has allowed a balance to be struck between the needs of preserving public safety and the Industry's need for operational flexibility. This flexibility is critical to the Industry and is possible *only* because of EWR 127-1's status as a technical guidance document. The Ranges' implementation of EWR 127-1 ensures public safety by focusing on meeting the intent, rather than the strict letter, of the requirements. This approach avoids imposing undue hardship of the Industry. This is key to the Industry's viability.

The NPRM briefly discusses the concept of "alternate means of achieving the same safety goal" and the requirement, in such a case, for the launch operator to "*clearly and convincingly demonstrate an equivalent level of safety . . .*"[7] in order for the FAA to consider that alternative. This proposed standard is a legal, evidentiary standard and is not appropriate when making technical judgments on whether proposed deviations meet rigorous safety standards. Moreover, no indication is given as to how this process would apply in situations requiring real-time responses. It is thus unclear how this process will avoid unnecessary schedule delays and the incurring of additional costs where public safety is in fact not negatively impacted. We are concerned that the process of convincing the FAA that an alternate approach provides an equivalent level of safety will prove unduly burdensome and, in some instances, unworkable, compared to the tailoring process with the Federal Ranges. This concern is particularly heightened where the original requirement retains the status of law and the required standard for establishing the appropriateness of a proposed deviation is inherently difficult to meet.

III. Adverse Cost and Schedule Impacts

We respectfully disagree with the assertion that the NPRM will not significantly affect the cost of processing and launch operations. Our cost estimates for implementation of the NPRM are provided via separate submissions to be made by each company. Due to the proprietary and highly sensitive nature of the data and information set forth therein, those submissions will be made independently of this consolidated submission and under seal. Uniformly, however, estimates indicate an impact to our respective companies on a rough order of magnitude ranging from $500 million to $1 billion over five years. These substantial cost increases are due to, among other factors, increased design requirements, additional analyses, more conservative approaches to flight constraints, the potential requirement to re-verify that existing components or processes meet standards established by the NPRM (despite already being qualified by the Federal Ranges for existing programs) and the requirement to demonstrate compliance to two governmental agencies (i.e., the Federal Ranges and the FAA).

The NPRM indicates that a cost benefit analysis is required for FAA rulemaking and that such analysis is subject to public comment and "*...ensures that issues regarding cost are taken into account.*" In the Preamble to the NPRM, the assertion is made that the impact on the Industry of the NPRM will be minimal and/or insignificant. As examples:

"*The FAA has determined that there would be no additional burden to respondents over and above that which the Office of Management and Budget has already approved under the existing rule, titled, 'Commercial Space Transportation Licensing Regulations.'*

"*The FAA gives due consideration to current practices in space transportation, generally involving launches from federal site.*"

"*The incremental cost of this proposal is expected to be at most, minimal.*"[8]

The Industry respectfully but firmly disputes the assertion that the NPRM will have no significant effect on the costs of launch processing and launch operations. We note that the FAA in making its determination did not consult any of the companies joining in this submission or, to our knowledge, any other members of the Industry. We

[7] NPRM Preamble, Section III, p. 63924.

[8] Quotes from NPRM p. 63963, Paperwork Reduction Act and Regulatory Evaluation Summary.

respectfully suggest that, without such consultation, the FAA's conclusions about costs are not comprehensive and can only be, at best, preliminary. We strongly believe that the NPRM, if promulgated as drafted, will add substantial cost to *every* launch vehicle program and every launch. While the NPRM asserts that a cost savings may be realized, the Industry was unable to duplicate the conclusions set forth in that analysis. We strongly disagree with the premise that the cost impact of the NPRM will be minimal. Our preliminary estimates indicate an adverse impact to us collectively on a rough magnitude of order ranging from $500 million to $1 billion. We present our individual cost impact analyses relating to the impact stemming from implementation of the NPRM in separate submissions in support of our determination.

We also believe it important to note that the issue of cost impact is one of critical importance to the Industry. Over the past several years, attainable prices for commercial launches have dropped significantly. This corresponds to an increase in the supply of launch services available to satellite owners and a decrease in demand for those launch services. Indeed, projections of demand for launches over the past several years have been consistently overestimated. Further, the aggressive competition presented by non-U.S. launch operators, particularly those that enjoy significant levels of continued foreign government support, is evident and well documented. As a result, the Industry has had to endure increasingly smaller margins and heightened pressure to compete even more aggressively just to maintain commercial viability. In an industry already subject to deteriorating financial health, any potential cost impact gives rise to grave concern.

IV. Highly Detailed, Legally Mandated Design Requirements versus Performance-based Standards

The NPRM requires an extraordinarily high level of detail for design, testing, analysis and operations. The level and scope of detail required under the NPRM would impose a significant burden on launch operators who already have an established safety record. It is also unwieldy, if not unrealistic, to try to apply detailed but uniform design standards to launch systems as varied in design as, for example, the EELV programs and the Pegasus launch vehicle. Moreover, detailed implementation mechanisms that are too difficult or time-consuming to modify would stifle or, at best, impede the development of new safety approaches. This is antithetical to the overall goal of the NPRM – to optimize public safety at launch sites. For these reasons, we note our belief that broad public safety guidelines are most effective at achieving the primary objective of ensuring public safety, and specific design requirements or solutions (to the extent they are issued) are most effective when provided as technical guidance for operators rather than as legally mandated and rigid design requirements.

We are aware that, in order to assist the FAA in achieving their primary objective, the Ranges recommended continuation of the approach that has evolved at the Ranges and which has, as previously noted, led to an exemplary safety record with the Industry. It is our understanding that the FAA, when drafting the NPRM, has tried to emulate the safety requirements currently being applied via EWR 127-1.

Moreover, we acknowledge that the current version of EWR 127-1 does include highly detailed design requirements. The success of the current EWR 127-1, however, does not arise from what level of detail it contains. Rather its success is grounded on its status as technically based guidelines as well the processes, understandings and relationships that allow flexibility in the application and implementation of those requirements. To illustrate and amplify this point, we note that, in 2000, the Air Force Space Command tasked the National Research Council ("NRC") to review current range safety guidelines and procedures. The NRC report, *Streamlining Space Launch Range Safety*, makes the following observations and recommendations relative to EWR 127-1:

> EWR 127-1 specifies in detail how to comply with established risk standards rather than expecting users to develop their own methods of compliance. These detailed requirements create the need for extensive "tailoring" of EWR 127-1 for each new launch vehicle to allow the use of alternate methods that are more practical than the specified methods of compliance. The committee believes that a more effective approach would be to streamline EWR 127-1 to focus on baseline performance-based requirements and move detailed solutions and lessons learned to a range user's handbook. This would draw a clear distinction between non-negotiable performance-based requirements and recommended methods of compliance that can be waived if an equally effective alternative is available and the user accepts the burden of demonstrating its effectiveness.
>
> Primary Recommendations on EWR 127-1. AFSPC should simplify EWR 127-1 so that all requirements are performance-based and consistent with both established risk standards for space launch (e.g., E_c of 30×10^{-6}) and objective industry standards. The process of revising EWR 127-1 should include the following steps:
>
> - Eliminate requirements that cannot be validated.
> - Remove all design solutions from EWR 127-1.
> - Establish a range user's handbook or other controlled document to capture lessons learned and design solutions recognized by the ranges as acceptable means of compliance (Requirements should be retained in EWR 127-1).

- Form a joint government/industry team to establish procedures for periodically updating EWR 127-1 and ensuring that future requirements are performance-based.
- Converge the modeling and analysis approaches, tools, assumptions, and operational procedures used at the Western and Eastern Ranges.[9]

Similarly, in 1994, the Office of the Under Secretary of Defense for Acquisition & Technology chartered a Process Action Team ("PAT") on Military Specifications and Standards. The resulting PAT report stated that industry involvement in the development of the first draft of new performance-based standards was essential. The report also noted that the transition from detailed implementation based specifications to performance-based standards is not an overnight process. The report projected a five to ten year transition period for many areas.

The PAT report also cited the need for a culture change in the oversight of the launch industry from a culture of risk aversion to that of risk management. In particular, the PAT recognized that the Department of Defense ("DoD") is conservative and, in many cases, tends to over specify its requirements. The report noted that many requirements are carried over from previous requirements documents on the assumption that what worked before will work again. The report also noted that, once established, requirements are difficult to change or remove, and that in spite of specific instructions that standards should be tailored to program needs, tailoring was frequently not permitted because the advocacy groups who wrote the documents insisted on complete compliance.

> Management standards tend to be particularly hard to change because they have their own advocacy groups. While these groups were created to provide expert advice in their own technical specialties, they are often lobbyists for the military standards they represent. They are empowered by DoD Instruction 5000.2, which lists 52 specifications and standards describing how these technical disciplines are to be incorporated in the acquisition process. This provides a mandate for the advocacy groups to resist anything less than full implementation of the codified wisdom embodied in their standards.[10]

The report also cautioned that as the military services transition to performance-based standards that military handbooks containing guidance on how to properly apply the standards might be overly applied.

Industry concurs with the conclusions reached in the NRC and the PAT reports, and recommends that the recommendations reached by those reports be applied to the NPRM.

It is our understanding that the FAA has attempted to reduce the incidence of design solutions, or implementation requirements (as opposed to functional or performance safety requirements). Our review reveals, however, that a significant number of design solutions remain embedded in the NPRM technical requirements, especially in the appendices to Subpart 417. In every instance in which a launch operator does not meet the letter of these design solutions (and there are literally hundreds of them on most launch programs), the NPRM as proposed would require the launch operator to *"clearly and convincingly demonstrate an equivalent level of safety . . . to the FAA to gain approval of the alternative approach."* [11] Because of the volume of individual requirements involved, as well as the high legal standard sought to be imposed, we are concerned that the process will be extremely burdensome, time-consuming and costly, while simultaneously failing to commensurately improve or enhance public safety.

We believe that the NPRM's discussion of the FAA's Boeing Sea Launch certification experience clearly demonstrates that a launch program can be certified by the application of broad public safety goals and acceptance of alternative means to achieve those goals. Public safety standards can be met or exceeded without promulgating detailed safety implementation requirements. We believe that if Sea Launch had sought FAA certification under a regulatory regime as set forth in the NPRM, the process would have been far slower and more expensive for the launch operator with no measurable improvement in safety.

If the FAA requires the level of detail for design and testing requirements as are set forth in the NPRM, we are concerned that we will be forced to request relief from each requirement for which there is or may be an alternative means to provide the equivalent level of safety. If these requirements were levied at the broader or higher level (*i.e.*, as standards), then the Industry would be able to retain latitude in choosing design and testing approaches while the FAA would still receive verification that the objectives of its Rules are being satisfied. Such an approach would encourage continuing development of even more robust design and engineering solutions and alternatives without compromising public safety.

For these reasons, we strongly recommend that any requirements included in any final rule not be highly detailed and rigid in nature. Performance-based standards would provide more flexibility while concurrently

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[9] National Research Council Report, *Streamlining Space Launch Range Safety* (2000). ISBN 0-309-06931-9.

[10] Report of Process Action Team on Military Specifications and Standards (Office of the Under Secretary of Defense for Acquisition & Technology) (1994).

[11] NPRM Preamble, Section III, p 63924.

maintaining public safety, and without incurring the significant and adverse costs noted above (particularly if released and applied in guideline format rather than as legal mandates).

V. Additional, More Conservative Requirements

The NPRM would impose a number of new, more conservative requirements on launch operators. Many of these requirements are more conservative in their approach than what is set out in the current EWR 127-1, particularly in the Flight Analysis area. These new and more conservative requirements were neither discussed with the companies submitting these comments nor, to our knowledge, other members of Industry, in advance of the NPRM's release. Nor were they previously or are they currently required under EWR 127-1

We believe these requirements will have the following three principal effects on launch operators:

1. *Add design and testing requirements that will increase operating costs for all launch programs;*

2. *Increase data and analysis requirements, particularly in the Flight Analysis area, which represent a substantial change from those currently required at the Ranges and will be difficult and costly to incorporate in currently successful safety plans; and*

3. *Adversely affect launch availability and, consequently, scheduling due to the NPRM's requirement for determination of casualty expectations and changes to predicted reliability of launch vehicles.*

In addition, we believe that these new burdens could in fact compromise or inhibit the development of new and innovative safety methods or processes.

The additional and highly conservative requirements that the NPRM would impose fall into the following major categories: data collection, reporting and updating, analysis and casualty expectation calculations, and new component testing requirements.[12] Imposition of these requirements will require the Industry to both redesign current launch vehicles and modify designs and operational approaches to both existing and future launch systems. This will impose significant additional costs and operational impacts to the launch processing and launch efforts for all launch operators.

Furthermore, in seeking to apply these additional and more conservative requirements, the FAA acknowledges in the Preamble of the NPRM that *no increase in safety is expected as a result of implementation of the NPRM.*[13] Therefore, we must question why the additional requirements are being imposed, especially when considering the adverse impact on the Industry's costs, schedules and operations. If the proposed requirements confer no benefit on any of the FAA's constituencies, then we respectfully submit that the FAA should refrain from imposing such requirements on the Industry.

For ease of reference, the following are examples of some these additional requirements:

1. A mandatory collective E_c limit for all hazards combined with extremely conservative failure probabilities

2. Surveillance of statistical analysis of ship density traffic for jettisoned body impacts downrange and outside of flight hazard area

3. Requirement for launch day forecasts of downrange winds

4. Statistical source population densities must be multiplied by a factor of 10

To illustrate the impact of just one of these examples, consider the requirement for determination of a collective mission risk (E_c). The E_c values from downrange debris risk assessment *alone* will be close to, or surpass the 30 x 10^{-6} E_c criteria for most missions with the desired flight azimuths that involve African or European overflights. Even when it is possible for a launch vehicle to have a downrange mission E_c less than 30 x 10^{-6}, the ability for the mission to accommodate all other aspects of launch risk seems unreasonable. The FAA apparently recognizes the fact that meeting the *collective* 30 x 10^{-6} E_c criteria may not be possible. The NPRM preamble states:

> For example, the FAA expects that no launch in the foreseeable future would be able to meet the E_c criteria of 30 x 10^{-6} if the planned trajectory involved placing a gate in a flight control line that would result in overflight of a city or other densely populated area.[14]

The concept of aggregating all potential launch risk into a single, collective E_c will undoubtedly restrict launch availability and cause launch delays, both of which are extremely costly. Unfortunately, the FAA's desire to utilize a single E_c is not being driven by any current, unacceptable risk to the public. The fact is, that the actual public risk can only be realized at one given point in the launch timeline. If a launch vehicle is terminated during up-range flight, there is no threat to the down-range public.

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[12] We provide our comments on these additional and more conservative requirements in more detail in Volume II.

[13] NPRM Preamble, Regulatory Evaluation Summary, p. 63963.

[14] NPRM Preamble, Section IIIE 5, *Protected Areas and Flight Control Lines* at p. 63933.

Conversely, by the time down-range public is potentially endangered, the up-range public is clear of risk. It is unreasonable to aggregate all launch risk into a single collective risk evaluation.

We respectfully assert that the currently required calculations and assessments provide adequate safety levels. As the new requirements afford no added value, are costly to implement and introduce further potential for schedule delays, they should be excluded from any final rule.

VI. Restrictions on Grandfathering, Tailoring and Waivers

A majority of the companies participating in this joint submission have operated under the concepts of grandfathering and tailoring as utilized by the ranges for over forty years. The NPRM is not clear on the FAA policy with respect to grandfathering, tailoring and waivers. If the FAA chooses to alter the current Federal Range policy on these practices or impose a "clear and convincing" burden, launch operators will experience a significant, adverse cost impact. This cost impact arises in connection with the need to reassess, reevaluate and redesign existing systems that have already been certified into compliance with the proposed requirements.

Where public safety is not compromised or adversely affected, the Federal Ranges presently allow grandfathering for sub-systems on launch vehicles that become non-compliant when new safety requirements are levied by later versions of the range safety requirements documents. The issue of grandfathering is briefly mentioned in the NPRM, but the accompanying text addresses only waivers granted to launch operators by the Federal Ranges. We respectfully assert that all three of the mentioned practices as implemented by the ranges – grandfathering, tailoring and waivers (as well as "meets intent" certifications) – form a supporting pillar of the Industry's operational efficiency and competitiveness. Furthermore, there has never been any evidence or assertion that these practices present any adverse implications for ensuring that public safety standards are met and/or exceeded. As such, these practices should be continued as currently applied and implemented, with any modifications to them undertaken only after consultation with the Industry as well as other interested and affected parties.

The NPRM's brief mention of the grandfathering concept implies that continuing modifications to safety components would have little effect on cost because the Industry often performs minor changes to each vehicle to address specific missions. While it is true that the Industry does accommodate minor changes for various missions, we respectfully point out that the main goal of any commercial launch program is to make each vehicle configuration standard to the maximum extent possible. It is this "standardization" which facilitates the commercial viability of the Industry, and allows for credibility of the program, operational and procedural efficiencies, as well as cost savings.

It should also be noted that changes to any flight safety system are in a category quite different from those mission-peculiar changes to accommodate specific mission requirements. Because of the criticality of the flight safety components, changes are particularly expensive and often time-consuming because of the testing required and the design and testing review process required.[15]

Presently, the Federal Ranges also allow tailoring of the specific design requirements included in EWR 127-1. Through the use of tailoring agreements, the Industry operates under arrangements with the Ranges where systems and operations often do not strictly meet the letter of all range safety requirements.[16] In such cases, however, the Range has determined that those systems and operations do meet the intent of the applicable safety requirements without compromising public safety. Tailoring precludes the need to issue deviations, waivers or meets intent certifications every time the range regulations change.[17] The Federal Range safety organizations periodically issue updates to safety documents. However, the existence of such new requirements does not necessarily make an existing system unsafe or expose the public to greater safety risks. Thus, requiring the range user to modify their systems to meet the new requirements is not justified from a safety or cost point of view.

As written, the NPRM will require significant and continued tailoring for each launch vehicle program. The 1997 version of EWR 127-1, on which the NPRM is based, contains over 9000 specific safety requirements. It is important to note that it is the tailored version of safety requirements that are used to control the safety of current launch programs, and that the *untailored* version of EWR 127-1 was used as the basis for the NPRM. If the FAA does not accept and adopt such tailoring agreements as they currently exist and are being implemented, and instead requires redesign of existing systems and

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[15] It should be noted that the Industry purchases and maintains substantial inventories of these components. Changes to design or testing requirements would require modification and re-testing of existing inventories.

[16] Likewise, tailoring agreements allow for systems and operations to deviate from Range safety requirements where the requirements do not apply to that system or operation.

[17] Since passage of the Commercial Space Act of 1984, seven different versions of the 127-1 Safety Requirements have been issued for the Eastern and Western Ranges alone.

programs, this will result in significant cost impacts and program delays. The same analysis applies to any retroactive revocation of current waivers by the FAA.

Currently, all of the designs and operations for each of our individual launch programs meet tailored and/or grandfathered applications of either EWR 127-1 or previous versions of the range safety requirements documents. These tailored applications were the result of negotiations and discussions held between the launch operator and the relevant Range. Often, these negotiations require lengthy periods of time and intense involvement, as well as the expenditures of substantial sums by the launch operator. We are gravely concerned that a requirement by the FAA to redesign current vehicles to meet the new rule would have significant cost and schedule effects on a launch operator's programs. This concern is amplified by the fact that the NPRM requirements are significantly more conservative than those in EWR 127-1 or its predecessors. The effort that would be required to integrate the new requirements and/or re-assessments and re-evaluations, particularly for existing programs, would be extensive and extremely costly. Moreover, in light of the Industry's excellent safety record, which we believe is a reflection of the effectiveness of the Ranges' safety requirements, we question the necessity and prudence of the FAA's more conservative approach.

VII. Impact of Proposed Procedural Changes and New Requirements for Launch Licenses

The heightened level and nature of detail required by the NPRM in a launch operator's launch license at Federal and Non-Federal Ranges, as well as the proposed method for providing updated information to the FAA on some of those detailed requirements, would impose a substantial burden on licensees and introduce potential delays to schedules.

The NPRM proposes that a significantly greater amount of data and information be included as part of the launch license application and subsequent supplemental submissions relating to that license, than is currently required. The level of detail and the nature of the information give rise to a significant concern that maintenance of the license itself will become an unduly burdensome and unwieldy process, without adding value or efficiencies in terms of providing relevant information to the FAA in a timely manner. Furthermore, the process proposed by the NPRM fails to realistically take into account the dynamics and schedule requirements of the launch process.

As an example, the NPRM proposes that tests, analyses, various reports, plans, schedules, *etc.*, should now be included and incorporated as *part* of the launch license. (They currently are not). Once included as part of the license, these items must be kept current. Doing so will require parallel amendments of the actual license itself to take into account any changed, modified or updated circumstances. Many of these new requirements constitute constantly evolving documents or situations that reflect the complex dynamics of the launch process. This proposed change to the licensing procedure would entail an extensive, administrative burden that is currently not part of the process of obtaining and maintaining a license.

The NPRM also proposes that the license process now begin twenty-four months prior to the commencement of licensable activities.[18] In addition to the new and significant amounts of additional data and information that the NPRM would require to be submitted, this is a substantially longer lead-time for preparing, submitting and maintaining a license than what is currently required. Typically, only very basic data and analysis products are available prior to 18 months from the expected launch date. Some programs do not have detailed data and analysis products available until less than 6 months prior to launch. Even if it is possible to perform detailed analyses and tests early in the launch program integration cycle, analyses and tests performed too early in the program integration cycle may be invalid later in the cycle, resulting in extra and unplanned work. Most launch operators are accustomed to making submittals incrementally, when the needed input data are available, and it is less likely that the input data will change. The Federal Ranges have been flexible in accommodating launch operator submittals on a best efforts basis, regardless of the submittal dates specified in EWR 127-1.

The NPRM also proposes requiring the launch operator to obtain FAA approval of any alternate analysis method or any proposed alternate flight safety system that does not satisfy *all* of the subpart requirements (including all requirements contained in referenced appendices) "before its license application or application for license modification will be found sufficiently complete to initiate review pursuant to § 413.11 of this chapter." In effect, this would mean that all tailoring agreements (evidencing approval of any proposed alternative means of compliance with public safety requirements) must be documented in the license. Experience has shown that tailoring agreements with the Federal Ranges have taken as long as two to three years to accomplish. Tailoring can be an ongoing, intensely involved process. We are deeply concerned as to how the tailoring mechanism will be affected, or can even be implemented, via the launch license.

[18] Furthermore, the extension of this preceding time period is more significant when one recognizes that licensable activities often commence months before the actual launch, or flight.

Given the complexity of launch processes, coupled with the level of detail required by the NPRM, the need to negotiate and resolve tailoring agreements for each point that differs from the technical requirements set forth therein will be extraordinarily time-consuming and burdensome. Worse, if a launch license approval were delayed pending completion of tailoring agreements the launch operator could suffer potentially devastating financial losses, as well as damage to its reputation as an on-time provider. The impact these proposed changes to the licensing process would have on the competitiveness of the U.S. launch industry in the global marketplace cannot be overstated.

No explanation or insight is provided as to what value is added or efficiencies are introduced into the launch license process as a result of the proposed changes. We find it difficult, moreover, to reconcile the onerous process proposed in the NPRM for obtaining and maintaining a launch license when it is directly contrasted with industry trends showing that commercial missions are targeting a much shorter time span from time of order to launch.

We propose that these changes to the launch licensing process should be re-considered and withdrawn. If they, or some aspects of the changes, are included, then we recommend that the notification approach be modified to constitute a more flexible and informal communication method. Such a method could provide the FAA with the data and information it deems relevant, independent from (but pursuant to) applying for and maintaining the launch license. In addition, we would respectfully recommend that the proposed timelines for requiring submissions to the FAA take into account more realistic timing requirements and the complexities of the launch process.

Conclusion

The FAA plays a critical role in the U.S. launch industry, and we acknowledge and support the FAA's mandate of ensuring public safety with regard to launch processing and launch activities. Likewise, we support the other aspects of the FAA's mission in considering national security concerns and promoting the U.S. commercial space launch industry to meet its mandates. We believe that the continued viability and competitiveness of the U.S. launch industry, for which our public safety record is a mainstay, equates to the FAA and the Industry jointly pursuing the same mutual objectives.

In December of 1999, then Deputy Defense Secretary John Hamre commented that the U.S. Department of Defense had crafted a strategy (*viz.*, the EELV Program) to link its need for assured access to space to a robust U.S. Commercial Launch Sector.[19] Likewise, both the National Aeronautics and Space Act [20] and the CSLA address the importance of an economically prosperous US commercial launch industry for supporting and enhancing the national security of the United States. The CSLA specifically states that: *"Providing launch services and reentry services by the private sector is consistent with the national security and foreign policy interests of the United States and would be facilitated by stable, minimal, and appropriate regulatory guidelines that are fairly and expeditiously applied."*[21]

We are firmly committed to ensuring public safety and enhancing the national security of the United States. We are likewise committed to working with the FAA in achieving these mutual objectives. We believe, however, that the NPRM does not represent the most efficient and effective approach towards meeting those objectives. We firmly maintain, in fact, that the NPRM, if issued as a final rule, will result in the serious erosion of the robustness and international competitiveness of the U.S. commercial launch industry by, among other things:

1. Significantly increasing financial and operational costs.

2. Eroding requisite operational flexibility on the part of launch operators.

3. Adversely impacting the launch industry's scheduling processes and capabilities, and introducing significant delays.

4. Discouraging alternative methods of meeting safety requirements.

In summary, it is our considered opinion that implementation of final regulations as written in the NPRM will have a profound adverse effect on both the operational and financial aspects of launch activities conducted by our respective companies. ***We believe that the NPRM proposes significant changes to a proven and robust safety process and does so at an enormous cost to industry without incremental benefit to public safety.*** We believe this was not the intent of the FAA and respectfully submit that the FAA's responsibilities along these lines can be fulfilled more effectively with an alternative approach to that presented in the NPRM.

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[19] *Defense Daily, "Hamre Fears Lower EELV Demand Could Jeopardize DoD Space Access," by Tago Muradian* (December 22, 1999).

[20] National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. §§ 2451-84, § 2473(a) (2000).

[21] CSLA at § 70101(a)(6).

Recommendations

We thus have concluded that the implementation of this NPRM in its current form will have a significant negative effect on the U.S. launch business. The Industry lauds the achievements in public safety that have been attained to date, and supports and is proud to participate in the continued enhancement of those requirements. The Industry is convinced, however, that the FAA public safety responsibilities can be positively fulfilled with an alternative approach to the one presented in the NPRM.

As noted, we are completely committed to helping assure the FAA mandate for public safety and we offer our experience and expertise to the FAA in the development of a final rule that meets that mandate in a more cost-effective, consistent and efficient manner while maintaining the exemplary public safety record that the U.S. launch industry has maintained for over forty years. Accordingly, we respectfully propose the following recommendations:

A. Publish a revised NPRM applicable only to Non-Federal Ranges:

   1) Address and adopt all recommended changes and comments (see applicable recommendations regarding the proposed approach to Federal Ranges below); and

   2) Hold a public hearing during the public comment period for revised NPRM.

B. For Federal Ranges:

   1) Identify a single agency responsible for consistent implementation and uniformity of range safety rules and safety certifications for commercial and government launches;

   2) If the Air Force is to continue as this single agency, support and encourage the involvement of the Industry in re-writing EWR 127-1 to reflect performance-based standards;

   3) If FAA assumes responsibility for the implementation, application and certification of safety rules:

      a) Adopt a phased approach to achieve FAA objectives;

      b) Revise requirements to performance-based standards, to be released and applied in guideline format rather than legal mandates;

         i) Implement only the highest-level safety requirements as law.

         ii) Re-draft requirements in a way that encourages alternative solutions and reduces oversight.

         iii) Create a formal process for validating requirements. Eliminate requirements that cannot be technically justified.

         iv) Include industry in the entirety of the development and validation process.

         v) Reduce demands for data for each launch.

         vi) If detailed requirements are deemed necessary, create a series of guidance documents (*e.g.*, RCC handbooks or advisory circulars) to incorporate such detailed design solutions. Utilize

launch operator prepared documentation (*e.g.*, test and analysis plans, test procedures, etc.) to control launch vehicle specific implementation.

vii) Establish a process for periodically reviewing and re-validating the standards involving industry review and input. Eliminate or rewrite requirements that are frequently tailored or waived.

c) Establish a COMSTAC working group to work with the FAA in drafting a separate NPRM eliminating the concerns set forth herein, and to establish an open and ongoing dialogue with FAA (working group to include Industry and other affected parties);

d) Accept and adopt current design and operational procedures, without requiring re-evaluation or re-certification;

e) Establish, in consultation with Industry, a reasonable time period in which to transition from existing arrangements with regard to range safety to any proposed alternate arrangement(s); and

f) Publish a new NPRM for application to Federal Ranges.

Volume II

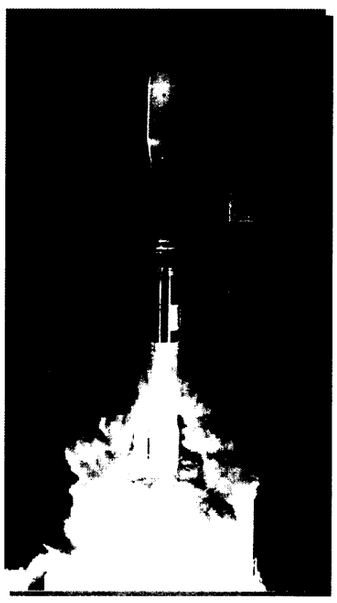
Detailed Comments

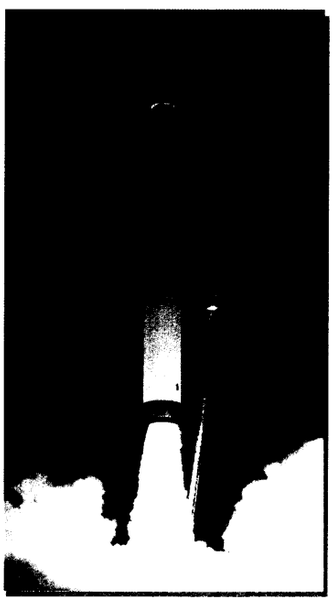
April 23,

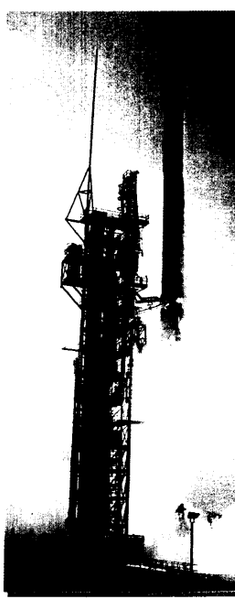
Consolidated Industry Response to FAA NPR Licensing and Safety Requirements for Laur

October 25, 2000

Docket Number FAA 2000-7953







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Consolidated Industry Response

Volume 2: Detailed Comments

FAA NPRM
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October 25, 2000
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The Boeing Company

International Launch Services

Lockheed Martin Corporation

Orbital Sciences Corporation

Sea Launch Company

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Introduction

The major members of the United States launch industry (Lockheed Martin Corporation, The Boeing Company, Orbital Sciences Corporation, Sea Launch, and International Launch Services, Inc.), hereafter referred to as the "Industry", conducted a detailed review of the NPRM. This review was performed to assess the technical, operational, legal, and financial impacts of the proposed regulations on the commercial launch industry.

The Industry review included independent and joint evaluation of the NPRM by experts in the ground safety, system safety, and flight safety disciplines. Areas of non-compliance or disagreement were noted, and, whenever possible, suggested changes to the wording of the NPRM requirements were made, along with the rationale for the suggested changes. These detailed comments made by the Industry experts also included responses to specific FAA requests for comments.

In general, the Industry comments reflect common concerns. However, due to the uniqueness of the programs represented, some requirements might impact some vehicles but not others. In some cases, the individual review comments are shown to further assist the FAA in understanding Industry concerns.

It is apparent that the FAA put considerable thought and effort into the development of the NPRM. The contributions of the 30th and 45th Space Wings are also evident. It is notable however, that the Industry was not included in the requirements determination prior to publication of the NPRM. Industry access to the NPRM authors during the comment period was also limited due tothe legal nature of the document. The Industry is concerned that, while this approach will generate specific comments, it comes far short of producing the meaningful exchange of information necessary to create a new document of this magnitude. The Industry believes joint industry and government participation in the development of new safety standards is essential if the new standards are to maintain the excellent safety record provided under the current safety process, while at the same time encouraging, facilitating, and promoting commercial launches by the private sector.

This volume is divided into nine sections: The first section contains an introduction and summary of the overall Industry review comments on the NPRM. The next eight sections contain the more detailed review discussions, including the proposed alternatives to the requirements offered in the NPRM. In these sections, added words are shown in bold blue text, deleted words are shown in blue text with strikethrough. The requirements listed in the paragraphs of NPRM Subpart C Section 417.235 and Appendix C were not considered applicable for the companies participating in this review, therefore, no review was performed for those NPRM paragraphs.

Summary of Comments

The comments on the following pages were made by the Industry reviewers in an attempt to emphasize the major concerns with the NPRM after performing the more detailed Industry review presented in the following sections. The comments are organized into groups representing the NPRM Subparts and Appendices that were reviewed by the Industry ground safety, flight safety, and system safety review teams, respectively.

Summary of Comments for Subparts A, B, and E – General and Ground Safety

A major concern with these Subparts is that much of what has been addressed there is also covered in applicable federal range documents. Such duplication raises significant concerns about different and/or conflicting interpretations between the two agencies with regard to the same basic requirement. Other concerns include possible overlaps between the NPRM and OSHA, EPA, NEC and other federal regulatory agencies' requirements. It seems by this rule that the FAA will be the final authority over those areas for issuing a launch license, but the FAA cannot give the licensee the authority to deviate from the requirements of other federal agencies.

The requirements in this rule should be consolidated into specific sections instead of spread between 415, and 417. Also, 417 sections A and B should be a general introduction to each area and the requirements should be placed into the applicable C, D and E sections.

Overall, we believe that there is too much specificity in these subparts. A preferable approach would be to address the manner in which a process is to be implemented, rather than how a specific test or action should be accomplished.

Summary of Comments for Subpart C, Appendices A, B, G, and I - Flight Safety Analysis

The NPRM should establish that the current flight safety analysis and launch support requirements, methodologies, policies, and procedures implemented by the range safety organization at an existing federal launch site are acceptable to the FAA for commercial launches at that launch site. A launch operator submittal that is acceptable to the existing range safety organization at a federal range, for a commercial launch at that range, should also be acceptable to the FAA.

It is very problematic to require all launch operators to be able to develop the capability to perform the same flight safety analysis and launch support tasks currently performed by the range safety organizations, or their subcontractors, at the federal ranges. Aside from the tremendous cost and schedule impact to the launch operator, there is a need to maintain a separate range safety organization at the federal ranges that is independent of the launch operator to ensure that there is no conflict of interest, or perceived conflict of interest, in any flight safety analysis or launch support task that could compromise public safety. Even if the federal range safety organizations were contracted by the launch operator to continue to perform flight safety analysis, the launch operator will be obligated to oversee, validate, and verify these analyses, since the NPRM proposes to make the launch operator responsible for all flight safety analyses. The launch operator will have to expend significant effort and resources to oversee and independently verify and validate flight safety analyses that have been the exclusive responsibility of the federal range safety organizations.

There should be one set of requirements, one set of data

submittals, and one certifying agency for each launch program. The NPRM, as written, will complicate the safety approval and certification process. For launches at a federal range, launch operators should not be required to make separate, but different submittals for the same flight safety analysis to the federal range safety organization and the FAA. Launch contractors have developed methodologies, software, and procedures to comply with the analysis product requirements established by the range safety organization at each federal range; therefore, all launch operator flight analysis submittals should be sent to that range safety organization, with copies available for the FAA, if requested.

Restricting the total mission E_C to 30 x 10^{-6} will prevent most, if not all, new commercial vehicles with orbital missions from launching at the Eastern Range, and possibly some other ranges, especially considering the failure probabilities proposed in the NPRM for vehicles with few launches. Due to the increased conservatism required by the NPRM, the E_C values from downrange debris risk assessment alone will be close to, or surpass the 30 x 10^{-6} E_C criteria for African or European overflights.

The risks posed by a launch vehicle in a launch area are mutually exclusive to the risks posed by the downrange overflight of populated regions, and it is much too conservative to combine the two risks and establish a collective E_C limit. It would be much better to establish separate E_C risk criteria for all phases of flight where hazards to populated regions are possible, as long as the criteria are designed to mitigate public risk, but reasonably permit vehicles to launch.

The proposed changes to ship surveillance practices currently employed by the federal ranges would result in decreased launch availability and increased cost without a significant benefit to public safety.

The concept of modifying launch licenses for every minor change is unrealistic, especially if the process is enacted as law. It is likely that time, effort, and money will be spent in legal and technical negotiations with the FAA trying to prove that a change, no matter how insignificant, is still covered by the original launch license. Vehicle and flight design are very dynamic processes, and launch operators require flexibility in responding to changes. For non-federal ranges, the FAA should deal with changes in a manner similar to the Flight Plan Approval and Launch Approval processes at the federal ranges, which provide the needed flexibility to launch operators, ensure the public is protected, and minimize schedule and cost impacts. For launches from federal ranges, the existing Flight Plan Approval and Launch Approval processes at the federal launch site should be acceptable to the FAA.

The FAA submittal schedules for flight safety analyses should be flexible, and the NPRM should permit this flexibility. Launch operators will not always be able to perform the flight safety analysis as early as the FAA requires, especially in the case of newer vehicles, since much of the information required to perform the analysis may not be available. The FAA should permit the flexibility in submittal schedule currently available from the range safety organizations at the federal launch sites.

Establishing requirements in one document that apply to all launch programs and all launch sites is extremely difficult, if not impossible, unless the requirements are general, or performance-based, rather than specific and detailed. More general requirements permit much more flexibility not only for current launch programs and launch sites, but for future launch programs and launch sites as well.

Summary of Comments for Subpart D, Appendices D, E, F, and H – Flight Safety Systems

The proposed regulation will require significant and continued tailoring for each launch vehicle program. The time and effort required to tailor this document for a new program will be substantial for both the launch operator and the regulatory agency. Subpart D should be limited to performance-based requirements that are applicable without tailoring. Detailed implementation and discussions of exceptions should be put in a document that can be treated as guidance. Vehicle requirements should be separated from ground systems requirements.

FTS reliability is shown as a goal in EWR 127-1, but as a hard requirement in the proposed regulation. The analysis and tests needed to demonstrate that FTS components meet the reworded requirement will be a significant cost impact. For example, the proposed regulation includes a requirement to perform ordnance qualification tests on 2994 flight units in a flight configuration to demonstrate that ordnance initiation occurs across each flight configured interface with a reliability of 0.999 at a 95% confidence level. (Ref Appendix E 417.39 C2).

The NPRM holds alternate methods to a higher standard. As written, the proposed regulation seems to imply that any flight safety system that does not meet every requirement in subpart B, subpart D, and the appendices referenced in these subparts would be considered an "alternate flight safety system". Using this interpretation, all flight safety systems used for current vehicles would be categorized as alternate flight safety systems. Per the NPRM wording, vehicles using alternate flight safety systems must pose significantly less risk and must be launched from an unpopulated area.

The NPRM also includes new design, analysis, and test requirements for ground-based command control systems

and support systems, as well as requirements for flight safety crew qualifications. In many cases, these requirements are not being met today by the federal ranges, and would be impractical to implement for non-federal ranges. The NPRM also attempts to make the launch operator responsible for oversight of the Federal Ranges.

The rule should not have firm time constraints without very good technical justification (e.g., 6 months before flight, 10 days before flight, etc.). Time constraints can be a constant source of waivers. Should the FAA choose to retain these time constraints, additional thought must be given to the purpose of the requirements and how the requirements are written.

The proposed regulation requires the launch operator to obtain FAA approval of any alternate analysis method or any proposed alternate flight safety system that does not satisfy all of the subpart requirements "before its license application or application for license modification will be found sufficiently complete to initiate review pursuant to § 413.11 of this chapter." In effect, this would mean that all tailoring agreements must be documented in the license. Experience has shown that tailoring agreements with the federal ranges have taken two to three years.

The approval process needs to be streamlined and clarified. There are too many things tied to the license. For example, the launch operator is to work flight termination system (FTS) preflight failure resolution as a license modification. This will lead to many delays. There should be at least three levels of submittals with corresponding levels of approval:

1. Information needed at time of application (this would include conceptual descriptions of Flight Safety Systems, and development and test plans).

2. One-time data submittals to be supplied during the course of development, including design review materials, qualification test reports, etc., environments updates, delta qualifications, etc. These should not be tied to the license.

3. Day-to-day working correspondence, including failure notification and corrective action, etc. These should not be tied to the license.

The NPRM does not address future safety systems and range architectures. No guidance is provided for future solutions including autonomous flight termination systems, or the use of space-based assets for flight termination.

Appendices D, E, F, and H. Due to time constraints, the Industry review of the NPRM flight safety system requirements focused primarily on Subpart D. Consequently, this volume does not provide a complete evaluation of these appendices. A significant number of comments relative to these appendices were collected and have been included in this volume for future reference. The Industry team did not have the opportunity to review each others comments on these appendices. Consequently, the recommendations shown in these appendices are generally the recommendations of the company that submitted the comment, and may not represent the Industry recommendation. However, the similarity of comments in many areas is typically an indicator of the type of issues that will need to be addressed.

The following general observations about the appendices can be made. First, the appendices contain detailed requirements which, in the view of the Industry, are not performance-based. Second, the NPRM does not differentiate between requirements in Subpart D and requirements in the appendices. Both are considered mandatory and legal requirements. The Industry understands the desire of the FAA and Air Force Range Safety to maintain detailed guidance for the design, test and analysis of flight safety systems. The Industry also recognizes that some launch vehicle operators have previously requested Range Safety to provide detailed guidance to clarify what the safety wings would or would not approve. However, the Industry also believes that it would be a serious mistake to write design solutions into law. The Industry also believes that it will be very difficult to make periodic updates to the appendices. Our general recommendations are as follows:

1. Move all detailed requirements currently in the appendices to some form of document that can be considered as guidance (e.g. design bulletins, advisory circulars, Range Commanders Council handbook, etc). The location chosen should be easy to update so that changes can be made periodically as appropriate. It may also be practical to modularize the requirements into smaller subjects (e.g. FTS component testing, FTS analysis, command destruct systems design, automatic destruct systems design, etc.)

2. Use test plans and procedures created by the launch operator to control flight safety system design, testing, and analysis to document the specific implementation for each program.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Preamble		
I. Introduction **Page 63923** By this notice of proposed rulemaking, the FAA proposes licensing and safety requirements for the conduct of a launch. The proposed requirements for obtaining a license would apply to a launch operator planning to launch from a non-federal launch site. A non-federal launch site is a launch site that is not located at a federal launch range. The proposed regulations for obtaining a license would not, however, apply to any launch from a non-federal launch site where a federal launch range performs the safety functions. For such a launch, the licensing requirements of 14 CFR part 415, subpart C applies. The proposed regulations are also intended to codify the safety requirements that a launch operator must satisfy to protect the public from the hazards of launch. The safety requirements contained in this proposed regulation apply to all licensed launches of expendable launch vehicles whether from a federal launch range or a non-federal launch site. This notice provides information regarding the criteria for obtaining a launch license, the responsibilities with which a launch licensee must comply, and operational requirements.	Many parts of 417 only refer to 415.101-131 that is Subpart F for non-federal ranges. Does this mean that those sections of 417 only apply to non-federal ranges and not federal ranges?	
§ II Background **Page 63923** **Second column, last paragraph.** Whether launching from a federal launch range, a launch site located on a federal range, or a non-federal launch site, a launch operator is responsible for ground and flight safety under its FAA license. At a federal launch range a launch operator must comply with the rules and procedures of the federal range. The safety rules, procedures and practices, in concert with the safety functions of the federal launch ranges, have been	Federal range safety systems have been determined to be adequately safe by the AF, NASA and FAA or	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
assessed by the FAA, and found to satisfy the majority of the FAA's safety concerns. In contrast, when launching from a non-federal launch site, a launch operator's responsibility for ground and flight safety takes on added importance. In the absence of federal launch range oversight, it will be incumbent upon each launch operator to demonstrate the adequacy of its ground and flight safety to the FAA.	be adequately safe by the AF, NASA and FAA or launches would not be allowed.	
§ II Background **Page 63924,** **First column, first and second full sentences.** The licensing regulations for launch from a federal launch range are designed to avoid duplication of effort between the FAA and the federal launch ranges in overseeing the safety of launches at the federal ranges. Although the FAA does require information and analyses not required by federal ranges to ensure that all flight safety issues are addressed, and imposes certain additional requirements derived from recommendations arising from a National Transportation Safety Board investigation, the FAA does not duplicate the safety assessments performed by federal launch ranges	The majority of this NPRM is duplication of what the federal ranges already do or require.	
§ II Background **Page 63924,** **Second column, first full paragraph.** The FAA performed baseline assessments of various federal launch ranges and found their safety services adequate. Under FAA regulations, the FAA does not require an applicant to demonstrate the adequacy of the range services it proposes to employ if the applicable baseline assessment included those federal launch range services and if those services remain adequate. Certain showings regarding the applicant's own capabilities are still required. The FAA requires specific information regarding the interface between the safety organizations	The first sentence seems to contradict the above statement the "majority of the FAA's concerns were met" Which is correct? Don't understand contradiction.	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
of a federal launch range and of an applicant. In the event that a service or procedure upon which an applicant proposes to rely is not within the documented experience of the federal launch range that the applicant proposes to utilize, the applicant would have to demonstrate the safety of that particular aspect of its launch. This is also true if a documented range safety service has changed significantly or has experienced a recent failure. In those cases, the burden of demonstrating safety shifts to the applicant.		
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **A. Proposed Revisions to Parts 415 and 417** **Page 63924, third column, last sentence continues to 63925, first column and the first full sentence on page 63925.** The FAA anticipates that, in most instances, satisfaction of the Air Force requirements will satisfy the FAA's ground safety requirements. In the event of conflicts, the FAA's requirements will govern licensed launch operators.	Will FAA's requirements also override those of agencies other than the federal launch range, i.e. OSHA, EPA, NEC? We recommend no duplication of existing government requirements in this NPRM. We believe the duplication of requirements will lead to conflicts, differing interpretations, added cost and schedule impacts.	
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **A. Proposed Revisions to Parts 415 and 417** **Page 63926, first column, first full paragraph.** This notice also addresses ground safety issues related to the preparation of a launch vehicle for flight. Many issues related to the safety of ground operations at a launch site are subject to regulation by other federal agencies. This notice would address ground safety issues, not otherwise addressed by other federal regulations, that are unique to space launch processing and that could affect the general public. A launch operator licensee would be responsible for developing and implementing a ground safety program in	If these statements are correct then reference the applicable "other regulatory agencies" documents and do not try to restate them in this rule. If you try to take the information from another regulation and state it here and the "real" regulation is changed it may not flow into this rule and there would be conflicts that could endanger the public instead of	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
compliance with the specified standards, and should note that this proposed rulemaking does not supersede the ground safety requirements of other regulatory agencies.	protect them. How is this statement to be interpreted in light of the comment in **§ III? Discussion of Proposed Licensing and Safety Regulations for launch, G. Ground Safety, page 63942, third column, first full paragraph,** Which indicates that the FAA has exclusive jurisdiction over launch processing at a launch site?	
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **B. Payload Review and Determination** **Page 63927, first column, first full paragraph, last sentence.** Accordingly, the FAA will continue to address payload safety issues that relate to the transport, or launch, of a payload, regardless of whether the payload is within the jurisdiction of the FCC or NOAA or whether it is owned or operated by the U.S. Government.	Does FAA have authority to "approve DoD payload safety issues since they are "owned or operated by the U.S. Government"?	
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **F. Flight Safety System** **Page 63940, paragraph 6. Deviations and Waivers.** A federal launch range may grant deviations and waivers when a launch operator does not meet EWR 127-1 requirements. EWR 127-1 permits deviations and waivers when the mission objectives of the range user cannot otherwise be achieved. Deviations are used when a flight termination system design noncompliance is known to exist prior to hardware production or an operational noncompliance is known to exist prior to beginning operations at a federal launch range. Waivers are used when, through an error in the		

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
manufacturing process or for other reasons, a hardware noncompliance is discovered after hardware production, or an operational noncompliance is discovered after operations have begun at the ranges. Unlike Meets Intent Certification, the latest EWR 127-1 contemplates acceptance of greater risk for both deviations and waivers. Under the federal launch range process, a launch operator may obtain a deviation or a waiver to meet mission requirements. By implication, this involves an acceptance of greater risk. A launch operator under the proposed regulations would have to demonstrate an equivalent level of safety if it wanted to avoid a published requirement. This is in keeping with the FAA's current practice for licensed commercial launch, but may mark a change from current practice for some who are accustomed to conducting government launches.	If the E_c were met then would a change have to show equivalent level of safety to previous system? The previous system may have exceeded the E_c requirement.	
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **F. Flight Safety System** **Page 63940, second column, paragraph 7. Alternate Flight Safety Systems, first paragraph.** A flight safety system would be required to satisfy all the functional, design, and test requirements of proposed subpart D of part 417 unless the FAA approved otherwise through the licensing process. The FAA would approve the use of a flight safety system that did not satisfy all of proposed subpart D if a launch operator demonstrated that the proposed launch achieved a level of safety equivalent to satisfying all the requirements of proposed subpart B and proposed subpart D. In such cases, a launch operator would have to demonstrate that the launch presented significantly less risk than would otherwise be required, both in terms of E_c and any other significant factors underlying a risk determination. The reduced level of public risk would have to correspond to the reduced capabilities of	An alternate flight safety system does not necessarily mean that it is less safe or has "reduced capabilities" then the one previously approved, just different. An alternate flight safety system should be held to the same safety standard as a traditional system. Existing flight safety systems that are currently approved by federal ranges have proven their level of safety. These systems meet the intent of this NPRM and should be accepted as is.	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
the proposed flight safety system. To achieve the reduced level of public risk, the launch would typically have to take place from a remote launch site with an absence of population and any overflight of a populated area taking place only in the latter stages of flight. The proposed alternate flight safety system would have to perform its intended functions, however they might differ from the requirements of subpart D, with a reliability comparable to that required by subpart D.	If an alternate system achieves a level of safety that is equivalent then why does it need to demonstrate that the launch presented significantly less risk than would otherwise be required, both in terms of E_c and any other significant factors underlying a risk determination?	
§ III. Discussion of Proposed Licensing and Safety Regulations for launch **G. Ground Safety** **Page 63942, third column, second full paragraph.** The FAA has neither the resources nor the intention of second guessing the regulatory requirements of other agencies nor purporting to issue approvals on their behalf. Under the Act, all requirements of the laws of the United States applicable to the launch of a launch vehicle are requirements for a launch license. 49 U.S.C. § 70105(b)(1). The Act also provides, however, that, except as otherwise provided by the requirements of the statute, a launch operator "is not required to obtain from an executive agency a license, approval, waiver, or exemption to launch a launch vehicle." 49 U.S.C. § 70117(a). The FAA may prescribe by regulation that a requirement of a law of the United States not be a requirement for a license, if, after consulting with the head of the appropriate executive agency, the FAA decides that the requirement is not necessary to protect, in relevant part, the public health and safety and safety of property. 49 U.S.C. § 70105(b)(2)(C). This rulemaking does not affect the regulatory requirements of other executive agencies	The note says " To date, the FAA has not exercised its exclusive jurisdiction over launch processing at a launch site, relying, for example, on NRC's handling of nuclear materials at federal launch ranges. This statement implies that the FAA has the authority to overrule any other executive agency when it concerns processing a vehicle for launch, launching a vehicle or payload and any public safety issues that may be involved.	This could be problematic if the FAA does decide to exercise this authority because it would create unnecessary and potentially costly confusion regarding compliance.
Regulatory Evaluation Summary **Page 63963, third column, first full paragraph.** The FAA does not expect there to be any change in	Since "the FAA does not expect there to be any change	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
safety benefits. There may be some cost savings to the licensee because launch operators would have improved knowledge of the FAA license requirements, data and information requirements, and reporting requirements and formats beforehand. The FAA codified requirements will apply to all licensed commercial launches. Launch operators would know the FAA and federal range requirements, data and information requirements, and reporting requirements and formats. Finally, there may be some cost savings from launching at federal ranges since the launch operators would have improved knowledge of requirements	in safety benefits" as a result of this regulatory action, the current federal range process with continued FAA insight should remain intact. This would ensure the same level of public safety that the federal ranges have accomplished over the last 40 years.	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Part 415, Licensing		
Page 63945 **§ 415.105 Launch description** (b) When applying for a new launch license, a pre-application consultation meeting must be conducted no later than 24 months before an applicant brings any launch vehicle to the proposed launch site and before the applicant begins preparation of the initial flight safety analysis required by § 415.115.	(b) When applying for a new launch license, a pre-application consultation **meeting is advised to** be conducted no later than 24 months before an applicant brings any launch vehicle to the proposed launch site and before the applicant begins preparation of the initial flight safety analysis required by § 415.115.	Many times circumstances arise in which a launch attempt is less than 24 months away. The rule making needs to make accommodations for such exceptions or be less stringent on the time frame.
Page 63965 **§ 415.107 Safety review document.** (a) A license applicant shall submit a safety review document that contains all the information required by this subpart for the FAA to conduct a launch safety review during the licensing process. An applicant shall comply with the scheduling requirements of part 417 and this subpart. This subpart contains requirements for an applicant to submit certain data by a specified time during the licensing process. An applicant shall submit a sufficiently complete safety review document no later than six months before the applicant brings any launch vehicle to the proposed launch site.	Rewrite this entire section to address what is to be submitted with the application versus what is required by the license. § 417 describes what submittals are required of the licensee and should comply with but supercede what is in the application.	The Safety Review Document should be a license requirement not an application requirement. A higher-level safety plan, i.e., System Safety Program Plan, is what should be submitted with the application. What is described in Appendix B of this part is similar to the Missile System Pre-launch Safety Plan that is submitted to the Federal Range at (preliminary) 90 days and (final) 45 days prior to the start of operations. The FAA should be working with the licensee in establishing the final Safety Review Document.
§ 415.109 Launch description (c) *Launch schedule.* An applicant's safety review document must identify each planned flight date and time and each alternate date and time. For the licensing of more than one launch, an applicant shall submit schedule information for the earliest planned launch and best estimates for each subsequent launch.	(c) *Launch schedule.* **For a Launch Operators License,** a licensee's safety review document must **identify any known planned missions and the dates of the launch periods.** For the licensing of more than one launch, a licensee shall submit schedule information for the earliest planned launch **period** and best estimates for each subsequent launch.	Delete: Launch dates should not have a bearing on the license application. This precludes the issuance of a Launch Operators license if the application must identify all the missions being applied for. Currently not in the Safety document provided to the Federal Ranges.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
	For a Launch Specific License, a licensee's safety review document must identify the planned launch period.	Normally missions are planned with launch period in the contract. Revise ALL references to "An Applicant's safety review document ..." to "A licensee's safety review document ...". The safety review document should not be part of the application process but a requirement of the license.
§ 415.109 Launch description (d) *Launch site description.* An applicant's safety review document must describe the proposed launch site and identify the following:	(d) *Launch site description.* **A licensee's** safety review document must **identify** the proposed launch site. If the launch is from a currently unlicensed launch site the applicant must meet the requirements of § 420.	Unless the launch operator is also the launch site operator, this information should have been provided in the Launch Site Operator's application. The launch operator need only identify the launch site and the pad from which the launch is to take place.
§ 415.109 Launch description (f) *Payload description.* An applicant's safety review document must contain, or reference documentation previously submitted to the FAA that contains, the payload information required by § 415.59 for any payload in accordance with part 415, subpart D. The safety review document must also contain a table specifying the type and quantities of all hazardous materials within each payload.	(f) *Payload description.* **A licensee's** safety review document must contain, or reference documentation previously submitted to the FAA that contains, the payload information required by § 415.59 for any **known payloads** in accordance with part 415, subpart D. The safety review document must also contain a table specifying the type and quantities of all hazardous materials within each **known** payload. The licensee shall provide payload descriptions on future payloads prior to the payload arriving to the launch site.	Regulation precludes the application for a Launch Operator's License. The types and quantities of all hazardous materials may not be known for launches not yet under contract.
§ 415.111 Launch operator information.	**Top-level information supplied with the application. Specifics supplied in later documentation required by license.**	Supplying such details in the application is likely to create an unnecessary need for revisions.
§ 415.115 Flight safety (a) (1) An applicant shall submit the flight safety analysis data required by this section no later than 18	(1) **A licensee** shall submit **the first draft** flight safety analysis data required by this section no later than	No provision to allow for expedited time line.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
months before the applicant brings any launch vehicle to the proposed launch site.	**12** months before the **launch** ~~applicant brings any launch vehicle to the proposed launch site~~.	
§ 415.117 Ground safety (a) *General.* An applicant shall submit a ground safety analysis report and ground safety plan for its launch processing and post-launch operations in accordance with this section when launching from a launch site in the United States. Launch processing and post-launch operations at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.	(a) *General.* **A licensee** shall submit**, as part of the safety review document,** a ground safety analysis report and ground safety plan for its launch processing and post-launch operations in accordance with this section when launching from a launch site in the United States. Launch processing and post-launch operations at a launch site outside the United States may be subject to the requirements of the governing jurisdiction. **A licensee shall submit an initial safety review document 2 months prior to bringing the launch vehicle to the proposed launch site.**	Should specify that these two are parts of an overall safety review document. Should specify the submittal time of the safety review document that should be a license requirement not part of the application.
§ 415.117 Ground safety (b) (1) An applicant shall submit an initial ground safety analysis report no later than 12 months before the applicant brings any launch vehicle to the proposed launch site.	**Delete here and add delivery time to § 415.117 (a). See above. This should be a required submittal by the license not part of the application.**	No provision to allow for expedited time line. At 12 months before launch vehicle to site, grounds processing plans would not be complete enough to perform an adequate safety analysis. This should be specified under § 415.117 (a) General.
§ 415.117 Ground safety (b) (3) All information in a ground safety analysis report must be verifiable, including design margins, fault tolerance and successful completion of tests. Any identified hardware must be traceable to an engineering drawing or other document that describes hardware configuration. Any test or analysis identified must be traceable to a report or memorandum that contains details about how the test or analysis was performed and the results and identifies those who ensure the accuracy of the test or analysis. Any procedural hazard control	(b) (3) All information in a ground safety analysis report must be verifiable, including design margins, fault tolerance and successful completion of tests. Any identified hardware must be traceable to an engineering drawing or other document that describes hardware configuration. Any test or analysis identified must be traceable to a report or memorandum that contains details about how the test or analysis was performed and the results and identifies those**, by position,** who ensure the accuracy of the test or analysis. Any procedural	We believe that it makes no sense to identify the person by name that performed an analysis.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
identified must be traceable to a written procedure, approved by the launch safety director or designee, with the paragraph or step number of the procedure specified. A verifiable hazard control shall be identified for each hazard. For each hazard control the report must reference a released drawing, report, procedure or other document that verifies the existence of the hazard control. A launch operator shall maintain records, in accordance with § 415.77, of the verification documentation that supports the information in the ground safety analysis report	hazard control identified must be traceable to a written procedure, approved by the launch safety director or designee, with the paragraph or step number of the procedure specified. A verifiable hazard control shall be identified for each hazard. For each hazard control the report must reference a released drawing, report, procedure or other document that verifies the existence of the hazard control. A launch operator shall maintain records, in accordance with § 415.77, of the verification documentation that supports the information in the ground safety analysis report	
§ 415.117 Ground safety (b) (5) A ground safety analysis report must be approved and signed by the launch safety director and the launch director. Each individual who prepares any part of a ground safety analysis report, shall sign and date a written statement certifying that the part of the report that person prepared is true, complete and accurate as of that date. Each statement must be included as part of the report or as an attachment.	**Delete these two sentences.**	These individuals are performing a job for the company and sign the documents as prepares. Further statements of certification are not justified. This is not done at the Federal Ranges.
§ 415.117 Ground safety (c)	**No time frame is specified for submittal of the ground safety plan. This should be specified under § 415.117 (a) General. This should be a required submittal by the license not part of the application.**	A new applicant would not have such detail during the application period.
§ 415.117 Ground safety (c) (1) A description of the launch vehicle and payload identifying all hazards, including explosives, propellants, toxics and other hazardous materials, radiation sources, and pressurized systems. A ground safety plan must include figures that show the location of each hazard on the launch vehicle	(1) A description of the launch vehicle and **any known payloads** identifying all hazards, including explosives, propellants, toxics and other hazardous materials, radiation sources, and pressurized systems. A ground safety plan must include figures that show the location of each hazard on the launch	This is not compatible for a Launch Operator's License application, as not all payloads would be known.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
and where at the launch site, launch processing involving the hazard is performed.	vehicle and where at the launch site, launch processing involving the hazard is performed. **New payload information is to be submitted in an addendum to the ground safety plan prior to the payload arriving at the launch site.**	
§ 415.119 Launch plans (a) *General.* In addition to the flight and ground safety plans required by §§ 415.115 and 415.117, an applicant's safety review document must contain the public safety related launch plans required by this section. Each plan must identify operation personnel and their duties, contain mission specific information for the first planned launch and include written procedures that contain the specifics of the operations and activities conducted in accordance with the plan. Procedures may be incorporated by reference. Each plan must identify personnel by position who approve and implement the plan, the related procedures, and any modification to the plan or procedures. An applicant shall incorporate each launch safety rule established in accordance with § 417.113 into each related launch safety plan. An applicant's launch plans shall include, but need not be limited to, those required by this section.	(a) *General.* In addition to the flight and ground safety plans required by §§ 415.115 and 415.117, **a licensee's** safety review document must contain the public safety related launch plans required by this section. Each plan must identify operation personnel and their duties, contain mission specific information for the first planned launch and include written procedures that contain the specifics of the operations and activities conducted in accordance with the plan. Procedures may be incorporated by reference. Each plan must identify personnel by position who approve and implement the plan, the related procedures, and any modification to the plan or procedures. A **licensee** shall incorporate each launch safety rule established in accordance with § 417.113 into each related launch safety plan. **A licensee's** launch plans shall include, but need not be limited to, those **plans agreed to during the application process.**	For a new launch site or new vehicle at an existing launch site, most of the requirements of these plans would not be worked out at the times called out for application submittals. On the Federal Ranges these issues are worked out w/ the Range over a period of time, even up to the time of use. The FAA representatives will need to participate with the launch operator in developing and working these issues. These plans should be submittals made by the launch operator during the launch not be part of the application process. There are plans listed in this part that are not currently done at the Federal Ranges.
§ 415.119 Launch plans (f) An applicant's safety review document must contain a communications plan that ensures clear concise communications between personnel involved in launch processing, countdown, and flight. A communications plan must list and describe all forms of communication that ensure public safety and any voice and data circuits required to allow real-time interface among launch control and safety personnel for each task during the conduct of hazardous operations, launch processing, countdown, and flight. This includes	(f) An applicant's safety review document must contain a communications plan that ensures clear concise communications between personnel involved in launch processing, countdown, and flight. A communications plan must ~~list and~~ describe all forms of communication that ensure public safety and ~~any voice and data circuits required to~~ allow real-time interface among launch control and safety personnel for each task during the conduct of hazardous operations, launch processing, countdown, and flight. This includes	In general, communication circuits are not assigned until near the start of processing. Assignment of circuits may vary depending on mission requirements.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
communications to locations outside of the launch site boundaries when those communications are necessary for public safety and includes those communications that are part of any flight safety system as required by § **417**.327. A communications plan must delineate clear lines of communication and unimpeded flow of reporting and direction. The plan must define precise and formal communication protocols using well-defined terminology and acronyms that can be clearly understood over a voice network. The communications plan must also identify communication system reliability and backup circuits.	communications to locations outside of the launch site boundaries when those communications are necessary for public safety and includes those communications that are part of any flight safety system as required by § 417.327. A communications plan must delineate clear lines of communication and unimpeded flow of reporting and direction. The plan must define precise and formal communication protocols using well-defined terminology and acronyms that can be clearly understood over a voice network. The communications plan must also identify communication system reliability and backup circuits.	
§ 415.119 Launch plans (i) *Public coordination plan.* An applicant's safety review document must contain a plan that describes the processes for coordinating launch processing and flight with the local population and local government officials to ensure public safety. A public coordination plan must include the following:	**Delete from § 415 and add to § 420.**	This should be a Site Operators requirement. The Site Operator is established with the local community and government.
§ 415.119 Launch plans (j) *Local agreements and plans.* An applicant's safety review document must contain any agreements and plans with local authorities at or near a launch site whose support is needed to ensure public safety during all launch processing and flight activities. An applicant's local agreements and plans must satisfy any launch site operator's local agreements and plans developed in accordance with part 420. Local agreements and plans must include coordination with the following where applicable:	**Delete from § 415 and add to § 420.**	This should be a Site Operators requirement. The Site Operator is established with the local community and government.
§ 415.119 Launch plans (d) *Launch support equipment and instrumentation plan.* An applicant's safety review document must	**This list of support equipment should be limited to launch safety critical equipment and**	Creating and maintaining a list of equipment and the associated operations and maintenance personnel is

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
contain a launch support equipment and instrumentation plan that ensures the reliability of the equipment and instrumentation that is involved in ensuring public safety during launch processing and flight. A launch support equipment and instrumentation plan must list and describe such equipment and must identify personnel who are responsible for its operations and maintenance and who must be certified in accordance with § 417.105. The plan must also contain, or incorporate by reference, written procedures for support equipment operation, test, and maintenance that are to be implemented for each launch. The plan must also identify equipment and instrumentation reliability and contingencies that protect the public in the event of a malfunction.	**instrumentation only**.	costly and not needed for most of the equipment. New mission unique items can be required at times on short notice that have nothing to do with launch or public safety.
§ 415.121 Launch schedule and points of contact (a) An applicant's safety review document must contain a launch schedule that identifies each test, review, rehearsal, and safety critical preflight operation to be conducted for each launch in accordance with §§ 417.115, 417.117, 417.119, and 417.121. The schedule must show start and stop times for each activity referenced to liftoff. A schedule must include, but need not be limited to those activities required by part 417. (b) Either as part of the schedule or as an attachment, an applicant's safety review document must contain a summary of each scheduled activity that includes criteria for successful completion of the activity and that identifies a person by position who oversees the activity	(a) ~~An applicant's~~ **A licensee** safety review document must contain **a top-level generic** launch schedule that identifies ~~each test~~, review, rehearsal, and safety critical preflight operation to be conducted for each launch in accordance with §§ 417.115, 417.117, 417.119, and 417.121. The schedule must show start and stop times for each activity referenced to liftoff. A schedule must include, but need not be limited to those activities required by part 417. ~~(b) Either as part of the schedule or as an attachment, an applicant's safety review document must contain a summary of each scheduled activity that includes criteria for successful completion of the activity and that identifies a person by position who oversees the activity.~~	The commentary on page 63947 refers to the "... first planned launch." It is not reflected here in the regulation. These schedules change on a daily basis during operations to allow for unplanned contingencies and attempt to maintain the launch date. Also, differences in missions determine changes to the schedule flow. The FAA representative must be part of the daily operations meeting. The schedule should not be apart of any document we give the FAA. We would constantly be revising the document to keep up with new schedules. Schedules can be provided outside of the SRD.
§ 415.123 Computing Systems and Software (a) An applicant's safety review document must describe all computing systems and software that perform a software safety critical function for any	(a) ~~An applicant's~~ **A licensee's** safety review document must describe all computing systems and software that perform a software safety critical	For an established company some of this information would be part of company polices and practices, however, a new start up may not have this developed in

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
operation performed during launch processing or flight that could have a hazardous effect on the public. This includes any software function that, if not performed, if performed out of sequence, or if performed incorrectly, may directly or indirectly cause a public safety hazard. An applicant shall implement such computing systems and software in accordance with § 417.123 and appendix H of part 417.	function for any operation performed during launch processing or flight that could have a hazardous effect on the public. This includes any software function that, if not performed, if performed out of sequence, or if performed incorrectly, may directly or indirectly cause a public safety hazard. ~~An applicant~~ **A licensee** shall implement such computing systems and software in accordance with § 417.123 and appendix H of part 417. **The computing systems and software section of the licensee's safety review document shall be submitted prior to the start of testing at the launch site.**	the required submittal time frame.
§ 415.127 Flight safety system design and operation data (a) An applicant's safety review document must contain the flight safety system data identified in this section for the launch of an orbital or guided sub-orbital launch vehicle that uses a flight safety system to protect public safety in accordance with § 417.107(a). Unless otherwise specified, all data required by this section that is applicable to an applicant's flight safety system must be submitted no later than 18 months before the applicant brings any launch vehicle to a proposed launch site. An applicant shall participate in a series of technical meetings with the FAA as needed to facilitate the review and approval of a flight safety system and its implementation.	(a) ~~An applicant's~~ **A licensee's** safety review document must contain the flight safety system data identified in this section for the launch … **Change the words "An applicant's" to "A licensee's" throughout this subsection.**	Revise submittal time frame. This should be a required submittal by the licensee, but not as part of the application process. Unless otherwise specified, all data required by this section that is applicable to **A licensee's** flight safety system must be submitted prior to the licensee bringing any launch vehicle to a proposed launch site.
§ 415.129 Flight safety system test data (a) *General* An applicant's safety review document must contain the flight safety system test data required by this section. Except for test reports, an applicant shall submit all required test data no later than 12 months before the applicant brings any launch vehicle to the proposed launch site.	(a) *General* ~~An applicant's~~ **A licensee's** safety review document must contain the flight safety system test data required by this section. Except for test reports, ~~an applicant~~ **a licensee** shall submit all required test data ~~no later than 12 months~~ before the **applicant licensee begins testing at the launch**	Revise submittal time frame. This should be a required submittal by the licensee, but not as part of the application process.

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launch vehicle to the proposed launch site. (e) *Test reports.* An applicant's safety review document must contain test reports, prepared in accordance with § 417.315(f) and § 417.325(d), for each flight safety system test completed at the time of license application. An applicant shall submit any remaining test reports before flight in accordance with § 417.315(f) and § 417.325(d).	**site.** ~~brings any launch vehicle to the proposed launch site.~~ (e) *Test reports.* An applicant ~~safety review document~~ must make available test reports~~, prepared in accordance with 417.315(f) and 417.325(d) of this chapter,~~ for each flight safety system test completed ~~at the time of license application. An applicant shall submit any remaining test reports before flight in accordance with 417.315(f) and 417.325(d) of this chapter.~~	
§ 415.131 Flight safety system crew data (b) An applicant's safety review document must identify the senior flight safety official by name and demonstrate that this individual's qualifications comply with the requirements of § 417.331.	(b) ~~An applicant's~~ **A licensee's** safety review document must ~~identify the senior flight safety official by name and~~ demonstrate that **the** ~~this individual's~~ qualifications **of the flight safety official** comply with the requirements of 417.331. **This information is to be submitted prior to the start of launch site vehicle testing involving the FTS.** **(c) An applicant's safety review document must describe the certification and training program for flight safety system.**	Revise submittal time frame. This should be a required submittal by the licensee, but not as part of the application process.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
§ Part 417, Launch Safety		
§ Part 417, Launch Safety **Sub Part A - General**	**Requirements that govern one aspect of the licensing process need to be placed in one location. Rewrite 417 to take requirements from Subpart A and B and place them in the respective sections. This will enable the applicant and the FAA to ensure that all requirements are met.**	
This part prescribes the responsibilities of a launch operator conducting a licensed launch of an expendable launch vehicle and the requirements with which a licensed launch operator must comply to maintain a license and conduct a launch. The safety requirements contained in this part apply to all licensed launches of expendable launch vehicles. The administrative requirements for submitting material to the FAA contained in this part apply in total to all licensed launches from a non-federal launch site. For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the administrative requirements contained in this part that apply to such a launch will be identified during the licensing process in accordance with subpart C of part 415, but may vary depending on the FAA's current baseline assessment of the federal launch range's safety process. Requirements for preparing a license application to conduct a launch, including all related policy and safety reviews and payload determinations are contained in parts 413 and 415.	For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the administrative requirements contained in this part **do not apply.** This part prescribes the responsibilities of a launch operator conducting a licensed launch of an expendable launch vehicle **from a non-federal range** and the requirements with which a licensed launch operator must comply to maintain a license and conduct a launch. The safety requirements contained in this part apply to all licensed launches of expendable launch vehicles. The administrative requirements for submitting material to the FAA contained in this part apply in total to all licensed launches from a non-federal launch site. ~~For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the administrative requirements contained in this part, that apply to such a launch will be identified during the licensing process in accordance with subpart C of part 415, but may vary depending on the FAA's current baseline assessment of the federal launch range's safety process.~~ Requirements for preparing a license application to conduct a launch, including all related policy and safety reviews and payload determinations are contained in parts 413 and 415.	For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the administrative requirements contained in this part should not apply since the federal range safety organization is responsible for all launch safety on their range. The Launch operator can supply the FAA with the analyses required by the ranges but not duplicate reports or analyses.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
	Add definition for Automatic Destruct System **A typical automatic (ADS) consists of a power source, control logic, activation device, arming device, destruct charge, and associated circuitry.**	Add this definition since ISDS is only one type of automatic destruct system.
	Add definition for Autonomous Flight Safety System	
§ 417.3 Definitions. *Destruct* means the act of terminating the flight of a launch vehicle in a way that destroys the launch vehicle and disperses or expends all remaining propellant and renders remaining energy sources non-propulsive before the launch vehicle or any launch vehicle component or payload impacts the Earth's surface.	*Destruct* means the act of terminating the flight of a launch vehicle in a way ~~that destroys the launch vehicle~~ **acceptable to the FAA and launch site operator.** ~~and disperses or expends all remaining propellant and renders remaining energy sources non-propulsive before the launch vehicle or any launch vehicle component or payload impacts the Earth's surface.~~	Not all destruct systems disperse or expend propellants or keep the parts from impacting the Earth's surface. Some just shut down the engines and allow the launch vehicle to impact intact.
§ 417.3 Definitions *Flight safety system* means the system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch vehicle failure. A flight safety system includes the hardware and software used to protect the public in the event of a launch vehicle failure and the functions of any flight safety system crew. One typical U.S. flight safety system, for example, incorporates a flight termination system, a command control system, and support systems such as tracking and telemetry.	*Flight safety system* means the system **(both hardware and software)** that provides a means of ~~control during flight for~~ preventing a launch vehicle and **it's hazards,** ~~any component~~, including any payload **hazards**, from reaching any populated or other protected area in the event of a launch vehicle failure. A flight safety system **must include** ~~includes the hardware and software used to protect the public in the event of a launch vehicle failure~~ **a flight termination system, a launch vehicle tracking system, and a telemetry system. For commercial launches from non-federal ranges, the definition of a flight safety system includes ground support systems as well as** ~~and~~ the functions of **the** ~~any~~ flight safety system crew. ~~One typical U.S. flight~~	Completed definition here to allow deletion of similar but different definition in § 417.301. Limited application of ground requirements to commercial launches from Non-Federal ranges. Deleted unnecessary example.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
	~~safety system, for example, incorporates a flight termination system, a command control system, and support systems such as tracking and telemetry~~.	
§ 417.3 Definitions *Flight safety system crew* means each of the personnel, designated by a launch operator, who operate flight safety system hardware and software. The functions of a flight safety system crew are part of the flight safety system. A flight safety system crew includes a flight safety official and the personnel who support the flight safety official during launch.	*Flight safety system crew* means each of the personnel~~, designated by a launch operator,~~ who operate flight safety system hardware and software. ~~The functions of a flight safety system crew are part of the flight safety system.~~ A flight safety system crew includes a flight safety official and the personnel who support the flight safety official during launch.	Whole document is for launch operator so delete "designated by a launch operator" Deleted sentence duplicates words in §417.3 definition for flight safety system.
§ 417.3 Definitions *Flight termination system* means all components, onboard a launch vehicle, that provide the ability to end a launch vehicle's flight in a controlled manner. A flight termination system consists of all command destruct systems, inadvertent separation destruct systems, or other systems or components that are onboard a launch vehicle and used to terminate flight.	*Flight termination system* means all components, onboard a launch vehicle, that provide the ability to end a launch vehicle's flight in a controlled manner. A flight termination system consists of all command ~~destruct~~ systems **and automatic**/inadvertent ~~destruct~~ **termination** systems **and their components.** ~~or other systems or components that are onboard a launch vehicle and used to terminate flight.~~	Not all flight termination systems destroy the vehicle. Sea Launch just terminates thrust.
§ 417.3 Definitions *Inadvertent separation destruct system* means an automatic destruct system that uses mechanical means to trigger the destruction of a launch vehicle stage.	*Inadvertent separation destruct* system means an automatic destruct system that uses mechanical **breakup** ~~means~~ to trigger the destruction of a launch vehicle stage.	Easier to understand, since "mechanical means" could be interpreted to mean mechanically initiated systems only.
§ 417.3 Definitions *Launch conductor* means a person designated by a launch operator who conducts preflight launch	**Deleted**	Job descriptions should not be part of law. Nor should the organizational structure of a licensee be subject to

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processing, hazardous operations, systems testing, and the launch countdown. A launch conductor coordinates activities with a launch safety director and reports directly to a launch director. *Launch director* means an internal launch operator management employee who ensures public safety and who has final approval authority for launch. A launch director ensures that all public safety related issues are resolved prior to flight. *Launch safety director* means a person designated by a launch operator who oversees a launch safety organization and all activities related to ensuring public safety. A launch safety director reports directly to the launch director.		federal law. The makeup of the contractor launch team should be included in the licensing process and approved as part of the FAA license with personnel names, responsibilities and qualifications agreed to by the FAA, and any other agencies at the time issuing the license.
	Launch Operator	This term is used frequently and almost interchangeably with Launch Site Operator but they are two distinct organizations, and the distinction needs to be clear.
	Launch Site Operator	This term is used frequently and almost interchangeably with Launch Operator but they are two distinct organizations, and the distinction needs to be clear.
§ 417.3 Definitions *Passive component* means a flight termination system component that does not contain active electronic piece parts such as microcircuits, transistors, and diodes. Passive components include, but need not be limited to, radio frequency antennas, radio frequency couplers, and cables and rechargeable batteries, such as nickel cadmium batteries.	*Passive component* means a flight termination system component that does not contain active electronic piece parts such as microcircuits, transistors, and diodes. Passive components include, but need not be limited to, radio frequency antennas, radio frequency couplers, and cables. ~~and rechargeable batteries, such as nickel cadmium batteries~~.	Batteries cannot be considered as passive components since they have the capability to cause injury and damage.
§ 417.3 Definitions *Public safety* means, for a particular licensed launch, the safety of people and property that are not involved	*Public safety* means, for a particular licensed launch, the safety of people and property that are not involved	Persons entering a launch site or processing facility, be they janitorial staff, delivery persons, or maintenance

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in supporting the launch and includes those people and property that may be located within the boundary of a launch site, such as, visitors, individuals providing goods or services not related to launch processing or flight, and any other launch operator and its personnel.	in supporting the launch. **Personnel that serve the needs of the processing facility or launch site are not considered members of the public.** ~~and includes those people and property that may be located within the boundary of a launch site, such as, visitors, individuals providing goods or services not related to launch processing or flight, and any other launch operator and its personnel.~~	crew, serve the needs of the facility and are not members of the public. The public should be restricted to be any personnel outside of the launch site or processing facility. All persons allowed on a launch site should be processed through an access approval process therefore there is not going to be free and open access by the public to the launch site.
§ 417.3 Definitions *System hazard* means a hazard associated with a hardware system and that generally exist even when no operation is occurring. System hazards that may be found at a launch site include, but are not limited to, explosives and other ordnance, solid and liquid propellants, toxic and radioactive materials, asphyxiants, cryogens, and high pressure.	*System hazard* means a hazard associated with a hardware system and that generally exist even when no operation is occurring. ~~System hazards that may be found at a launch site include, but are not limited to, explosives and other ordnance, solid and liquid propellants, toxic and radioactive materials, asphyxiants, cryogens, and high pressure.~~	Keep definitions brief - do not add examples.
§ 417.5 Launch safety responsibility A launch operator shall safely conduct a licensed launch in accordance with § 415.71. A launch operator shall conduct the flight of a launch vehicle from any launch site in accordance with the requirements of parts 415 and this part.	**Deleted**	This statement does not mean anything. All the requirements for safely launching are covered elsewhere.
Page 63979 **417.7 Launch Site Responsibility** A launch operator shall ensure the safe conduct of launch processing at a launch site in the United States in accordance with the requirements of this part 417. Launch processing at a launch site outside the United States may be subject to the requirements of the governing jurisdiction. Requirements that apply to a launch site operator are contained in part 420 of this chapter. A launch operator shall coordinate and perform launch processing in	**Deleted and replaced with:** **For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the requirements contained in this part do not apply. For non-federal launch sites the launch site operator is responsible for ensuring all operations performed on its launch site are in accordance with its license and local agreements. The launch operators are**	Since the FAA does not license federal launch sites this requirement will apply only to non-federal ranges where federal range safety organizations are not involved.

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accordance with any local agreements designed to ensure that the responsibilities and requirements in this part and part 420 of this chapter are met. Where there is a licensed launch site operator, a launch operator licensee shall ensure that its operations are conducted in accordance with any agreements that the launch site operator has with any federal and local authorities pursuant to part 420 of this chapter. A licensed launch operator shall coordinate with the launch site operator and provide the launch site operator any information on its activities and potential hazards necessary for the launch site operator to determine how to protect any other launch operators and persons and their property at the launch site in accordance with the launch site operator's obligations under 14 CFR 420.55. For a launch that is conducted from an exclusive use site where there is no licensed launch site operator, the launch licensee shall satisfy the requirements of this part and the public safety requirements of part 420 of this chapter.	**responsible for coordinating with the launch site operator to ensure the launch operators launch processing and launch operations are conducted in accordance with the local agreements. The launch operator shall establish and maintain a launch complex operations safety program to support efficient and effective achievement of overall operations safety objectives.**	Specific requirements should be controlled by the launch site operators and launch operators documents. This will allow for internal flexibility and document revision without changing federal law.
	417.7 Launch Site Responsibility (a) *Command control system.* **A launch site operator shall, if required, employ ~~a~~ an approved command control system as part of a flight safety system for commercial launches from Non-Federal ranges. The command control system must consist of the flight safety system elements that ensure that a command signal will be transmitted if needed during the flight of a launch vehicle and received by the onboard vehicle flight termination system. Guidance on the design of command control systems is provided in FAA advisory circular TBD** (b) *Command control system testing.* **Command control systems, subsystems, and components used for Non-Federal ranges must be validated in accordance with FAA approved test plans and procedures. Guidance on the testing of**	Words moved from 417.323, 325 and 327 since they are more general in nature and would better fit in Subpart A. Sea Launch does not need a command control system for their flight termination system.

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	command control systems is provided in FAA advisory circular TBD (c) ***Support systems*. Flight safety systems for commercial launches from Non-Federal ranges must also include FAA-approved ground systems to support the flight safety system crew. Flight safety support systems, subsystems, and components used for Non-Federal ranges must be validated in accordance with FAA-approved test plans and procedures. Guidance on the design and test of these flight safety support systems is provided in FAA advisory circular TBD**	
§ 417.9 Safety review document and launch specific updates.	**Delete all of 417.9**	Each of these paragraphs only repeats and reference requirements in other locations.
§ 417.9 Safety review document and launch specific updates. (a) *General*. A launch operator shall conduct each launch in accordance with a safety review document developed in accordance with part 415 and maintained and updated for each launch in accordance with the requirements of this part. A launch operator shall submit launch specific updates required by this part and any required by the terms of the launch operator's license. A launch specific update must be submitted to the FAA to allow for review and determination prior to the associated scheduled activity. Any change to the information in a licensee's safety review document that is not identified as a launch specific update must be submitted to the FAA as a request for license modification in accordance with § 415.73 of this chapter and the license modification	(a) *General*. A launch operator shall conduct each launch in accordance with a safety review document developed in **coordination with the FAA** ~~accordance with part 415~~ and maintained ~~and updated~~ for each launch in accordance with the requirements of this part. A launch operator shall submit launch specific updates required by this part and any required by the terms of the launch operator's license. A launch specific update **affecting public safety** must be submitted to the FAA to allow for review and determination prior to the associated scheduled activity. ~~Any change to the information in a licensee's safety review document that is not identified as a launch specific update must be submitted to the FAA as a request for license modification in accordance with § 415.73 of this chapter and the license modification plan required by § 415.119(n) of this chapter~~. A	Keep requirements in one place and there is not need to update the document if there have been no changes. Public safety should be used as the criteria for requiring an update. The rest of this section needs to be deleted because it is too specific. This kind of detail should be placed into an advisory circular that suggests ways of performing this task. Most of these details will be worked out during the licensing process also.

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plan required by § 415.119(n) of this chapter. A launch operator must obtain FAA approval of any license modification before flight. (b) *Launch specific updates.* For each launch, a launch operator's launch specific updates shall include, but need not be limited to, the following: (1) *Launch schedule and points of contact.* A launch operator shall conduct a launch in accordance with the launch schedule submitted during the licensing process in accordance with § 415.121 and as updated for each launch. For each launch, a launch operator shall submit an updated launch schedule and points of contact no later than six months before flight. A launch operator shall immediately submit any later change to ensure that the FAA has the most current data. (2) *Flight safety system test schedule.* A launch operator shall test its flight safety system in accordance with the flight safety system test schedule submitted during the licensing process in accordance with § 415.129(c) and as updated for each launch. For each launch, a launch operator shall submit an updated flight safety system test schedule and points of contact no later than six months before flight. A launch operator shall immediately submit any subsequent change to ensure that the FAA has the most current data. (3) *Launch operator organization.* A launch operator shall submit updated organization data no later than six months prior to flight in accordance with § 417.103(a). (4) *Launch plans.* A launch operator shall submit any changes or additions to its flight safety plan, ground safety plan, or other launch plans to the FAA no later than 15 days before the associated activity is to take place in accordance with §	launch operator must obtain FAA approval of any license modification before flight. **Deleted (b)**	The schedule and frequency of the updates required does not support a commercial launch venture. For example, having to submit changes (license modifications) every time the launch schedule changed would be prohibitively expensive. Change of schedule does not affect safety. FAA should be kept informed of schedule changes, but it should not be a license change. Sea Launch cannot provide these analyses at L-18 & L-6 for a <12-month integration. Points of contact should be by title. Some personnel may not be selected by L- 6 months. (8) Reports are available but it is not per current practice to provide a summary of the acceptance test data for each launch. (9) Report requirement should be included in AC on Command control system design guidelines.

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417.111(b). (5) *Six-month flight safety analysis.* A launch operator shall perform flight safety analysis for each launch and submit launch specific analysis products to the FAA no later than six months prior to the date of each planned flight in accordance with § 417.203(c)(2). (6) *Thirty-day flight safety analysis update.* A launch operator shall submit updated flight safety analysis products for each launch no later than 30 days prior to flight in accordance with § 417.203(c)(3). (7) *Flight termination system qualification test reports.* A launch operator shall submit all flight termination system qualification test reports to the FAA no later than six months prior to the first flight attempt in accordance with § 417.315(f)(1). (8) *Flight termination system acceptance and age surveillance test report summaries.* A launch operator shall submit a summary of the results of each flight termination system acceptance and age surveillance test no later than 30 days prior to the first flight attempt for each launch in accordance with § 417.315(f)(2). (9) *Command control system acceptance test reports.* A launch operator shall submit all command control system acceptance test reports to the FAA no later than 30 days prior to the first flight attempt in accordance with § 417.325(d). (10) *Ground safety plan.* A launch operator shall keep current its ground safety plan for each launch and shall submit any change to the FAA no later than 15 days before the change is implemented in accordance with § 417.403(c).		

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§ 417.11 License flight readiness. (e) For each licensed launch, the launch operator shall provide the FAA with a console for monitoring the progress of the countdown and communication on all channels of the countdown communications network. The launch operator shall ensure that the FAA is polled over the communications network during the countdown to verify that the FAA has identified no issues related to the launch operator's license.	(e) For each licensed launch, the launch operator shall provide the FAA with a console for monitoring the progress of the countdown and communication on ~~all~~ **public safety critical and the launch director** channels of the countdown communications network. The launch operator shall ensure that the FAA ~~is polled over the communications network during the countdown to verify that the FAA~~ has identified no issues related to the launch operator's license **prior to beginning the launch countdown.**	Some communications channels are for internal range, payload, and launch operator use. We agree that monitoring all communication channels directly related to the launch countdown must be provided. Polling the licensing agency for a Go/NoGo decision in the last seconds of the launch countdown is not standard control room procedure, and could result in significant, unnecessary costs. Any licensing issues should be brought out, and resolved, long before the countdown phase of the launch.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Part 417, Subpart B – Launch Safety Requirements		
Page 63980 **§ 417.101 Scope.** This subpart contains requirements that apply to the launch of orbital and suborbital expendable launch vehicles. This subpart provides an overview of the public safety issues that a launch operator's launch safety program must address. For each public safety issue, this subpart provides either the applicable requirements in their entirety or an overview of the requirements and references other subparts, sections, or appendices that contain additional requirements.	**For a licensed launch from a federal launch site or where there is a federal range safety organization overseeing the safety of each licensed launch, the requirements contained in this part do not apply.** This subpart contains requirements that apply to the launch of orbital and suborbital expendable launch vehicles. This subpart provides an overview of the public safety issues that a launch operator's launch safety program must address. For each public safety issue, this subpart provides ~~either the applicable requirements in their entirety or~~ an overview of the requirements and references other subparts, sections, or appendices that contain ~~additional~~ **the** requirements.	Existing federal range launch safety requirements have proven to work very well so there is no need to add other requirements on top of them. Place the requirements in one place.
Page 63980 **§ 417.103 Launch operator organization.** (a) For each launch, a launch operator shall establish and maintain an organization that ensures public safety and that the requirements of this part are satisfied. Each launch management position and organizational element must have documented roles, duties, and authorities. Any change in a licensee's organization from the data that was provided during the licensing process must provide for an equivalent level of safety. For each launch a launch operator shall submit updated organization data no later than six months prior to flight. A launch operator shall immediately submit any later change to ensure that the FAA has the most current data as the date of the planned flight approaches.	(a) For each launch, a launch operator shall establish and maintain an organization that ensures public safety and that the requirements of this part are satisfied. ~~Each launch management position and organizational element~~ **This organization** must have documented roles, duties, and authorities. Any change in a licensee's organization from the data that was provided during the licensing must provide for an equivalent level of safety. For ~~each~~ **the first** launch a launch operator shall submit ~~updated~~ organization data no later than six months prior to flight. A launch operator shall ~~immediately submit~~ **provide changes to organizational data when it occurs**. ~~any later change to ensure that the FAA has the most current data as the date of the planned flight approaches~~..	The federal ranges have their own requirements and this document should not duplicate or contradict those requirements. Resubmitting organization data for each launch, when no changes have occurred, is not a good use of the Company resources. Only put submittal date on first submittal and only require updates after that as changes occur.
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§ 417.103 Launch operator organization (b) A launch operator's organization must include, but need not be limited to, the following launch management positions and organizational elements: (1) *Launch director.* A launch operator shall designate as launch director the launch operator employee who has the launch operator's final approval authority for launch. The launch director shall ensure public safety and shall ensure that all of the launch safety director's concerns are resolved prior to flight. (2) *Launch safety director.* A launch operator shall designate an official who oversees its launch safety organization and all activities related to ensuring public safety. A launch safety director shall report directly to the launch director. (3) *Launch conductor.* A launch operator shall designate an official who conducts preflight launch processing, hazardous operations, systems testing, and countdown. A launch conductor shall coordinate activities with the launch safety director and shall report directly to the launch director. (4) *Flight safety organization.* For a launch using a flight safety system, a launch operator shall establish an organization that performs and documents the flight safety analysis required by subpart C of this part and ensures compliance with the flight safety system requirements of subpart D, including the flight safety system crew requirements of § 417.331. For launch of a unguided suborbital rocket that uses a wind weighting safety system, a launch operator shall establish an organization that ensures compliance with the flight safety analysis required by subpart C of this part and the flight safety and personnel requirements of § 417.125(g).	**Deleted (b) and subs**	These subsections should be deleted because the requirement for the launch operator's operations organization should be contained in the license and agreed with during the licensing process. The definitions are too restrictive and the qualifications do not allow the operator to propose alternative uses of personnel. The rules for the safety organization restrict the operator to use only previously government range personnel for their safety roles and require the inclusion of positions only used by government ranges. Each operator should propose an organization to the FAA that meets the intent of the rules governing safety and supply personnel names and qualifications to support this organization. The resulting license should specify that the operator perform the launch with the approved organization and any changes will be subject to review by the FAA. The guidelines that the FAA would like the contractor to consider in structuring his organization can be included in appendices or other areas, and not made part of the law. Disagree with the paragraphs' intent of specifying exactly how a program can be organizationally setup. Requiring specific organizational structure within a company is unnecessary and arbitrarily limits flexibility.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
(5) *Ground safety organization.* A launch operator shall establish an organization that ensures compliance with the ground safety analysis and program requirements of subpart E of this part. (6) *Launch processing.* A launch operator shall establish organizational elements that implement launch plans in accordance with § 417.111 and accomplish the tests, reviews, rehearsals, and safety critical operations required by §§ 417.115, 417.117, 417.119, and 417.121.		
Page 63980 **§ 417.105 Launch personnel qualifications and certification** (a) *General.* A launch operator shall establish and document the qualifications, including education, experience, and training, for each launch personnel position that oversees, performs, or supports a hazardous operation with the potential to adversely affect public safety or who uses or maintains safety critical systems or equipment that protect the public. A launch operator shall implement a certification program that ensures that personnel possess the qualifications for their assigned tasks. These personnel positions include, but need not be limited to, those listed in § 417.103(b). Flight safety system crew qualification requirements for a launch using a flight safety system are provided in § 417.331.	(a) *General.* A launch operator shall establish and document the qualifications, including education, experience, and training, for each launch personnel position that oversees, performs, or supports a hazardous operation with the potential to adversely affect public safety or who uses or maintains safety critical systems or equipment that protect the public. A launch operator shall implement a certification program that ensures that personnel possess the qualifications for their assigned tasks. ~~These personnel positions include, but need not be limited to, those listed in § 417.103(b). Flight safety system crew qualification requirements for a launch using a flight safety system are provided in § 417.331.~~	These subsections should be deleted. The requirement for the launch operator's operations organization should be contained in the license and agreed with during the licensing process. The definitions are too restrictive and the qualifications do not allow the operator to propose alternative uses of personnel. The rules for the safety organization restrict the operator to use only previously government range personnel for their safety roles and require the inclusion of positions only used by government ranges. Each operator should propose an organization to the FAA that meets the intent of the rules governing safety and supply personnel names and qualifications to support this organization. The resulting license should specify that the operator perform the launch with the approved organization and any changes will be subject to review by the FAA. The guidelines that the FAA would like the contractor to consider in structuring his organization can be included in appendices or other areas, and not made part of the law. Setting up a certification/qualification program, beyond what individual companies require for their personnel, is redundant/expensive. The launch operator shall

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
		guarantee the personnel meet specific qualifications. The flight safety system crew qualification requirements called out in 417.331 are prohibitively restrictive, possibly requiring hiring of Federal range-type personnel only (if they qualified).
Page 63980 **§ 417.105 Launch personnel qualifications and certification** (b) *Personnel certification program.* A launch operator's personnel certification program must include, but need not be limited to, the following: (1) For each hazardous operation or safety critical system or equipment, a launch operator shall designate an individual by position who reviews personnel qualifications and issues certifications for demonstrated knowledge, skill and competence to perform safety related tasks. (2) Re-certification of personnel shall be performed annually or for each launch if the time period between each launch is greater than one year. Re-certification procedures shall be established and followed by the certifying organization, and shall include, but need not be limited to, a review of an individual's work record and current job knowledge and skill requirements, determination of the need for additional training, and completion of additional training where needed. (3) A launch operator shall revoke individual certifications for negligence or failure to satisfy certification or re-certification requirements. (4) A launch operator shall maintain qualification and certification records for each individual performing safety-related functions.	**Deleted (b) and subs**	Personnel are currently qualified according to company policies and applicable regulations. Imposing another layer of requirements for personnel qualifications is expensive, and may be in conflict with existing regulations.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Page 93981 **§ 417.107 Flight Safety** (a) *Flight Safety System* For each launch, a launch operator shall employ a flight safety system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch vehicle failure. For each launch vehicle, vehicle component, and payload, a launch operator shall employ a flight safety system that satisfies all the functional, design, and test requirements of subpart D of this part unless one of the following exceptions applies: (1) A launch operator need not employ a flight safety system if the launch vehicle, vehicle component, or payload does not have sufficient energy at any time during flight to reach any protected area. (2) A launch operator need not employ a flight safety system if the launch vehicle is a suborbital rocket that does not employ a guidance system for directional control and the launch operator demonstrates that the launch will be conducted safely using a wind weighting safety system in accordance with § 417.125. (3) A launch operator's flight safety system must satisfy all the functional, design, and test requirements of subpart D of this part unless the FAA approves the use of an alternate flight safety system through the licensing process. The FAA will approve the use of an alternate flight safety system that does not satisfy all of subpart D of this part if a launch operator demonstrates clearly and convincingly that the proposed launch achieves a level of safety that is equivalent to satisfying all the requirements of this subpart and subpart D of this part. The following apply when a launch operator	(a) *Flight Safety System* For each launch, a launch operator shall employ a flight safety system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch vehicle failure. **Existing flight safety systems that have been approved by the federal range safety organization and/or the FAA shall be deemed acceptable.** ~~For each launch vehicle, vehicle component, and payload, a launch operator shall employ a flight safety system that satisfies all the functional, design, and test requirements of subpart D of this part unless one of the following exceptions applies:~~ (1) A launch operator need not employ a flight safety system if the launch vehicle, vehicle component, or payload does not have sufficient energy at any time during flight to reach any protected area. (2) A launch operator need not employ a flight safety system if the launch vehicle is a suborbital rocket that does not employ a guidance system for directional control and the launch operator demonstrates that the launch will be conducted safely using a wind weighting safety system ~~in accordance with § 417.125~~. (3) A launch operator's flight safety system must ~~satisfy all the functional, design, and test requirements of subpart D of this part unless the FAA approves the use of an alternate flight safety system~~ **be approved** through the licensing process. ~~The FAA will approve the use of an alternate flight safety system that does not satisfy all of subpart D of this part if a launch operator demonstrates clearly and convincingly that the proposed launch~~	Industry has a proven safety record. No re-justification of existing designs is required. Existing launch vehicles have been shown to provide acceptable protection of the public from hazards created by launch vehicles. This protection has been demonstrated through thousands of suborbital and orbital launches. If the alternate flight safety system "demonstrates clearly and convincingly that the proposed launch achieves a level of safety that is equivalent to satisfying all the requirements of this subpart and subpart D of this part," then it is not less capable of protecting the public and should not have reduced capabilities. Thus it should not be subjected to the restriction that "the launch must take place from a remote launch site with an absence of population and any overflight of a populated area must take place only in the later stages of flight" Requiring reliability to be demonstrated through analysis, testing and use is not realistic. Recommend that 417.107 and Subpart D be rewritten as design guidelines, or as a design handbook, with the primary requirement being that public safety (Ec, Pc, Pi,) be shown to be at the level, or less, than what is stated. Paragraph a. requires that launch operators employ systems that meet all the requirements detailed in subpart D, except for the noted (1), (2), (3) exceptions. The requirements called out in subpart D are excessively detailed, requiring specific designs/tests/plans/monitoring/etc. It will be nearly impossible for any commercial venture to meet all the requirements called out in 417.107 and subpart D, and do so in a timely, cost-effective manner.

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seeks FAA approval for such a launch: (i) The launch operator shall demonstrate that the launch presents significantly less public risk than the risk criteria required by paragraph (b) of this section. The reduced level of public risk must correspond to the reduced capabilities of the proposed alternate flight safety system. To achieve the reduced level of public risk, the launch must take place from a remote launch site with an absence of population and any overflight of a populated area must take place only in the later stages of flight. (ii) The launch operator shall demonstrate the reliability of the proposed alternate flight safety system to perform its intended functions. An alternate flight safety system that does not possess all the functional capabilities required by subpart D of this part must perform its intended functions with a reliability that is comparable to that required by subpart D of this part. A launch operator shall demonstrate the reliability of a proposed alternate flight safety system through analysis, testing, and use	~~achieves a level of safety that is equivalent to satisfying all the requirements of this subpart and subpart D of this part. The following apply when a launch operator seeks FAA approval for such a launch:~~ **Deleted (a)(3)(i)-(ii)**	do so in a timely, cost-effective manner. Since the Sea Launch flight safety system does not have a flight destruct system, it would fall under the category of 417.107.a.3 (Alternate flight safety system), which allows the FAA to approve the use of a system that does not meet all the requirements of subpart D. However, 417.107.a.3(i) requires the alternate system to present significantly less risk to the public than a conventional flight destruct system? "Significantly Less" is not defined, and it does not make sense that one flight safety system has to meet a different standard of public safety than another. The FAA should have the same criteria for all, how each launch operator meets that can be different.
Page 93981 **§ 417.107 Flight Safety** (b) *Public risk criteria.* A launch operator shall conduct all licensed launches in accordance with the following public risk criteria: (1) A launch operator shall initiate flight only if the risk to the public due to all hazards associated with the flight does not exceed an expected average number of 0.00003 casualties (E_C) per launch ($E_C \leq 30 \times 10^{-6}$), excluding water-borne vessels and aircraft. A launch operator shall determine the risk to the public from liftoff through orbital insertion for an orbital launch vehicle, and through final	~~(b) *Public risk criteria.* A launch operator shall conduct all licensed launches in accordance with the following public risk criteria:~~ ~~(1) A launch operator shall initiate flight only if the risk to the public due to all hazards associated with the flight does not exceed an expected average number of 0.00003 casualties (E_C) per launch ($E_C \leq 30 \times 10^{-6}$), excluding water-borne vessels and aircraft. A launch operator shall determine the risk to the public from liftoff through orbital insertion for an orbital launch vehicle, and through final~~	This requirement is discussed in detail in 417 Subpart C and should not be repeated here.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
stage impact for a suborbital launch vehicle. A launch operator's determination of E_C for a launch shall account for, but need not be limited to, risk due to impacting debris determined in accordance with § 417.227 and any risk determined for toxic release and distant focus overpressure blast in accordance with § 417.229 and § 417.231, respectively.	~~stage impact for a suborbital launch vehicle. A launch operator's determination of E_C for a launch shall account for, but need not be limited to, risk due to impacting debris determined in accordance with § 417.227 and any risk determined for toxic release and distant focus overpressure blast in accordance with § 417.229 and § 417.231, respectively.~~	
(2) A launch operator shall initiate flight only if the risk to any individual member of the public does not exceed a casualty probability (P_C) of 0.000001 per launch ($P_C \leq 1 \times 10^{-6}$). A launch operator shall define an individual casualty contour in accordance with § 417.225, such that if a single person were present inside that contour at the time of liftoff, the $P_C \leq 1 \times 10^{-6}$ criteria would be exceeded. A launch operator shall treat an individual casualty contour as a safety clear zone and ensure that no member of the public is present within the contour during the flight of a launch vehicle.	~~(2) A launch operator shall initiate flight only if the risk to any individual member of the public does not exceed a casualty probability (P_C) of 0.000001 per launch ($P_C \leq 1 \times 10^{-6}$). A launch operator shall define an individual casualty contour in accordance with § 417.225, such that if a single person were present inside that contour at the time of liftoff, the $P_C \leq 1 \times 10^{-6}$ criteria would be exceeded. A launch operator shall treat an individual casualty contour as a safety clear zone and ensure that no member of the public is present within the contour during the flight of a launch vehicle.~~	
Page 63982 **§ 417.109 Ground safety** (a) FAA requirements for ground safety apply to launch processing at a launch site in the United States. Launch processing at a launch site outside the United States may be subject to the requirements of the governing jurisdiction. (b) A launch operator shall protect the public from any hazards presented by operations and support systems at a launch site that are used in preparing a launch vehicle for flight. A launch operator shall perform a ground safety analysis and conduct each launch in accordance with a ground safety plan designed to protect the public from any adverse effects of preparing a launch vehicle for flight.	(a) FAA requirements for ground safety apply to launch processing at a launch site in the United States. Launch processing at a launch site outside the United States may be subject to the requirements of the governing jurisdiction. **For federal ranges the ground safety requirements of the federal range shall be met.** (b) **For a non-federal launch site it is the launch operators responsibility to protect the public from any hazards presented by operations and support systems at a launch site that are used in preparing a launch vehicle for flight.** ~~A launch~~	Ground Safety Plan covered in subpart E. 417.403c, so do not duplicate requirements here, just summarize what is needed.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Specific ground safety requirements that must be met by a launch operator are provided in subpart E of this part	~~operator shall protect the public from any hazards presented by operations and support systems at a launch site that are used in preparing a launch vehicle for flight.~~ A launch operator shall perform a ground safety analysis and conduct each launch in accordance with a ground safety plan designed to protect the public from any adverse effects of preparing a launch vehicle for flight. ~~Specific ground safety requirements that must be met by a launch operator are provided in subpart E of this part.~~	
Page 63982 **§ 417.111 Launch plans.** (a) A launch operator shall implement a flight safety plan, a ground safety plan, and additional written launch plans that define how launch processing and flight of a launch vehicle will be conducted without adversely affecting public safety and how to respond to accidents and other unplanned emergencies.	(a) A launch operator shall implement a flight safety plan, a ground safety plan, and additional written launch plans, **as needed,** that define how launch processing and flight of a launch vehicle will be conducted without adversely affecting public safety and how to respond to accidents and other unplanned emergencies.	Delete or rewrite to delete the requirements.
(b) A launch operator shall update its flight safety plan, ground safety plan, and the additional launch plans that were prepared during the licensing process in accordance with §§ 415.115, 415.117 and 415.119 for each specific launch. A launch operator shall submit any launch plan changes or additions to the FAA no later than 15 days before the associated activity is to take place. If a change involves the addition of a new public hazard or the elimination of any control for a previously identified public hazard, a launch operator licensee shall submit a license modification request in accordance with § 415.73 and the license modification plan required by § 415.119(n).	(b) A launch operator shall update its flight safety plan, ground safety plan, and the additional launch plans that were prepared during the licensing process in **the event a change occurs involving the addition of a new public hazard or the elimination of any control for a hazard.** ~~accordance with §§ 415.115, 415.117 and 415.119 of this chapter for each specific launch. A launch operator shall submit any launch plan changes or additions to the FAA no later than 15 days before the associated activity is to take place. If a change involves the addition of a new public hazard or the elimination of any control for a previously identified public hazard, a launch operator licensee shall submit a license modification request in accordance with § 415.73 and the license modification plan required by § 415.119(n) of this chapter.~~	The Plans are covered in other parts, so do not duplicate requirements here - just summarize what is needed. Plan submittal requirements should be in 415.119.
(c) A launch operator shall ensure that its activities are conducted in accordance with the public safety and		

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
conducted in accordance with the public safety and environmental plans and agreements of any launch site operator for the launch site from which a launch operator launches.	**Delete (c)**	
Page 63982 **§ 417.113 Launch Safety Rules** (a) *General* (b) *Flight commit criteria.* (1) (2) Surveillance of established hazard areas and any aircraft and ship traffic to verify that any exposure to the public satisfies the public safety criteria of § 417.107 as determined by a flight hazard area analysis performed in accordance with § 417.225. (3)-(4) (5) Verification that flight day meteorological conditions, such as wind, lightning, and visibility, are within required limits defined by a flight safety analysis performed in accordance with subpart C of this part. If the flight day conditions violate the meteorological limits, flight must not be initiated unless an updated analysis is performed and shows that the public risk criteria in § 417.107(b) can be met under the existing conditions. For a launch vehicle flown with a flight safety system, a launch operator shall implement weather constraints designed to avoid natural lightning strikes and lightning triggered by the flight of the launch vehicle. A launch operator's flight safety rules must include the lightning related weather constraints provided in appendix G of this part unless otherwise approved by the FAA during the licensing process based on applicability to each planned launch.	(2) ~~Surveillance~~ **Public notification** of established hazard areas is **required to warn** ~~and~~ any aircraft and ship traffic. This **is sufficient to** ~~will~~ ensure ~~to verify~~ that any exposure to the public satisfies the public safety criteria ~~of § 417.107 as determined by a flight hazard area analysis performed in accordance with § 417.225.~~ (3)-(4) (5) Verification that flight day meteorological conditions, such as wind, lightning, and visibility, are within required limits defined by a flight safety analysis. ~~performed in accordance with subpart C of this part. If the flight day conditions violate the meteorological limits, flight must not be initiated unless an updated analysis is performed and shows that the public risk criteria in § 417.107(b) can be met under the existing conditions. For a launch vehicle flown with a flight safety system, a launch operator shall implement weather constraints designed to avoid natural lightning strikes and lightning triggered by the flight of the launch vehicle. A launch operator's flight safety rules must include the lightning related weather constraints provided in appendix G of this part unless otherwise approved by the FAA during the licensing process based on applicability to each~~	This subject is discussed in detail in 417 Subpart C and should not be addressed here also. If the FAA deems the safety efforts of the federal ranges to be adequate, then there is little justification for changing/adding requirements. Mandating survey of downrange planned impact points is impractical and unacceptable from a cost, delay risk, and scheduling perspective. Compliance would require multiple airborne assets to survey multiple drop zones for a single launch. Note that some downrange drop zones are several thousand square miles. Mechanical problems on any of these search aircraft enroute would require scrub of the launch. Weather (rain, low clouds) at any point in the drop area would require launch abort. Public notification is sufficient to ensure public safety. For an autonomous flight termination system such as the one employed on Sea Launch, this would not be applicable for flight safety purposes. Lightning, wind, etc. are mission assurance items and are verified as part of the launch commit criteria.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
	~~planned launch.~~	
Page 63982 **§ 417.113 Launch Safety Rules** (c) *Flight termination rules.* For a launch vehicle flown with a flight safety system, a launch operator shall implement a set of written rules that specify the conditions under which flight termination shall be initiated to ensure public safety. Flight termination rules must include, but need not be limited to the following: (1) Flight must be terminated when valid data indicate that the launch vehicle has violated a flight safety limit established by a flight safety analysis performed in accordance with § 417.213. This shall be accomplished by monitoring real-time launch vehicle flight status parameters (such as debris footprint, instantaneous impact point, or vehicle present position and velocity vector flight angles) using the flight safety data processing system and the flight safety official console in accordance with § 417.327(f) and § 417.327(g), respectively, and initiating flight termination when a flight status parameter reaches a pre-defined flight safety limit. (2) Flight must be terminated at the straight up time established in accordance with § 417.215 if the launch vehicle continues to fly a straight up trajectory and, therefore, does not turn downrange when it should. (3) Flight must be terminated when real-time data provide grounds for concluding that the performance of the launch vehicle is erratic and the potential exists for the loss of flight safety system control of the launch vehicle when further flight is likely to violate the established safety criteria. (4) A launch operator shall establish flight termination	**Delete (c) and subs**	Flight termination rules do not apply to all launch vehicles so this requirement should be determined during the flight approval process.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
rules that apply the data loss flight times, earliest destruct time, and no longer endanger time determined in accordance with § 417.221. These flight termination rules must satisfy the following: (i) Flight must be terminated no later than the earliest destruct time if tracking of the launch vehicle is not established and vehicle position and status data is not available to the flight safety official by the earliest destruct time. (ii) Once launch vehicle tracking is established, if there is a loss of tracking data before the no longer endanger time and tracking data is not re-established, flight must be terminated no later than the expiration of the data loss flight time for the point in flight that the data was lost. (5) In order to permit its launch vehicle to traverse a "gate" established in accordance with § 417.219, a launch operator shall verify that the launch vehicle is performing normally and shows no indication that the launch vehicle's performance will deviate from normal performance. If a launch vehicle is not performing normally immediately prior to entering a gate, the launch operator shall terminate flight. Once the launch vehicle has successfully traversed a gate, a launch operator shall not terminate flight while the launch vehicle's debris impact dispersion is over a populated or other protected area.		
Page 63982 **§ 417.113 launch Safety Rules** (d) *Launch crew work shift and rest rules.* A launch operator shall implement written rules governing the maximum length of work shifts and the amount of rest that must be afforded a launch crew. A launch operator's launch crew work shift and rest policies must provide for the following for any operation with the potential to have an adverse	(d) *Launch crew work shift and rest rules.* A launch operator shall implement written rules governing the maximum length of work shifts and the amount of rest that must be afforded a launch crew **to ensure crew and public safety**. ~~A launch operator's launch crew work shift and rest policies must provide for the following for any operation~~	The items listed in (d) are good practice to follow but should be published as guidelines rather than requirements at this time. There are ongoing studies as to what restrictions need to be placed on persons in hazardous occupations/work locations but they have not been completed.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
operation with the potential to have an adverse effect on public safety: (1) Maximum 12-hour work shift with at least 8 hours of rest after 12 hours of work. The 8 hours of rest must be in addition to the round trip travel time between work and home or living quarters. (2) Maximum 60 hours worked in the preceding 7 days. (3) Maximum of 14 consecutive workdays. (4) No more than five consecutive 12-hour work shifts shall be scheduled without a 48-hour rest period.	~~must provide for the following for any operation with the potential to have an adverse effect on public safety:~~ ~~(1) Maximum 12-hour work shift with at least 8 hours of rest after 12 hours of work. The 8 hours of rest must be in addition to the round trip travel time between work and home or living quarters.~~ ~~(2) Maximum 60 hours worked in the preceding 7 days.~~ ~~(3) Maximum of 14 consecutive work days.~~ ~~(4) No more than five consecutive 12-hour work shifts shall be scheduled without a 48-hour rest period.~~	NPRM requirements are more restrictive than current range requirements. Need to have some flexibility in handling unforeseen circumstances.
Page 63983 **§ 417.115 Tests** (a) *General.* A launch operator shall test all flight and ground systems and equipment that protect the public from any adverse effect of a launch in accordance with its test plans and procedures prepared during the licensing process in accordance with part 415, subpart F and updated for each launch in accordance with § 417.111. A launch operator shall coordinate test plans and all associated test procedures with any launch site operator or other local entity associated with the operation. A launch operator shall determine the cause of any discrepancy identified during testing, develop and implement all corrective actions, and perform re-testing to verify each correction. A launch operator shall notify the FAA, including any onsite FAA inspector, of any discrepancy identified during testing and submit information on corrections implemented and the results of re-testing before the system or equipment is used in support of a launch.	~~(a)~~ *General.* A launch operator shall test ~~all~~ **its** flight and ground systems and equipment that protect the public from any adverse effect of a launch. ~~in accordance with its test plans and procedures. prepared during the licensing process in accordance with part 415, subpart F of this chapter and updated for each launch in accordance with § 417.111.~~ A launch operator shall coordinate test plans and all associated **hazardous** test procedures with any launch site operator or other local entity associated with the operation. ~~A launch operator shall determine the cause of any discrepancy identified during testing, develop and implement all corrective actions, and perform re-testing to verify each correction. A launch operator shall notify the FAA, including any onsite FAA inspector, of any discrepancy identified during testing and submit information on corrections implemented and the results of re-testing before the system or equipment is used in support of a launch.~~	The launch operator should not be required to test the launch site operator's equipment nor fix it if something is wrong. Problems occurring during testing of equipment/systems as a matter of course. Launch site operator doesn't necessarily review all procedures. Most discrepancies result in no increase in public risk. Propose restricting the scope of discrepancy reporting to those discrepancies that, after corrective action has been implemented, result in an increase in the risk to the public.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
(b) *Flight safety system testing.* A launch operator shall test any flight safety system and all flight safety system components, including any onboard launch vehicle flight termination system, command control system, and support system, in accordance with the test requirements of subpart D of this part. (c) *Ground system testing.* A launch operator shall meet the test requirements of paragraph (a) of this section for any system or equipment used to support hazardous ground operations identified by the ground safety analysis required by § 417.405. (d) *Communications systems testing.* A launch operator shall meet the test requirements of paragraph (a) of this section for any communication system used for voice, video, or data transmission that support a flight safety system or any other communication system that is used for a launch.	(b) Flight safety system testing. A launch operator shall test any **of it's** flight safety system and all **it's** flight safety system components, including any onboard launch vehicle flight termination system, command control system, and support system~~, in accordance with the test requirements of subpart D of this part.~~ (c) Ground system testing. A launch operator shall ~~meet the~~ test ~~requirements of paragraph (a) of this section for~~ any **of it's** system or equipment used to support hazardous ground operations ~~identified by the ground safety analysis required by § 417.405.~~ (d) Communications systems testing. A launch operator shall ~~meet the~~ test ~~requirements of paragraph (a) of this section for~~ any communication system used for voice, video, or data transmission that support a flight safety system or any other communication system that is used for a launch.	Paragraph (a) already covers ground and communication systems that are used to protect the public from adverse affects of launch. All communications systems involved in the launch should not be subject to the testing requirements (e-mail? Internet? etc.).
Page 63984 **§ 417.117 Reviews** (a) *General.* A launch operator shall conduct meetings to review the status of operations, systems, equipment, and personnel required by part 417. A launch operator shall implement its launch processing schedule submitted at the time of license application according to § 415.121 and updated in accordance with § 417.9, which identifies each review to be conducted and when it is to be conducted, referenced to the planned liftoff. A launch operator shall maintain documented criteria for successful completion of each review. A launch operator shall document all review proceedings. Any corrective actions identified during a review shall be tracked to completion and documented. Launch operator personnel who oversee a review shall attest to successful completion of the review's criteria in writing.	(a) *General.* A launch operator shall conduct meetings **to address** ~~to review~~ the status of operations, systems, equipment, and personnel **associated with to safety critical or hazardous operations.** ~~required by part 417. A launch operator shall implement its launch processing schedule submitted at the time of license application according to § 415.121 and updated in accordance with § 417.9, which identifies each review to be conducted and when it is to be conducted, referenced to the planned liftoff. A launch operator shall maintain documented criteria for successful completion of each review. A launch operator shall document all review proceedings. Any corrective actions identified during a review shall be tracked to completion and documented. Launch operator personnel who oversee a review shall attest to~~	Meetings should not be required which are not necessary. This is not good commercial practice. Additional paperwork requirements exact a toll on program personnel. Each program will be different, and will need different meetings. Forcing everybody to have meetings - whether they need them or not - does not help to streamline the commercial space industry. It is not a good use of time to document all review proceedings, however, corrective actions and other issues should be documented. It is standard operating procedure for the operations crew to have a pre-operational meeting before each hazard operations to discuss the operations and its hazards and how to perform the operation safely.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Reviews conducted by a launch operator for each launch shall include, but need not be limited to those identified in this section. (b) *Hazardous operations safety readiness reviews.* A launch operator shall conduct a review prior to performing any hazardous operation with the potential to adversely effect public safety. The review must determine the launch operator's readiness to perform the operation and ensure that safety provisions are in place. The review must determine the readiness status of safety systems and equipment and verify that the personnel involved satisfy certification and training requirements. (c) *Flight termination system design review.* A launch operator shall conduct a review of any onboard vehicle flight termination system and all components to ensure the design requirements have been satisfied and that the system components are ready for qualification testing in accordance with subpart D of this part. (d) *Flight safety analysis review.* A launch operator shall conduct a flight safety analysis review to ensure that each analysis method used satisfies subpart C of this part and that the results are correct for each launch. A flight safety analysis review shall be conducted to allow any corrective actions to be completed before the launch safety review required in paragraph (f) of this section. The person who prepares the analysis must not conduct its review. (e) *Ground safety analysis review.* A launch operator shall conduct a review of the ground safety analysis required by subpart E of this part and the status of ground safety systems, plans, procedures, and personnel that ensure public safety during ground operations. This review must be conducted in	~~successful completion of the review's criteria in writing. Reviews conducted by a launch operator for each launch shall include, but need not be limited to those identified in this section.~~ **Delete (b)-(e)**	

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coordination with any launch site operator. A ground safety review must be successfully completed before ground operations begin at a launch site for each launch.		
Page 63984 **§ 417.117 Reviews** (h) *Post-launch review and report* A launch operator shall conduct a post-launch review no later than 48 hours after completion of a launch and provide a post-launch report to the FAA no later than ten working days following completion of a launch. [...] A post launch report must contain the results of any monitoring of flight environments performed in accordance with § 417.307(b) and any measured wind profiles used for the launch in accordance with § 417.217(d)(2).	(h) *Post-launch review and report.* A launch operator shall ~~conduct a post-launch review no later than 48 hours after completion of a launch and~~ provide a post-launch report to the FAA no later than ~~ten working~~ 60 days following completion of a launch. ~~[...] A post launch report must contain the results of any monitoring of flight environments performed in accordance with § 417.307(b) and any measured wind profiles used for the launch in accordance with § 417.217(d)(2).~~	This is a very costly task and for DoD launches they pay for this quick assessment. The commercial launch operators are not staffed to perform this task today and the post-flight analysis and derivation of flight environments would require a minimum of two months. Additional data presentation requirements.
Page 63984 **§ 417.119 Rehearsals** (a) A launch operator shall rehearse the launch crew and systems to identify corrective actions needed to ensure public safety. All rehearsals shall be conducted in accordance with each of the following: (1) A launch operator shall conduct all rehearsals in accordance with the launch processing schedule submitted at the time of license application in accordance with § 415.121 and any launch specific updates for each launch in accordance with § 417.9. (2) A launch operator shall assess any anomalies identified by a rehearsal, ensure any changes needed to ensure public safety are incorporated into the launch processing and flight, and ensure the	(a) *General* A launch operator shall rehearse the launch crew and systems to identify corrective actions needed to ensure public safety. ~~All rehearsals shall be conducted in accordance with each of the following.~~ **Delete subs to (a)**	The requirement to perform launch rehearsals is too restrictive as written in this section. The need to perform crew training and assessment prior to a launch is well established industry policy and each organization has internal practices and procedures that define in detail how the respective launch crews will be trained and certified, including rehearsals, simulations and anomalous actions. The requirement for this should be included in the launch crew certification and requirements, and be part of the licensing process, not part of federal law. The FAA should require the launch operator to ensure trained personnel with the use of rehearsals. How the rehearsals are conducted and the content should be up

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rehearsal or the related part of the rehearsal is repeated until successfully completed. A launch operator shall ensure that all rehearsals are completed at least 48 hours before the first flight attempt. (3) A launch operator shall inform the FAA of any anomalies and related changes in operations performed during launch processing or flight resulting from a rehearsal. (4) For each launch, each person that is to participate in the launch processing or flight of a launch vehicle shall participate in at least one related rehearsal that exercises all that person's functions. (5) A launch operator must develop and conduct the rehearsals identified in this section for each launch unless the launch operator clearly and convincingly demonstrates an equivalent level of safety through the licensing process. (6) Each rehearsal must simulate normal and abnormal preflight and flight conditions as needed to exercise the launch operator's launch plans. (7) Rehearsals may be conducted at the same time provided that joint rehearsals do not create hazardous conditions, such as changing a hardware configuration that affects public safety.		to the launch operator.
Page 63984 **§ 417.119 Rehearsals** (b) *Countdown rehearsal.* A launch operator shall develop and conduct a rehearsal with the countdown plan, procedures, and checklist required by § 415.119(l) and updated as needed for each launch according to § 417.111. A countdown rehearsal must familiarize launch personnel with all countdown activities, demonstrate that the planned sequence of events is correct, and demonstrate that	**Delete (b)-(e)**	The requirement to perform launch rehearsals is too restrictive as written in this section. The need to perform crew training and assessment prior to a launch is well established industry policy and each organization has internal practices and procedures that define in detail how the respective launch crews will be trained and certified, including rehearsals, simulations and anomalous actions. The requirement for this should

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there is adequate time allotted for each event. A launch operator shall hold a countdown rehearsal after the launch vehicle and any launch support systems are assembled into their final configuration for flight and before the launch readiness review required by § 417.117 (c) *Launch abort or delay recovery and recycle rehearsal.* A launch operator shall conduct a rehearsal of the launch abort or delay recovery and recycle plan developed during the licensing process in accordance with § 415.119(m) and updated as needed for each launch in accordance with § 417.111. A launch operator shall conduct this rehearsal after or in conjunction with a countdown rehearsal (d) *Emergency response rehearsal.* A launch operator shall conduct a rehearsal of the emergency response plan developed in accordance with § 415.119(b) and updated as needed for each launch according to § 417.111. A launch operator shall conduct an emergency response rehearsal for a first launch, for any additional launch that involves a new safety hazard, for a launch where there is a change in emergency response personnel, or for any launch where more than a year has passed since the last rehearsal. An emergency response rehearsal shall be conducted in conjunction with a countdown rehearsal. (e) *Communications rehearsal.* A launch operator shall ensure that each part of the communications plan developed according to § 415.119(f) and updated as needed for each launch according to § 417.111, is rehearsed either in conjunction with another rehearsal or during a specific communications rehearsal.		be included in the launch crew certification and requirements, and be part of the licensing process, not part of federal law. The FAA should require the launch operator to ensure trained personnel with the use of rehearsals. How the rehearsals are conducted and the content should be up to the launch operator.
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§ 417.121 Safety critical preflight operations (a) *General.* A launch operator shall perform safety critical preflight operations that protect the public from the adverse effects of hazards associated with launch processing and flight of a launch vehicle. All safety critical preflight operations must be identified in the launch schedule submitted according to § 415.121 of this chapter. Safety critical preflight operations must include, but need not be limited to those defined in this section.	(a) *General.* A launch operator shall perform safety critical preflight operations that protect the public from the adverse effects of hazards associated with launch processing and flight of a launch vehicle. All safety critical preflight operations **will be performed using approved procedures.** ~~must be identified in the launch schedule submitted according to § 415.121 of this chapter. Safety critical preflight operations must include, but need not be limited to those defined in this section.~~	Safety critical preflight operations are defined as part of the launch vehicle development process and documented in procedures. The hazardous procedures are reviewed and approved by range safety presently. This process could be used for non-federal ranges also without setting into law details that may not apply to future launch vehicle.
Page 63985 **§ 417.121 Safety critical preflight operations** (b) *Countdown* A launch operator shall conduct a launch countdown in accordance with a countdown plan, including procedures and checklists, developed during the licensing process according to § 415.119 and which must be updated as needed for each specific launch according to § 417.111. A countdown plan must be disseminated to, and followed by, all personnel responsible for the countdown and flight of a launch vehicle. A countdown shall be communicated over a dedicated communications network that is controlled by a launch conductor responsible for ensuring that all countdown checklist items are successfully completed. A launch operator shall ensure that all channels of the communications network are recorded during each countdown. A launch conductor shall be in direct communication with launch support personnel and receive readiness statements when checklist events are successfully completed.	**Delete (b)**	Safety critical preflight operations are defined as part of the launch vehicle development process and documented in procedures. The hazardous procedures are reviewed and approved by range safety presently. This process could be used for non-federal ranges also without setting into law details that may not apply to future launch vehicle All channels of the communications network do not have to be recorded. Please define "all". Sea Launch does record critical communications/ telemetry, but not "all" communication (handheld radios, e-mail, etc.). It would be very expensive to try to setup a system to record "all" communications.
Page 63985 **§ 417.121 Safety critical preflight operations** (e) A launch operator shall implement any local plans		Safety critical preflight operations are defined as part of

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and agreements developed during the licensing process according to § 415.119. For a launch from a site with a licensed launch site operator, the launch operator shall coordinate as needed to ensure that the launch site operator's local plans and agreements are implemented and satisfied in accordance with part 420. A launch operator shall ensure the following are accomplished for each launch, either as part of its local plans and agreements or as part of any launch site operator's local plans and agreements: (1) Any local plans and agreements shall be updated to reflect each launch. (2) Local authorities shall be informed of designated hazard areas associated with a launch vehicle's planned trajectory and any planned impacts of flight hardware as defined by the flight safety analysis required by subpart C of this part. Notifications must be designed to ensure that the public is aware of hazard areas and when to avoid them.	**Delete (e) and subs (1)-(2)**	the launch vehicle development process and documented in procedures. The hazardous procedures are reviewed and approved by range safety presently. This process could be used for non-federal ranges also without setting into law details that may not apply to future launch vehicle.
(3) Any hazard area information prepared in accordance with § 417.225 or § 417.235 shall be provided to the local United States Coast Guard for dissemination to mariners. (4) Hazard area information prepared in accordance with § 417.225 or § 417.235 for each aircraft hazard area within a flight corridor shall be provided to the FAA Air Traffic Control (ATC) office having jurisdiction over the airspace through which the launch will take place for the issuance of notices to airmen. (5) A launch operator shall be in communication with the local Coast Guard and the FAA ATC office, either directly or through any launch site operator, to ensure that notices to airmen and mariners are issued and in effect at the time of flight.	(3) Any hazard area information prepared in accordance with § 417.225 or § 417.235 shall be provided to the local United States Coast Guard **or equivalent local authority** for dissemination to mariners. (4) Hazard area information prepared in accordance with § 417.225 or § 417.235 for each aircraft hazard area within a flight corridor shall be provided to the FAA Air Traffic Control (ATC) office **or equivalent local authority** having jurisdiction over the airspace through which the launch will take place for the issuance of notices to airmen. (5) A launch operator shall be in communication with the local Coast Guard and the FAA ATC office **or equivalent local authorities**, either directly or	If not deleted then these notifications need to be modified as shown because foreign launch sites will not have USCG and FAA offices locally.

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issued and in effect at the time of flight.	through any launch site operator, to ensure that notices to airmen and mariners are issued and in effect at the time of flight.	
Page 63985 **§ 417.121 Safety critical preflight operations** (f) *Hazard area surveillance.* A launch operator shall implement its security and hazard area surveillance plan developed in accordance with § 415.119(h) of this chapter to ensure that the public safety criteria in § 417.107(b) are met for each launch. A launch operator shall determine any hazard areas that require surveillance in accordance with § 417.225 for an orbital launch or § 417.235 for a suborbital launch. For hazard areas requiring surveillance, a launch operator shall ensure that each hazard area is surveyed on the day of launch, and ensure that the presence of any members of the public in a surveyed hazard area is consistent with flight commit criteria developed for each launch in accordance with § 417.113. A launch operator shall verify the accuracy of any radar or other equipment used for hazard area surveillance and ensure that any inaccuracies in the surveillance system are accounted for when enforcing the flight commit criteria.	**Delete (f)**	If the FAA deems the safety efforts of the federal ranges to be adequate, then there is little justification for changing/adding requirements. Mandating survey of downrange planned impact points is impractical and unacceptable from a cost, delay risk, and scheduling perspective. Compliance would require multiple airborne assets to survey multiple drop zones for a single launch. Note that some downrange drop zones are several thousand square miles. Mechanical problems on any of these search aircraft enroute would require scrub of the launch. Weather (rain, low clouds) at any point in the drop area would require launch abort. Public notification is sufficient to ensure public safety.
Page 63985 **§ 417.121 Safety critical preflight operations** (g) *Flights safety system preflight test.* A launch operator shall conduct preflight tests of any flight safety system in accordance with the requirements in subpart D of this part. (h) *Launch vehicle tracking data verification.* For each launch a launch operator shall implement written procedures for verifying the accuracy of any launch vehicle tracking data provided to the flight safety official during flight. Any source of tracking data	**Delete (g)-(h)**	Safety critical preflight operations are defined as part of the launch vehicle development process and documented in procedures. The hazardous procedures are reviewed and approved by range safety presently. This process could be used for non-federal ranges also without setting into law details that may not apply to future launch vehicle.

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must satisfy the requirements of § 417.327(b).		
Page 63987 **§417.127 Unique safety policies and practices.** For any new launch operator unique safety policy or practice or change to an existing safety policy or practice, the launch operator shall submit a request for license modification in accordance with § 415.73 and the license modification plan required by § 415.119(n).	For any new launch operator unique safety policy or practice or change to an existing safety policy or practice **where the risk to the public may increase**, the launch operator shall **coordinate with the FAA.**~~submit a request for license modification in accordance with § 415.73 and the license modification plan required by § 415.119(n).~~	License modification should not be required if safety practices are changed to increase the protection of the public, or if the public is unaffected. Only if safety practices result in an increased public risk should license modification be required.

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Part 417, Subpart C - Flight Safety Analysis		
§ 417.201 Scope. This subpart provides requirements for performing flight safety analysis in accordance with § 417.107(d) and performance standards for the analyses that a launch operator shall complete. This subpart also identifies the analysis products that a launch operator shall submit to the FAA when applying for a launch license in accordance with subpart F of part 415 and as required by this subpart for each launch.	This subpart provides requirements for performing flight safety analysis in accordance with § 417.107(d) and performance standards for the analyses that a launch operator shall complete. This subpart also identifies the analysis products that a launch operator shall submit to the FAA when applying for a launch license in accordance with subpart F of part 415 and as required by this subpart for each launch, **or series of similar launches. Flight safety analyses performed by, or approved by, range safety personnel at existing federal launch sites shall be acceptable for commercial launches at existing federal launch sites. Flight safety analyses currently performed by range safety personnel at existing federal ranges are not required to be submitted to the FAA by the launch operator. Launch operator flight safety analysis products in support of launches at federal ranges shall be submitted to the range safety organization at the launch site per the requirements of that organization, with copies available for submittal to the FAA.**	Subpart F of part 415, section 415.115 requires flight safety analysis data to be submitted 18 months prior to the vehicle being brought to the launch site. This timeline does not support a commercial launch business. If several similar, or identical missions are planned, it may only be necessary to perform applicable flight safety analysis once for these missions. There is no need to change any flight safety analyses currently performed, or accepted by, the range safety organizations at existing federal launch sites, especially considering the exemplary safety records of these launch sites. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. It is not practical, or economical, for the launch operator to be required to submit different analysis products to satisfy both the FAA and the range safety organizations at the federal launch sites. When the analyses are performed and approved by the resident range safety organizations at the federal launch sites, their product requirements should be fulfilled and

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		accepted by the FAA, with copies available to the FAA.
63987 **§ 417.203 General** (a) Compliance. A launch operator shall perform flight safety analysis to demonstrate that it will monitor and control risk to the public from normal and malfunctioning launch vehicle flight in accordance with the public risk criteria of § 417.107(b) and subpart C of this part. For each launch, a licensee shall perform flight safety analysis using methods approved by the FAA during the licensing process or as a license modification. Any change to a licensee's flight safety analysis methods shall be submitted to the FAA as a request for license modification in accordance with § 415.73 before the launch to which the proposed change applies.	(a) Compliance. A launch operator shall perform flight safety analysis to demonstrate that it will monitor and control risk to the public from normal and malfunctioning launch vehicle flight in accordance with the public risk criteria of § 417.107(b) and subpart C of this part. **For launches at existing federal ranges, a launch operator will support the range safety organizations at the federal launch site who monitor and control risk to the public from normal and malfunctioning launch vehicle flight.** For each launch, **or series of similar launches**, a licensee shall perform flight safety analysis using methods **either** approved by the FAA during the licensing process, ~~or as a license modification~~. **or by the range safety organization at a federal launch site supporting the launch**. Any change to a licensee's flight safety analysis methods shall be **coordinated with the appropriate range safety organization at the federal launch site, or the FAA**. ~~as a request for license modification. in accordance with § 415.73 before the launch to which the proposed change applies.~~	The existing range safety organizations should continue to perform their current launch support tasks and analyses, and launch operators should continue to support those analyses by providing the necessary data to the ranges. The existing range safety organizations should continue to be responsible for determining whether launch operator supplied data and analyses are acceptable. A launch operator does not have the technical or financial resources to easily and quickly perform analyses currently done by the existing range safety organizations at the launch sites. If several similar, or identical missions are planned, it may only be necessary to perform applicable flight safety analysis once for these missions. The concept of modifying launch licenses is problematic. It will lead to increased paperwork, especially if minor changes will force launch license modifications.
63987 **§ 417.203 General** (b) Flight safety plan. Flight safety analysis products must be incorporated in a launch operator's flight safety plan. This plan shall be prepared during the license application process in accordance with § 415.115 and updated to incorporate final analysis products for each launch in accordance with §	(b) Flight safety plan. Flight safety analysis products must be incorporated in a launch operator's flight safety plan. This plan shall be prepared during the license application process in accordance with § 415.115 and updated to incorporate final analysis products for each launch, **or series of similar**	If several similar, or identical missions are planned, it may only be necessary to perform applicable flight safety analyses once for these missions. While the due date for the flight safety plan is within

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417.107(d).	**launches**, in accordance with § 417.107(d). **For launches from existing federal ranges, the range safety organization at the launch site shall determine the launch operator flight safety analysis product requirements and submittal schedule. Launch operator flight safety analysis products in support of launches at federal ranges shall be submitted to the range safety organization at the launch site per the requirements of that organization, with copies available for submittal to the FAA.**	the times listed in the EWR 127-1 Preliminary Flight Plan Approval requirement, the existing ranges have been very flexible regarding this due date. Commercial launch operator schedules require this flexibility, especially with regard to new vehicles, since data and analyses required for submittal are not always available to support the specific due date. The existing range safety organizations at federal launch sites should continue to perform their current functions. Copies of launch operator flight safety submittals to the range safety organization should be available to the FAA.
63987 § **417.203 General** (c) Submission of analysis products. (1) License application flight safety analysis. A launch operator shall perform flight safety analysis at the time of license application and submit the analysis products required by this subpart as part of the launch operator's safety review document in accordance with § 415.115(a). The FAA will evaluate the submitted analysis material to determine whether a launch operator's analysis methods for each launch are in compliance with the requirements of this subpart.	(1) License application flight safety analysis. A launch operator shall perform flight safety analysis at the time of license application and submit the analysis products required by this subpart as part of the launch operator's safety review document in accordance with § 415.115(a). The FAA will evaluate the submitted analysis material to determine whether a launch operator's analysis methods for each launch are in compliance with the requirements of this subpart. **For launches from existing federal ranges, the launch operator flight safety analysis products approved by the range safety organization at the federal launch site shall be acceptable to the FAA. Launch operator flight safety analysis products in support of launches at federal ranges shall be submitted to the range safety organization at the launch site per the requirements of that organization, with copies**	The existing range safety organizations at federal launch sites should continue to perform their current functions. Copies of launch operator flight safety submittals to the range safety organization should be available to the FAA.

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	available for submittal to the FAA.	
63987 **§ 417.203 General** (c) Submission of analysis products. (2) Six-month flight safety analysis. A launch operator shall perform flight safety analysis for each launch, and submit launch specific analysis products to the FAA no later than six months prior to the date of each planned flight. This analysis shall be performed with vehicle and mission specific input data as intended for the planned flight. A launch operator may reference previously submitted analysis products and data that are applicable to the launch. A launch operator shall identify any analysis product that may change as a flight date approaches. A launch operator shall describe what needs to be done to finalize any analysis product and identify when it will be finalized. The launch operator shall submit the analysis products using the same format and organization as submitted during the license application process. The FAA may request the launch operator to present the six-month flight safety analysis products in a technical meeting at the FAA.	(2) Six-month flight safety analysis. A launch operator shall perform flight safety analysis for each launch, **or series of similar launches**, and submit launch specific analysis products to the FAA ~~no later than~~ **at approximately** six months prior to the date of each planned flight. This analysis shall be performed with vehicle and mission specific input data as intended for the planned flight. A launch operator may reference previously submitted analysis products and data that are applicable to the launch, **or series of similar launches**. A launch operator shall identify any analysis product that may change as a flight date approaches. A launch operator shall describe what needs to be done to finalize any analysis product and identify when it will be finalized. The launch operator shall submit the analysis products using the same format and organization as submitted during the license application process. The FAA may request the launch operator to present the six-month flight safety analysis products in a technical meeting at the FAA. **For launches from existing federal ranges, the launch operator must only fulfill the flight safety analysis requirements determined by the range safety organization at the federal launch site, with copies of any submittals available to the FAA.**	If several similar, or identical missions are planned, it may only be necessary to perform an applicable flight safety analysis once for these missions. The launch operator requires the flexibility currently afforded by the range safety organizations at the federal ranges in meeting any deadlines imposed for flight safety submittals. The number, frequency, and timing of submittal of flight safety analysis products places a large burden on commercial space ventures, which may not be attainable/sustainable. The existing range safety organizations at the federal launch sites should continue to perform their current function. Copies of launch operator flight safety submittals to the range safety organization should be available to the FAA.
63987 **§ 417.203 General** (3) Thirty-day flight safety analysis update. A launch operator shall perform analysis and submit updated analysis products no later than 30 days prior to	(3) Thirty-day flight safety analysis update. A launch operator shall perform analysis and submit updated analysis products ~~no later than~~ **by approximately**	The launch operator requires the flexibility currently afforded by the range safety organizations at the federal ranges in meeting any deadlines imposed for flight

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flight. The analysis must account for potential variations in input data that may affect the analysis products within the final 30 days prior to flight. The launch operator shall submit the analysis products using the same format and organization employed during the license application process. A launch operator shall not change an analysis product within the final 30 days prior to flight unless the change is an enhancement to public safety and making the change is identified as part of the launch operator's flight safety analysis process approved by the FAA through the licensing process.	30 days prior to flight **if changes affecting public safety have occurred.** The analysis must account for potential variations in input data that may affect the analysis products within **approximately** 30 days prior to flight. The launch operator shall submit the analysis products using the same format and organization employed during the license application process. A launch operator shall not change an analysis product within **approximately** 30 days prior to flight **unless the change does not adversely affect** ~~is an enhancement to~~ public safety. ~~and~~ **Making the change within approximately 30 days prior to flight shall be** ~~is~~ identified as part of the launch operator's flight safety analysis process approved by the FAA through the licensing process. **For launches from existing federal ranges, the launch operator must only fulfill the flight safety analysis requirements determined by the range safety organization at the federal launch site, with copies of any submittals available to the FAA.**	safety submittals. The number, frequency, and timing of submittal of flight safety analysis products places a large burden on commercial space ventures, which may not be attainable/sustainable. The existing range safety organization at each launch site should continue to perform their current function. Copies of launch operator flight safety submittals to the range safety organization should be available to the FAA. Schedule flexibility is also required by launch contractors in order to make necessary changes that do not negatively affect public safety, even if these changes are closer to the launch date.
63987 **§ 417.203 General** (d) Applicability of analyses. Flight safety analysis must assess the flight of a guided or unguided expendable launch vehicle, whether it uses a flight safety system or a wind weighting safety system to protect the public. The requirements for wind analysis of § 417.217, the debris risk analysis of § 417.227, the toxic release hazard analysis of § 417.229, the distant focus overpressure blast effects risk analysis of § 417.231, and the conjunction on launch assessment requirements of § 417.233 apply to all launches. The requirements in § 417.235 apply only to the flight of any unguided suborbital launch vehicle that uses a wind weighting safety system. All other analyses required by this subpart apply to the flight of any launch vehicle that uses a	Recommend revision by joint FAA/Industry committee	These tasks are normally performed by the resident range safety organizations at existing federal launch sites. A significant burden would be placed on the launch operator to develop the capability to perform these tasks.

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flight safety system to ensure public safety in accordance with § 417.107(a).		
63987 **§ 417.203 General** (e) Dependent analyses. Because some analyses required by this subpart are inherently dependent on one another, a launch operator shall ensure that each product or data output of any one analysis is compatible in form and content with the data input requirements of any other analysis that depends on that output. Figure 417.203-1 illustrates the flight safety analyses that would be performed for a typical launch that uses a flight safety system and the dependent relationships that exist between the analyses.	(e) Dependent analyses. Because some analyses required by this subpart are inherently dependent on one another, a launch operator shall ensure that each **launch operator** product or data output of any one **launch operator** analysis is compatible in form and content with the data input requirements of any other analysis that depends on that output. Figure 417.203-1 illustrates the flight safety analyses that would be performed for a typical launch that uses a flight safety system and the dependent relationships that exist between the analyses.	Many of the analyses referred to in this subsection are analyses performed by the existing range safety agencies at the launch sites. Verification of the output of these analyses, and the compatibility of the output with other analyses, is, and should continue to be the function of the existing range safety organization at the launch site.
63988 **§ 417.203 General** (f) Alternate analyses. A launch operator shall meet the requirements in this subpart unless the FAA approves an alternate analysis method though the licensing process. The FAA will approve an alternate method if a launch operator provides a clear and convincing demonstration that its proposed method provides an equivalent level of safety to that required by this subpart. A launch operator shall obtain FAA approval of an alternate method before the FAA will find the launch operator's license application or application for license modification sufficiently complete to initiate review pursuant to § 413.11 of this chapter. An alternate flight safety analysis method used by a federal launch range, that is documented and approved in the FAA baseline safety assessment of that federal launch range, is an acceptable alternate analysis method for a commercial launch from that range.	(f) Alternate analyses. A launch operator shall meet the requirements in this subpart unless the FAA approves an alternate analysis method though the licensing process. The FAA will approve an alternate method if a launch operator provides a clear and convincing demonstration that its proposed method provides an equivalent level of safety to that required by this subpart. A launch operator shall obtain FAA approval of an alternate method before the FAA will find the launch operator's license application ~~or application for license modification~~ sufficiently complete to initiate review pursuant to § 413.11 of this chapter. An alternate flight safety analysis method used by a federal launch range, that is documented and approved in the FAA baseline safety assessment of that federal launch range, is an acceptable alternate analysis method for a commercial launch from that range.	The concept of modifying launch licenses is problematic. It will lead to increased paperwork, especially if minor changes will force launch license modifications. The launch licensing process should be independent of the flight and launch approval processes. The document should emphasize, wherever possible, that the analyses performed by range safety organizations at existing federal launch ranges are acceptable to the FAA.

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63988 **§ 417.205 Trajectory analysis** (a) General. A launch operator shall perform a trajectory analysis to determine a launch vehicle's nominal trajectory and potential three-sigma trajectory dispersions about the nominal trajectory. A launch operator's trajectory analysis shall also determine, for any time after lift-off, the limits of a launch vehicle's normal flight. Normal flight is defined as a properly performing launch vehicle whose real-time instantaneous impact point does not deviate from the nominal instantaneous impact point by more than the sum of the wind effects and the three-sigma performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions. Figure 417.205-1 illustrates the nominal trajectory and the three-sigma left and right dispersed trajectories for a sample launch from Florida.	Recommend revision by joint FAA/Industry committee	The Sea Launch flight design group has provided data for past licenses that satisfy the goal of safety, and the data have been acceptable to the FAA. What was provided were not the specific products requested in the paragraph. Sea Launch Flight Design needs to be very sure that they could still use alternative approaches, or the additional costs will be large. The differences in launch vehicles and launch sites may make it impossible to adequately cover all launch operator programs with specific analysis requirements that are laws. Either the requirements will have to be more general, or some sort of tailoring process will be needed.
63989 **§ 417.205 Trajectory analysis** (b) Wind standards. A trajectory analysis shall incorporate wind data developed in accordance with the wind analysis in § 417.217 and in accordance with the following:	Recommend revision by joint FAA/Industry committee	The wind analysis in § 417.217 applies to many analyses only performed by the existing range safety organization at a federal launch site. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges.
63989 **§ 417.205 Trajectory analysis** (b) Wind standards. (1) A launch operator shall compute "with-wind" launch vehicle trajectories pursuant to § 417.205(f)(6) using annual composite wind profiles. When a launch operator will launch only at a particular time period during the year the launch operator may use the monthly composite wind for	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force

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that time period.		launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
63989 **§ 417.205 Trajectory analysis** (b) Wind standards. (2) A launch operator shall compute the annual composite wind profile with a cumulative percentile frequency that represents wind conditions that are at least as severe as the worst wind conditions under which flight would be attempted. These worst wind conditions must account for the launch vehicle's ability to operate normally in the presence of wind and accommodate any flight safety limit constraints.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
63989 **§ 417.205 Trajectory analysis** (d) Dispersed trajectories. (1) Three-sigma maximum and minimum performance trajectories. (i) In calculating the three-sigma maximum and minimum performance trajectories, a launch operator shall use annual composite head wind and annual composite tail wind profiles that represent the worst wind conditions under which a launch would be attempted as described in accordance with paragraph (b)(2) of this section.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a

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		federal launch site.
63989 **§ 417.205 Trajectory analysis** (d) Dispersed trajectories. (2) Three-sigma left and right lateral trajectories. (i) In calculating each left and right lateral trajectory, composite left and composite right lateral-wind profiles shall be used which represent the worst wind conditions for which a launch would be attempted as required by paragraph (b)(2) of this section.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
63990 **§ 417.205 Trajectory analysis** (d) Dispersed trajectories. (3) Fuel-exhaustion trajectory. A launch operator shall compute a fuel exhaustion trajectory that is an extension of either the nominal trajectory taken through fuel exhaustion or the three-sigma maximum trajectory taken through fuel exhaustion, whichever of the two trajectories produces instantaneous impact points with the greatest range for any given time-after-liftoff. The fuel exhaustion trajectory shall be determined in accordance with the following:	(3) Fuel-exhaustion trajectory. A launch operator **may be required to** compute a fuel exhaustion trajectory that is an extension of either the nominal trajectory taken through fuel exhaustion or the three-sigma maximum trajectory taken through fuel exhaustion, whichever of the two trajectories produces instantaneous impact points with the greatest range for any given time-after-liftoff. **A fuel exhaustion trajectory is not required if the stages listed in (ii) and (iii) below nominally burn to propellant depletion without a programmed thrust termination.** The fuel exhaustion trajectory shall be determined in accordance with the following:	The new wording makes it clear that a fuel-exhaustion trajectory is not always required.

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63990 **§ 417.205 Trajectory analysis** (d) Dispersed trajectories. (3) Fuel-exhaustion trajectory. (iv) The wind constraints for a fuel exhaustion trajectory shall be the same as those that apply to the nominal or three-sigma trajectory used to compute the fuel exhaustion trajectory.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
63990 **§ 417.205 Trajectory analysis** (e) Straight-up trajectory. A launch operator shall compute a straight-up trajectory, beginning at the planned time of ignition, which simulates a malfunction that causes the launch vehicle to fly its entire flight in a vertical or near vertical direction above the launch point. The amount of time that a straight-up trajectory lasts must be no less than the sum of the straight-up time determined in accordance with § 417.215 plus the duration of a potential malfunction turn determined in accordance with § 417.207(b)(2).	(e) Straight-up trajectory. A launch operator shall compute a straight-up trajectory, beginning at the planned time of ignition, which simulates a malfunction that causes the launch vehicle to fly its entire flight in a vertical or near vertical direction above the launch point. The amount of time that a straight-up trajectory lasts must be no less than the sum of the straight-up time determined in accordance with § 417.215 plus the duration of a potential malfunction turn determined in accordance with § 417.207(b)(2). **For launches from federal ranges, the straight-up trajectory analysis performed by the range safety organization at the federal launch site shall be acceptable to the FAA.**	This paragraph pertains to an analysis performed exclusively by range safety personnel at existing federal ranges in support of launch operations. This analysis should continue to be performed by the existing range safety organization at federal launch sites and accepted by the FAA. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges.
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§ **417.205 Trajectory analysis** (f) Analysis process and computations. A launch operator shall use a six-degree-of freedom trajectory model to generate each required three-sigma trajectory in terms of instantaneous impact point distance from the nominal location. In the course of generating each trajectory a launch operator shall use a root-sum-square trajectory analysis method that satisfies the requirements of (1) through (6) of this paragraph or may employ an alternate method, such as a Monte Carlo analysis, if the launch operator demonstrates clearly and convincingly through the licensing process that its alternate method provides an equivalent level of safety. When using the root-sum-square method, a launch operator shall:	(f) Analysis process and computations. A launch operator shall ~~use a six-degree-of freedom trajectory model to~~ generate each required three-sigma trajectory in terms of instantaneous impact point distance from the nominal location. In the course of generating each trajectory a launch operator shall use a root-sum-square trajectory analysis method that satisfies the requirements of (1) through (6) of this paragraph or may employ an alternate method, such as a Monte Carlo analysis, if the launch operator demonstrates clearly and convincingly through the licensing process that its alternate method provides an equivalent level of safety. When using the root-sum-square method, a launch operator shall:	Six-degree-of-freedom trajectories are not required to perform this analysis.
63990 § **417.205 Trajectory analysis** (f) Analysis process and computations. (2) No-wind trajectory simulation. Perform a series of no-wind trajectory simulation runs using a six degree-of-freedom model. Each trajectory simulation run must introduce no more than one three-sigma value of a performance error parameter while all other parameters are held at nominal levels.	(2) No-wind trajectory simulation. Perform a series of no-wind trajectory simulation runs ~~using a six degree-of-freedom model~~. Each trajectory simulation run must introduce no more than one three-sigma value of a performance error parameter while all other parameters are held at nominal levels.	Six-degree-of-freedom trajectories are not required to perform this analysis.
63990 § **417.205 Trajectory analysis** (f) Analysis process and computations. (5) No-wind matching trajectories. By further trajectory simulation, generate four thrusting flight no-wind trajectories that match the three-sigma instantaneous impact point deviations calculated in accordance with paragraph (f)(4) of this section.	Recommend revision by joint FAA/Industry committee	This may be acceptable for some vehicles. For other vehicles, it may be better to determine the uprange, downrange, left, and right instantaneous impact point deviations from the nominal no-wind trajectory due to worst case head, tail, left, and right winds. These deviations can then be added to the root-sum-square

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		deviations can then be added to the root-sum-square calculated from the performance dispersion instantaneous impact point deviations. The three-sigma trajectories can then be generated to match the combined wind + performance root-sum-square instantaneous impact point deviations.
63990 **§ 417.205 Trajectory analysis** (f) Analysis process and computations. (6) With-wind three-sigma trajectories. Generate each three-sigma trajectory using the worst wind conditions determined in accordance with paragraph (b) of this section and the launch vehicle performance error parameters and magnitudes used to generate the no-wind matching trajectories in accordance with paragraph (f)(5) of this section. The effect of winds on the three-sigma trajectory must be modeled from liftoff through the point in flight where the launch vehicle attains an altitude where the wind no longer affects the launch vehicle.	Recommend revision by joint FAA/Industry committee	This may be acceptable for some vehicles. For other vehicles, it may be better to determine the uprange, downrange, left, and right instantaneous impact point deviations from the nominal no-wind trajectory due to worst case head, tail, left, and right winds. These deviations can then be added to the root-sum-square calculated from the performance dispersion instantaneous impact point deviations. The three-sigma trajectories can then be generated to match the combined wind + performance root-sum-square instantaneous impact point deviations.
63990 **§ 417.205 Trajectory analysis** (g) Trajectory analysis products. A launch operator shall submit the products of its trajectory analysis to the FAA in accordance with § 417.203(c). Those products shall include the following:	(g) Trajectory analysis products. A launch operator shall submit the products of its trajectory analysis to the FAA in accordance with § 417.203(c). **For launches from existing federal ranges, the launch operator is only required to submit trajectory analysis products to the range safety organization at the federal launch site per the requirements of that organization, with copies available to the FAA.** Those products shall include the following:	The existing range safety organization at each launch site should continue to perform their current function. Copies of launch operator flight safety submittals should be available to the FAA.
63990 **§ 417.205 Trajectory analysis**		

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(g) Trajectory analysis products. (1) Assumptions and procedures. A description of all assumptions, procedures and models used in deriving the nominal and dispersed trajectories, with particular attention to the six-degrees-of-freedom model.	(1) Assumptions and procedures. A description of all assumptions, procedures and models used in deriving the nominal and dispersed trajectories~~, with particular attention to the six-degrees-of-freedom model~~.	Six-degree-of-freedom trajectories are not required to perform this analysis.
63990 **§ 417.205 Trajectory analysis** (g) Trajectory analysis products. (3) Wind profile(s). A graph and tabular listing of the annual winds required by paragraph (b)(1) of this section and the worst case winds required by paragraph (b)(2) of this section. The graph and tabular wind data must be the same as that used in performing the trajectory analysis and must provide wind magnitude and direction as a function of altitude for the air space regions from the Earth's surface to 100,000 feet in altitude for the area intersected by the launch vehicle trajectory. Altitude intervals must not exceed 1000 feet. Statistical wind geographic reference points shall not exceed spatial intervals greater than 2.5 degrees latitude or 2.5 degrees longitude. The graphical and tabular data shall conform to the presentation requirements of § 417.217(d)(1)(i) and § 417.217(d)(1)(ii), respectively.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
63991 **§ 417.205 Trajectory analysis** (g) Trajectory analysis products. (7) Temporal trajectory items. A launch operator shall provide the following temporal trajectory data for time intervals not in excess of one second and for the discrete time points that correspond to each jettison, ignition, burnout, and thrust termination of	(7) Temporal trajectory items. A launch operator shall provide the following temporal trajectory data for time intervals not in excess of one second and for the discrete time points that correspond to each jettison, ignition, burnout, and thrust termination of	The AFSCM 80-12 format has been the standard submittal format required by the ranges. Any new FAA data requirements should be included in AFSCM 80-12 updates.

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each stage. For a sub-orbital launch vehicle, these data must account for the weight of any and all payloads to be flown and the planned nominal quadrant elevation angles of the vehicle's launcher. These data must be provided on paper in text format or electronically via disk files. The text format must have a column for each data item and a row for each time point. Disk files must be in ASCII text, space delimited format, with a column for each data item and a row for each time point. An electronic "readme" file shall be provided that clearly identifies the data, and their units of measure, in the individual disk files.	each stage. For a sub-orbital launch vehicle, these data must account for the weight of any and all payloads to be flown and the planned nominal quadrant elevation angles of the vehicle's launcher. These data must be provided on paper in text format or electronically via ~~disk files. The text format must have a column for each data item and a row for each time point. Disk files must be in ASCII text, space delimited format, with a column for each data item and a row for each time point. An electronic "readme" file shall be provided that clearly identifies the data, and their units of measure, in the individual disk files.~~ **any acceptable media. The data should be provided as ASCII files in the current AFSCM 80-12 format.**	It is not clear what type of disk media "disk files" refers to. It would be much better to permit a variety of media formats, e.g., 4mm tape, CD-R, ZIP disk, etc., or employ direct electronic data transmission methods.
63991 **§ 417.205 Trajectory analysis** (g) Trajectory analysis products. (7) Temporal trajectory items. (iii) X, Y, Z, XD, YD, ZD trajectory coordinates. The launch vehicle position coordinates (X, Y, Z) and velocity magnitudes (XD, YD, ZD) must be referenced to an orthogonal, Earth-fixed, right-handed coordinate system. The XY-plane must be tangent to the ellipsoidal Earth at the origin, which is the launch point, the positive X-axis must coincide with the launch azimuth, the positive Z-axis must be directed away from the ellipsoidal Earth, and the Y-axis must be positive to the left looking downrange.	Recommend revision by joint FAA/Industry committee	The current standard AFSCM 80-12 format requires a left-handed range safety coordinate system. This change will require software modifications, and should be included in an update to the AFSCM 80-12 document if the range safety organizations are also planning to make this coordinate system change.
63991 **§ 417.205 Trajectory analysis**		

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(g) Trajectory analysis products. (7) Temporal trajectory items. (xiii) Dynamic pressure as a function of time-of-flight. Tabular data as part of the temporal trajectory items and a two-dimensional graph, with time-of-flight on the X-axis and dynamic pressure on the Y-axis.	Recommend revision by joint FAA/Industry committee	This is a new requirement and not part of the current standard AFSCM 80-12 format. This change will require software modifications, and should be included in an update to the AFSCM 80-12 document if the range safety organizations are also planning to make this coordinate system change.
63991 **§ 417.205 Trajectory analysis** (g) Trajectory analysis products. (7) Temporal trajectory items. (xiv) Coriolis displacement. The geodetic distance from the instantaneous impact point to the displacement point caused by Coriolis accelerations if this effect is not included in the trajectory computations.	Recommend revision by joint FAA/Industry committee	This is a new requirement and not part of the current standard AFSCM 80-12 format. This change will require software modifications, and should be included in an update to the AFSCM 80-12 document if the range safety organizations are also planning to make this coordinate system change.
63991 **§ 417.207 Malfunction turn analysis.** (a) General. A launch operator shall perform a malfunction turn analysis to determine a launch vehicle's greatest turning capability as a function of trajectory time. A launch operator shall use the products of its malfunction turn analysis as input to its flight safety limits analysis and other analysis where it is necessary to determine how far a launch vehicle's impact point can deviate from the nominal impact point when a malfunction occurs. A launch operator shall determine the set of launch vehicle velocity vector angular deviations, measured from the nominal launch vehicle velocity vector, that cause deviation from the nominal instantaneous	(a) General. **For applicable launch vehicles**, a launch operator shall perform a malfunction turn analysis to determine a launch vehicle's greatest turning capability as a function of trajectory time. ~~A launch operator shall use~~ **The** products of ~~it's~~ **the** malfunction turn analysis **shall be used** as input to its flight safety limits analysis and other analysis where it is necessary to determine how far a launch vehicle's impact point can deviate from the nominal impact point when a malfunction occurs. A launch operator shall determine the set of launch vehicle velocity vector angular deviations, measured from the nominal launch vehicle velocity vector, that	This analysis should not be applicable for Sea Launch due to the vehicle Thrust Termination System design. If Sea Launch is required to perform this analysis just to meet the letter of the law, the cost will be very large. The wording changes allow either the launch operator, in the case of launches from non-federal ranges, to use the malfunction data to perform other analyses, or, in the case of launches from existing federal ranges, the range safety organization at the launch site.

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impact point. The velocity vector angular deviations shall be determined as a function of time, beginning at the malfunction start time. A launch operator shall also determine the corresponding change in launch vehicle velocity magnitude from the nominal velocity magnitude, as a function of time, beginning at the malfunction start time.	cause deviation from the nominal instantaneous impact point. The velocity vector angular deviations shall be determined as a function of time, beginning at the malfunction start time. A launch operator shall also determine the corresponding change in launch vehicle velocity magnitude from the nominal velocity magnitude, as a function of time, beginning at the malfunction start time.	
63992 **§ 417.207 Malfunction turn analysis.** (b) Malfunction turn analysis constraints. (1) A launch operator shall determine a flight safety system time delay in accordance with § 417.223 and use the results to determine the required malfunction turn duration in accordance with paragraph (b)(2) of this section.	Recommend revision by joint FAA/Industry committee	The required duration of the turn can be specified as a fixed, conservative value. It does not take any significant effort to continue a tumbling turns simulation for a longer period of time.
63994 **§ 417.207 Malfunction turn analysis.** (b) Malfunction turn analysis constraints. (9) A launch operator shall evaluate both pitch and yaw turns for malfunction start times that correspond to each sub-vehicle point. A launch operator shall use the velocity vector turn angle rate that causes the largest dispersion, from either the pitch or yaw turn computations, in the development of flight safety limits. If the pitch turn angle and yaw turn angle are the same except for the effects of gravity, the yaw turn angles may be determined from pitch calculations that, in effect, have had the gravity component subtracted out at each step in the computations.	(9) A launch operator shall evaluate both pitch and yaw turns for malfunction start times that correspond to each sub-vehicle point. **During the first 100** sec of flight both pitch and yaw turns shall be provided. After 100** sec, turns need be computed only in the yaw plane. During the first 100** seconds,** a launch operator shall use the velocity vector turn angle rate that causes the largest dispersion, from either the pitch or yaw turn computations, in the development of flight safety limits. If the pitch turn angle and yaw turn angle are the same except for the effects of gravity, the yaw turn angles may be determined from pitch calculations that, in effect, have had the gravity component subtracted out at each step in the	The change incorporates the current EWR 127-1 requirement for calculating both pitch and yaw malfunction turns, and eliminates unnecessary work.

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	computations.	
63995 **§ 417.207 Malfunction turn analysis.** (e) Malfunction turn analysis products. The products of a launch operator's malfunction turn analysis to be submitted to the FAA in accordance with § 417.203(c) must include the following:	(e) Malfunction turn analysis products. **For launches from a federal range**, the products of a launch operator's malfunction turn analysis **shall** be submitted to the **range safety organization at the federal launch site, with copies available to the FAA. For launches from a non-federal range**, the products of a launch operator's analysis, **when the analysis is applicable, shall** be submitted to the FAA in accordance with § 417.203(c) must include the following:	The range safety organizations at existing federal ranges should continue to perform their current function. Copies of launch operator flight analysis submittals to the range safety organizations should be available to the FAA. The analysis products should not be applicable for Sea Launch due to the vehicle Thrust Termination System design. If Sea Launch is required to produce these analysis products just to meet the letter of the law, the cost will be very large.
63999 **§ 417.209 Debris Analysis.** (a) General. A launch operator shall perform a debris analysis that identifies inert, explosive and other hazardous launch vehicle debris resulting from a launch vehicle malfunction and from any planned jettison of launch vehicle components for orbital and sub-orbital launch.	(a) General. A launch operator shall perform a debris analysis that identifies inert, explosive and other hazardous launch vehicle debris resulting from a launch vehicle malfunction and from any planned jettison of launch vehicle components for orbital and sub-orbital launch. **Debris analysis methodology previously accepted by the FAA or range safety organizations at the federal launch sites shall still be acceptable to the FAA or the range safety organizations at the federal launch sites.**	Launch vehicle programs that have submitted acceptable debris analysis data to the FAA or the range safety organizations at the federal launch sites should not be required to re-perform the analysis, especially if the analysis has already been used to support launches.
63999 **§ 417.209 Debris Analysis.** (b) Debris analysis constraints. A debris analysis must produce the debris models described in paragraphs (c) and (d) of this section, in the form of lists of debris that results from breakup of a launch vehicle	(b) Debris analysis constraints. A debris analysis must produce the debris models described in paragraphs (c) and (d) of this section, in the form of lists of debris that results from breakup of a launch vehicle	Launch operators have only been required, under EWR 127-1 interpretations, to perform a debris analysis that results in a best-estimate debris model for use in range safety analyses. Range subcontractors have used these

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and any planned jettison of debris or components. Each list must describe each debris fragment produced, including its physical characteristics, whether it is inert or explosive, and the effects of impact, such as explosive overpressure, skip, splatter, or bounce radius. Each debris list must be produced in accordance with the following:	and any planned jettison of debris or components. Each list must describe each debris fragment produced, including its physical characteristics, whether it is inert or explosive, and the effects of impact, such as explosive overpressure, skip, splatter, or bounce radius. **For launches from federal ranges, the launch operator debris model and debris model analysis accepted by the range safety organization at the federal launch site shall be acceptable to the FAA**. Each debris list must be produced in accordance with the following:	models to perform debris impact and risk assessment analyses in the launch area. It would be a major burden to a launch operator to develop the capability to duplicate the analyses performed by the range subcontractors in the launch area.
64000 **§ 417.209 Debris Analysis.** (b) Debris analysis constraints. (4) A debris analysis must account for the impact overpressure, fragmentation, and secondary debris effects of any confined or unconfined solid propellant chunks and fueled components containing either liquid or solid propellants that could survive to impact, as a function of vehicle malfunction time.	Recommend revision by joint FAA/Industry committee	Launch operators have only been required, under EWR 127-1, to perform a debris analysis that results in a best-estimate debris model for use in analyses performed by the range safety organization at the launch site. Range safety subcontractors have calculated detailed debris impact overpressure, fragmentation, and secondary impact effects to perform debris impact and risk assessment analyses in the launch area. Launch operators have only provided estimates for the above parameters, when applicable, to satisfy debris risk assessment requirements for downrange locations. It would be a major burden to a launch operator to develop the capability to duplicate the analyses performed by the range subcontractors in the launch area.
64000 **§ 417.209 Debris Analysis.** (b) Debris analysis constraints. (5) Debris Analysis. A debris analysis must account for the effects of impact of the intact vehicle as a function of failure time. The intact impact debris	Recommend revision by joint FAA/Industry committee	Range safety subcontractors have performed detailed debris impact and risk assessment analyses for the launch area using the basic debris models provided by

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analysis must identify the trinitrotoluene (TNT) yield of impact explosions, and the numbers of fragments projected from all such explosions, including non-launch vehicle ejecta and the blast overpressure radius. The TNT yield of impact explosion may be estimated from several models. The input to these models must include the propellant weight at impact, the impact speed, the orientation of the propellant, and the impacted surface material. Figure 417.209-1 shows the generic relationship between impact speed and TNT yield. A launch operator shall identify the impact yield relationship for its launch vehicle propellant for use in the debris analysis.		the launch operator. The evaluation of the TNT yield of impact explosions, and the effects of the intact impact are included in the range safety subcontractor analyses. It would be a major burden to a launch operator to develop the capability to duplicate the analyses performed by the range subcontractors.
64001 **§ 417.209 Debris Analysis.** (c) Debris model. (5) Fragment ballistic coefficient. A debris model must include the axial, transverse, and tumble orientation ballistic coefficient for each fragment's projected area as described in paragraph (c)(8) of this section.	Recommend revision by joint FAA/Industry committee	Launch operators typically calculate average ballistic coefficients. Range safety subcontractors have calculated the axial, transverse, and tumble ballistic coefficients for their launch area debris risk assessment analyses.
64001 **§ 417.209 Debris Analysis.** (c) Debris model. (7) Fragment imparted velocity. A debris model must include the maximum velocity imparted to each fragment due to potential explosion or pressure rupture. Unless otherwise defined by the launch operator, the velocity shall be modeled with a Maxwellian distribution with the specified maximum value equal to the 97th percentile. If the velocity distribution is different than the Maxwellian, a launch operator shall define the	Recommend revision by joint FAA/Industry committee	Fragment imparted velocities have been calculated based on a different and much more simple, but conservative, methodology. If the current methodology were not acceptable, changing this methodology would result in yet another burden to the launch operator.

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distribution, including whether the specified maximum value is interpreted as a fixed value with no uncertainty.		
64001 **§ 417.209 Debris Analysis.** (c) Debris model. (9) Fragment effective casualty area. A debris model must identify the effective casualty area of each debris fragment. For inert fragments and non-explosive propellant fragments the casualty area must account for the size of the fragment, the path angle of the fragment trajectory at impact, the effects of slide, bounce and splatter produced from hard and soft surfaces, and whether a non-explosive propellant fragment is contained or un-contained. For explosive propellant fragments the effective casualty area must account for blast overpressure, non-explosive remains, ejecta originating from the impact location, and whether the propellant fragment is contained or un-contained. For other non-inert fragments, such as toxic or radioactive fragments, the effective casualty area must account for the diffusion, dispersion, deposition, radiation or other hazard exposure characteristics of the non-inert debris and must be a circle that is defined by a hazard radius for the non-inert fragment.	Recommend revision by joint FAA/Industry committee	Launch operator debris model casualty areas are typically calculated much more simply to support downrange debris risk assessment analyses. Range safety subcontractors have calculated detailed casualty areas in order to perform detailed debris impact and risk assessment analyses for the launch area. It would be a major burden to a launch operator to develop the capability to duplicate the analyses performed by the range subcontractors.
64001 **§ 417.209 Debris analysis.** (c) Debris Model (11) Fragment classes. (ii) A launch operator shall use the debris subsonic ballistic coefficient (β_{sub}) as the secondary parameter for categorizing fragments. A launch operator shall keep the difference of the smallest $\log_{10}(\beta_{sub})$ value	Recommend revision by joint FAA/Industry committee	The requirement for limiting ballistic coefficient values in each class based on the difference of the smallest $\log_{10}(\beta_{sub})$ value from the largest $\log_{10}(\beta_{sub})$ value is new. This requirement will result in more debris

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from the largest $\log_{10}(\beta_{sub})$ value in a class less than 0.5.		coefficient groups than launch operators typically uses for downrange debris risk assessments.
64001 **§ 417.209 Debris analysis.** (c) Debris Model (11) Fragment classes. (iii) A launch operator shall use the breakup-imparted velocity (ΔV) as the tertiary parameter for categorizing fragments. Fragments shall be categorized as a function of the range of ΔV for the fragments within a class and the class's median subsonic ballistic coefficient. For each class, a launch operator shall keep the ratio of the maximum breakup-imparted velocity (ΔV_{max}) to minimum breakup-imparted velocity (ΔV_{min}) within the following bound: $\frac{\Delta V_{max}}{\Delta V_{min}} < \frac{5}{1+\log_{10}(\beta'_{sub})}$ Where: β'_{sub} is the median subsonic ballistic coefficient for the fragments in a class.	Recommend revision by joint FAA/Industry committee	The requirement to maintain the ΔV_{max} to ΔV_{min} ratio is new.
64001 **§ 417.209 Debris Analysis.** (d) Jettisoned body model. A launch operator's debris analysis must produce a jettisoned body model of the launch vehicle debris resulting from scheduled launch vehicle events for use as input to other	(d) Jettisoned body model. A launch operator's debris analysis must produce a jettisoned body model of the launch vehicle debris resulting from scheduled launch vehicle events for use as input to other	The new wording removes the implication that the launch operator will perform the flight safety limits, hazard areas, and debris risk analyses normally performed by range safety organizations for launches

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analyses, such as the flight safety limits, hazard areas, and debris risk analyses. Jettisoned bodies include, but need not be limited to, stages, payload fairings, thrust reversal ports, solid rocket motors, attach fittings and associated hardware components. A jettisoned body model must include, but need not be limited to the following:	analyses. ~~such as the flight safety limits, hazard areas, and debris risk analyses.~~ Jettisoned bodies include, but need not be limited to, stages, payload fairings, thrust reversal ports, solid rocket motors, attach fittings and associated hardware components. A jettisoned body model must include, but need not be limited to the following:	from federal ranges without exempting the launch operator from performing those analyses for launches at non-federal ranges.
64001 **§ 417.209 Debris Analysis.** (d) Jettisoned body model. (6) Ballistic coefficient. The axial, transverse, and tumble orientation ballistic coefficient for each fragment's projected area as identified in accordance with paragraph (d)(5) of this section.	Recommend revision by joint FAA/Industry committee	Launch operators typically calculate average ballistic coefficients for tumbling or, if necessary, trim conditions.
64001 **§ 417.209 Debris analysis.** (e) Debris analysis products. A launch operator shall submit the products of its debris analysis to the FAA in accordance with § 417.203(c). Those products shall include the following:	(e) Debris analysis products. A launch operator shall submit the products of its debris analysis to the FAA in accordance with § 417.203(c). **Debris analysis products previously accepted by the FAA or range safety organizations at the federal launch sites shall still be acceptable to the FAA or the range safety organizations at the federal launch sites. For launches from existing federal ranges, the launch operator is only required to submit the debris analysis products to the range safety organization at the federal launch site, with copies available to the FAA.** Those products shall include the following:	Launch vehicle programs that have submitted acceptable debris analysis data to the FAA or the range safety organizations at the federal launch sites should not be required to re-perform the analysis, especially if the analysis has already been used to support launches. The existing range safety organizations at each launch site should continue to perform their current roles in defining launch operator analysis requirements and evaluating and approving the analysis products. Copies of launch operator flight analysis products should be available to the FAA.
64001 **§ 417.209 Debris analysis.** (e) Debris analysis products. (3) Minimum distance fragment. As a function of	Recommend revision by joint FAA/Industry committee	Launch operators do not provide this data, and it is not required by the range safety organizations at federal

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breakup time, identification of the fragment that, in the absence of winds, will travel the least distance in comparison to all other fragments.		required by the range safety organizations at federal launch sites.
64001 **§ 417.209 Debris analysis.** (e) Debris analysis products. (4) Intact impact TNT yield. For an intact impact of a launch vehicle, for each failure time, a launch operator shall identify the TNT yield of each impact explosion, blast overpressure radius, and the number of fragments projected from all such explosions including non-launch vehicle ejecta.	Recommend revision by joint FAA/Industry committee	Range subcontractors, not the launch operator, perform this task. Developing the capability to perform this task would be a major burden to launch operators.
64002 **§ 417.209 Debris analysis.** (e) Debris analysis products. (5) Maximum distance fragment. As a function of breakup time, identification of the fragment that, in the absence of winds, will travel the greatest distance in comparison to all other fragments.	Recommend revision by joint FAA/Industry committee	Launch operators do not provide this data, and it is not required by the range safety organizations at federal launch sites.
64002 **§ 417.211 Flight control lines analysis** (a) General. A launch operator shall determine the geographic placement of flight control lines that define the region over which a launch vehicle will be allowed to fly and where any debris resulting from normal flight and any launch vehicle malfunction will be allowed to impact. A launch operator shall implement flight safety limits in accordance with § 417.213 and flight termination rules in accordance with § 417.113, to ensure that debris associated with a malfunctioning launch vehicle does not impact any populated or other protected area outside the flight control lines. Flight over any populated or other protected area may be	(a) General. **For applicable launch vehicles**, a launch operator shall determine the geographic placement of flight control lines that define the region over which a launch vehicle will be allowed to fly and where any debris resulting from normal flight and any launch vehicle malfunction will be allowed to impact. A launch operator shall implement flight safety limits in accordance with § 417.213 and flight termination rules in accordance with § 417.113, to ensure that debris associated with a malfunctioning launch vehicle does not impact any populated or other protected area outside the flight control lines. Flight over any populated or other	The requirement should not apply to vehicles that do not have a commanded flight termination system, or launch from an extremely remote location, like Sea Launch. Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges.

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over any populated or other protected area may be performed when a launch operator establishes a gate through a flight control line in accordance with § 417.219.	control lines. Flight over any populated or other protected area may be performed when a launch operator establishes a gate through a flight control line in accordance with § 417.219. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.
64006 **§ 417.213 Flight safety limits analysis** (a) General. A launch operator shall perform a flight safety limits analysis to establish criteria for terminating a malfunctioning launch vehicle's flight. The criteria must ensure that the launch vehicle's debris impact dispersion does not extend beyond the flight control lines established in accordance with § 417.211. A launch operator's flight safety limits analysis must determine the temporal and geometric extents of a launch vehicle's debris impact dispersion on the Earth's surface resulting from any planned debris impacts and potential debris impacts created by unplanned events for any point during flight. At any time during a launch vehicle flight, a launch operator's flight safety limits must provide for the identification of a launch vehicle malfunction and the termination of flight before any adverse effects of the resulting debris could reach outside the flight control lines.	(a) General. **For applicable launch vehicles**, a launch operator shall perform a flight safety limits analysis to establish criteria for terminating a malfunctioning launch vehicle's flight. The criteria must ensure that the launch vehicle's debris impact dispersion does not extend beyond the flight control lines established in accordance with § 417.211. A launch operator's flight safety limits analysis must determine the temporal and geometric extents of a launch vehicle's debris impact dispersion on the Earth's surface resulting from any planned debris impacts and potential debris impacts created by unplanned events for any point during flight. At any time during a launch vehicle flight, a launch operator's flight safety limits must provide for the identification of a launch vehicle malfunction and the termination of flight before any adverse effects of the resulting debris could reach outside the flight control lines. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	The requirement should not apply to vehicles that do not have a commanded flight termination system, or launch from an extremely remote location, like Sea Launch. Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.
64007 **§ 417.215 Straight-up time analysis**		

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(a) General. A launch operator shall perform a straight-up time analysis to determine the latest time-after-liftoff by which flight termination must be initiated were a launch vehicle to malfunction and fly a vertical or near vertical trajectory (a straight-up trajectory) rather than follow a normal trajectory downrange.	(a) General. **For applicable launch vehicles,** a launch operator shall perform a straight-up time analysis to determine the latest time-after-liftoff by which flight termination must be initiated were a launch vehicle to malfunction and fly a vertical or near vertical trajectory (a straight-up trajectory) rather than follow a normal trajectory downrange. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	The requirement should not apply to vehicles that do not have a commanded flight termination system, or launch from an extremely remote location, like Sea Launch. Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.
64007 **§ 417.217 Wind analysis** (a) General. A launch operator shall perform a wind analysis to determine wind magnitude and direction as a function of altitude for the air space through which its launch vehicle will fly and for the airspace through which malfunction and jettisoned debris will travel. The products of this analysis must satisfy the input requirements of the other flight safety analyses that are dependent on wind data. A launch operator operating a suborbital launch vehicle flown with a wind weighting safety system shall meet the applicable requirements in this section and the wind analysis requirements of § 417.235(e) and appendix C of this part.	(a) General. A launch operator shall perform a wind analysis to determine wind magnitude and direction as a function of altitude for the air space through which its launch vehicle will fly and for the airspace through which malfunction and jettisoned debris will travel. The products of this analysis must satisfy the input requirements of the other flight safety analyses that are dependent on wind data. A launch operator operating a suborbital launch vehicle flown with a wind weighting safety system shall meet the applicable requirements in this section and the wind analysis requirements of § 417.235(e) and appendix C of this part. **For launches from existing federal ranges, the range safety organization at the launch site will**	Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.

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	perform this analysis using the methods that have been established at the federal launch site.	safety.
64008 **§ 417.217 Wind analysis** (c) (4) Measured and forecasted winds. (ii) Downrange area forecasted winds. Using the last measured wind, a launch operator shall forecast for any predicted impact time, the downrange area wind speed and wind direction as a function of altitude in the region of the no-wind three-sigma impact dispersion of each normally jettisoned stage or component.	Recommend revision by joint FAA/Industry committee	This requirement is impractical for all launches with jettisoned body impacts occurring at significant downrange distances from the launch site, since no wind data is available for the downrange locations where the jettisoned bodies are predicted to impact. This requirement implies that jettisoned body impacts must be calculated on launch day, which is not a standard practice for all launch programs. Also, if sufficiently conservative winds are used in the jettisoned body impact analysis, the actual downrange winds will not matter.
64008 **§ 417.217 Wind analysis** (c) (5) Wind data for trajectory analysis. (i) Three-sigma maximum performance trajectory and fuel exhaustion trajectory. For this trajectory, a wind analysis must determine the wind magnitude for each trajectory computation point, in the azimuthal direction zero degrees to the projection of the launch vehicle velocity vector azimuth into the horizontal plane that is tangent to the ellipsoidal Earth model at the launch vehicle sub-vehicle point.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently.

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		trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
64008 **§ 417.217 Wind analysis** (c) (5) Wind data for trajectory analysis. (ii) Three-sigma minimum performance trajectory. For this trajectory, a wind analysis must determine the wind magnitude at each trajectory computation point, in the azimuthal direction 180 degrees to the projection of the launch vehicle velocity vector azimuth into the horizontal plane that is tangent to the ellipsoidal Earth model at the launch vehicle sub-vehicle point.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
64008 **§ 417.217 Wind analysis** (c) (5) Wind data for trajectory analysis. (iii) Three-sigma left lateral trajectory. For this trajectory, a wind analysis must determine the wind magnitude at each trajectory computation point, in the azimuthal direction 90 degrees counter-clockwise to the projection of the launch vehicle velocity vector azimuth into the horizontal plane that is tangent to the ellipsoidal Earth model at the launch vehicle's sub-vehicle point.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.

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64008 **§ 417.217 Wind analysis** (c) (5) Wind data for trajectory analysis. (iii) Three-sigma right lateral trajectory. For this trajectory, a wind analysis must determine the wind magnitude at each trajectory computation point, in the azimuthal direction 90 degrees clockwise to the projection of the launch vehicle velocity vector azimuth into the horizontal plane that is tangent to the ellipsoidal Earth model at the launch vehicle's sub-vehicle point.	Recommend revision by joint FAA/Industry committee	Each launch operator has employed wind statistics primarily for trajectory analyses related to mission design and mission success. These wind statistics are not necessarily the same wind statistics used by the range safety organizations for establishing flight control lines and flight safety limits. It is not necessary to force launch operators to use the same wind statistics used by the ranges, especially for the generation of three-sigma trajectories used to support analyses currently performed by the existing range safety organization at a federal launch site.
64008 **§ 417.217 Wind analysis** (d) Wind analysis products. The products of wind analysis to be submitted to the FAA in accordance with § 417.203(c) must include the following:	(d) Wind analysis products. **For launches from only non-federal ranges**, the products of wind analysis to be submitted to the FAA in accordance with § 417.203(c) must include the following:	Launch operators should not be required to submit products of analysis to the FAA when the analysis is performed by range safety organizations at existing federal launch sites.
64009 **§ 417.219 No longer terminate (gate) analysis** (a) General. A launch operator shall perform an analysis to determine the portion, referred to as a gate, of a flight control line or other flight safety limit boundary, through which a launch vehicle's tracking icon is allowed to proceed without a launch operator being required to terminate flight. A tracking icon is the representation of a launch vehicle's present position or instantaneous impact point position displayed to a flight safety official at the flight safety official console during real-time tracking of the launch vehicle's flight. A launch	(a) General. A launch operator shall perform an analysis to determine the portion, referred to as a gate, of a flight control line or other flight safety limit boundary, through which a launch vehicle's tracking icon is allowed to proceed without a launch operator being required to terminate flight. A tracking icon is the representation of a launch vehicle's present position or instantaneous impact point position displayed to a flight safety official at the flight safety official console during real-time tracking of the launch vehicle's flight. A launch	Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. The range safety organization at each federal range, with support from the launch operator, should continue to determine the requirements and characteristics for

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operator may use a gate for planned launch vehicle flight over a populated or other protected area only if the launch can be accomplished while meeting the public risk criteria of § 417.107(b).	operator may use a gate for planned launch vehicle flight over a populated or other protected area only if the launch can be accomplished while meeting the public risk criteria of § 417.107(b). **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	any destruct line gate in support of any launch from the federal launch site. The gate location and width should be calculated by the range safety organization based on the policies, procedures, and practices of the applicable federal range, and factor in, whenever possible, any launch contractor mission success requirements or enhancements; this has been done successfully, e.g., at the Eastern Range with respect to the African Gate, and there is no reason for the FAA to impose any new gate requirements or analysis methodologies. Downrange assets, such as the facilities at Antiqua, should be retained in order to give the federal ranges as much flexibility as possible in calculating a downrange gate location and width, as well as provide the tracking and telemetry data required by launch operators.
64011 **§ 417.221 Data loss flight time analysis** (a) General. A launch operator shall perform a data loss flight time analysis to determine the shortest elapsed thrusting time during which a launch vehicle can move from its normal trajectory to a condition where public endangerment is possible. A data loss flight time analysis must also determine an earliest destruct time, which is the earliest time after liftoff that public endangerment is possible, and a no longer endanger time, which is the time after liftoff that public endangerment is no longer possible from that time forward. Data loss flight times are used following any malfunction that prevents a flight control officer from knowing the location or	(a) General. A launch operator shall perform a data loss flight time analysis to determine the shortest elapsed thrusting time during which a launch vehicle can move from its normal trajectory to a condition where public endangerment is possible. A data loss flight time analysis must also determine an earliest destruct time, which is the earliest time after liftoff that public endangerment is possible, and a no longer endanger time, which is the time after liftoff that public endangerment is no longer possible from that time forward. Data loss flight times are used following any malfunction that prevents a flight control officer from knowing the	Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and

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behavior of a launch vehicle and that occurs during flight before the no longer endanger time is reached. A launch operator shall incorporate the results of its data loss flight time analysis into its flight termination rules in accordance with § 417.113(c).	location or behavior of a launch vehicle and that occurs during flight before the no longer endanger time is reached. A launch operator shall incorporate the results of its data loss flight time analysis into its flight termination rules in accordance with § 417.113(c). **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	would result in decreased launch availability and increased cost with no significant benefit to public safety.
64012 **§ 417.223 Time delay analysis** (a) General. A launch operator shall perform a time delay analysis to determine the mean elapsed time between the start of a launch vehicle malfunction and the final commanded flight termination. The time delay must include a flight safety official's decision and reaction time. A launch operator shall also determine the time delay plus and minus three-sigma values relative to the mean time delay.	(a) General. A launch operator shall perform a time delay analysis to determine the mean elapsed time between the start of a launch vehicle malfunction and the final commanded flight termination. The time delay must include a flight safety official's decision and reaction time. A launch operator shall also determine the time delay plus and minus three-sigma values relative to the mean time delay. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.
64012 **§ 417.225 Flight hazard areas analysis** (a) General. A launch operator shall perform a flight hazard areas analysis to determine the regions of land, sea, and air (hazard areas) exposed to the potential adverse effects of planned and unplanned launch vehicle flight events and that must be monitored, controlled, or evacuated in order to ensure public safety. The flight hazard area	(a) General. A launch operator shall perform a flight hazard areas analysis to determine the regions of land, sea, and air (hazard areas) exposed to the potential adverse effects of planned and unplanned launch vehicle flight events and that must be monitored, controlled, or evacuated in order to ensure public safety. The flight hazard area	Range safety personnel at existing federal ranges exclusively perform this analysis in support of launch operations. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges.

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requirements of this section apply to orbital and ballistic launch vehicles that use a flight termination system to protect the public. Flight hazard area requirements that apply to launch of an unguided suborbital rocket that use a wind weighting safety system are contained in § 417.235. A launch operator's flight hazard areas analysis for an orbital launch must satisfy the following:	requirements of this section apply to orbital and ballistic launch vehicles that use a flight termination system to protect the public. Flight hazard area requirements that apply to launch of an unguided suborbital rocket that use a wind weighting safety system are contained in § 417.235. **Alternate flight hazard analysis methodologies must be approved by the FAA. For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.** ~~A launch operator's flight hazard areas analysis for an orbital launch must satisfy the following:~~	Also, there are concerns that the differences in the requirements and methodologies proposed by the FAA in these sections vs. the requirements and methodologies currently in place at the existing ranges would result in decreased launch availability and increased cost with no significant benefit to public safety.
64013 **§ 417.225 Flight hazard areas analysis** (c) Flight corridor. For regions outside the flight hazard area, a launch operator shall define a flight corridor, which extends downrange from a flight hazard area as illustrated by figure 417.225-3. A flight corridor must be bounded by the flight control lines established in accordance with § 417.211, and must include any land overflight permitted by a gate established in accordance with § 417.219. Any land overflight area must be bounded by a five-sigma cross range trajectory dispersion about the nominal launch vehicle trajectory. A flight corridor must extend for all downrange positions from the flight hazard area to the no longer endanger time determined in accordance with § 417.221(c).	Recommend revision by joint FAA/Industry committee	Why is there a requirement for a five-sigma cross range bound about the nominal vehicle trajectory? This is more restrictive than the usual three-sigma bound used in flight safety analyses.
64015 **§ 417.225 Flight hazard areas analysis** (i) Flight corridor ship hazard areas. Within a flight corridor outside the flight hazard area, a launch operator shall establish a ship hazard area for each planned debris impact for the issuance of notice to mariners in accordance with § 417.121(e). The ship	Recommend revision by joint FAA/Industry committee	Federal ranges do not calculate ship-hit probabilities for jettisoned body impact locations outside the flight hazard area, nor is any surveillance performed in these areas.

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mariners in accordance with § 417.121(e). The ship hazard area must consist of an area centered on the planned impact point and defined by the larger of the three-sigma impact dispersion ellipse or an ellipse with the same semi-major and semi-minor axis ratio as the impact dispersion, where, if a ship were located on the boundary of the ellipse, the probability of hitting the ship would be less than or equal to 1×10^{-5}. A launch operator shall determine ship hazard areas for planned debris impacts using the methodologies contained in paragraphs C417.5(h) and C417.5(i) of appendix C, which apply to both orbital and suborbital launch unless the launch operator demonstrates, clearly and convincingly, through the licensing process that another methodology achieves an equivalent level of safety. A launch operator shall determine if surveillance of a ship hazard area is required in accordance with paragraph C417.5(g) of appendix C of this part.		There is much concern about any proposed changes to the current practice of ship surveillance by federal ranges that would result in decreased launch availability and increased cost without a significant increase in public safety. The proposed FAA requirement to calculate downrange ship-hit probabilities and survey downrange jettisoned body impact areas on launch day is impractical for any launch where the jettisoned bodies nominally impact many miles downrange of the flight hazard area; this is why the federal ranges do not currently perform ship surveillance outside of the flight hazard area. Surveillance resources, such as ships and aircraft, are extremely expensive, and enough ships and aircraft would be needed to patrol two or three broad ocean areas of significant size, which would be cost-prohibitive for commercial launch operators. Besides the added risk to the surveillance ship and air crews due to potential accidents, launch availability is significantly decreased if downrange surveillance is mandatory, since the surveillance resources, for reasons such as severe downrange weather conditions or mechanical problems, may not be available on launch day. Assuming valid ship density data are available to perform ship impact probability calculations, is the level of confidence in the resulting calculations, assuming the results reveal no downrange surveillance is required, significantly improving the protection provided by the NOTAM process? If the results of the calculation indicate that surveillance is required, can launch operators provide reasonable launch costs to commercial customers and stay competitive in the commercial launch business? The launch operators believe the answer to both questions is "No", and the current ship surveillance practices at the federal ranges should remain unchanged.

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64017 **§ 417.227 Debris risk analysis.** (a) General. A launch operator shall perform a debris risk analysis to determine the expected average number of casualties (E_C) to the collective members of the public exposed to inert and explosive debris hazards from the proposed flight of a launch vehicle. The results of the debris risk analysis must be included in the launch operator's demonstration of compliance with the public risk criteria required by § 417.107 (b). A launch operator's debris risk analysis must include an evaluation of risk to populations on land, including regions of launch vehicle flight following passage through any gate in a flight safety limit boundary established in accordance with § 417.219. The debris risk analysis requirements of this section apply to all launches.	(a) General. A launch operator shall perform a debris risk analysis to determine the expected average number of casualties (E_C) to the collective members of the public exposed to inert and explosive debris hazards from the proposed flight of a launch vehicle. The results of the debris risk analysis must be included in the launch operator's demonstration of compliance with the public risk criteria required by § 417.107 (b). A launch operator's debris risk analysis must include an evaluation of risk to populations on land, including regions of launch vehicle flight following passage through any gate in a flight safety limit boundary established in accordance with § 417.219. ~~The debris risk analysis requirements of this section apply to all launches.~~	Some requirements in this section may not be applicable for all launch vehicles, particularly Sea Launch. Other requirements should not be applicable for launch operators using existing federal ranges, since the range safety organizations at the federal ranges have already established debris risk analysis requirements for themselves and for the launch operators.
64017 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (1) A launch operator shall use the methodologies and equations provided in appendix B of this part when performing a debris risk analysis unless, through the licensing process, the launch operator provides a clear and convincing demonstration that an alternate method provides an equivalent level of safety.	(1) A launch operator shall use the methodologies and equations provided in appendix B of this part when performing a debris risk analysis unless, through the licensing process, the launch operator provides a clear and convincing demonstration that an alternate method provides an equivalent level of safety. **For launches from existing federal ranges, the range safety organization at the launch site shall determine the launch operator**	The launch operator only performs debris risk assessment analysis for downrange populated areas that may be hazarded by a trajectory. The range safety organization at the federal launch site performs debris risk assessment analysis for the launch area and flight hazard area. The launch operator downrange debris risk assessment must be approved by the range safety organization at the federal launch site to obtain flight plan approval.

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	requirements to be met for debris risk assessment analysis and determine the acceptability of this analysis.	plan approval. The above process has worked well for public and property protection and launch operators. If this process is changed, the launch operator will incur a significant cost impact by being forced to both develop and perform more analyses, or directly contract the range safety organization at the launch site to perform the analyses they already are doing.
64017 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (2) (i) The overflight of populations located outside a flight hazard area and inside any flight control lines established in accordance with § 417.211.	Recommend revision by joint FAA/Industry committee	The range safety organizations at the federal ranges, and their subcontractors, perform launch area and flight hazard area debris risk analyses. Launch operators have been responsible for downrange debris risks, typically beginning at 100 nautical miles from the launch site, depending upon which federal range is supporting the launch.
64017 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (2) (ii) All populations located within five-sigma left and right crossrange of a nominal trajectory instantaneous impact point ground trace and within five-sigma of each planned nominal debris impact.	(ii) **All populations located left and right crossrange of a nominal trajectory instantaneous impact point ground trace with a combined Ec that significantly increases the previously calculated total Ec.**	The distance left and right of the nominal instantaneous impact point trace for population centers should not be fixed for downrange debris risk assessments. It should be up to the analyst, based on the change in the total Ec due to the inclusion of more distant population centers, to determine if including those populations is necessary. Also, the five-sigma limit is much more conservative

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		than the usual three-sigma limit used in flight safety analyses.
64017 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (5) (ii) The dispersion for each debris class must account for the position and velocity state vector dispersions at breakup, the delta velocities incurred from breakup produced by either aerodynamic forces or explosive forces from flight termination system activation, the variance produced by winds, variance in ballistic coefficient for each debris class, and any other dispersion variances.	(ii) The dispersion for each debris class must account for the position and velocity state vector dispersions at breakup, the delta velocities incurred from breakup produced by either aerodynamic forces or explosive forces from flight termination system activation, ~~the variance produced by winds,~~ **the effect of winds on both the ascent trajectory state vector at breakup and the descending debris piece impact location**, variance in ballistic coefficient for each debris class, and any other significant dispersions.	The added words clarify the wind dispersion effects to be included in the analysis.
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (6) (i) For a launch vehicle with fewer than 15 flights, a launch operator shall use an overall launch vehicle failure probability of 0.31.	(i) For a launch vehicle with fewer than 15 flights, a launch operator shall use ~~an overall launch vehicle failure probability of 0.31.~~ a failure probability established jointly by the FAA, the range safety organizations at federal launch sites, and the launch operator.	Launch operators, the FAA, and the range safety organizations at the federal ranges should derive failure probabilities jointly. Given an overall launch vehicle failure probability of 0.31, meeting a total mission Ec requirement of 30×10^{-6} will be impossible for most orbital missions flown by "new" vehicles.

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64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (6) (ii) For a launch vehicle with at least 15 flights, but fewer than 30 flights, a launch operator shall use an overall launch vehicle failure probability of 0.10 or the empirical failure probability, whichever is greater.	(ii) For a launch vehicle with at least 15 flights, but fewer than 30 flights, a launch operator shall use ~~an overall launch vehicle~~ a failure probability ~~of 0.10 or the empirical failure probability, whichever is greater.~~ established jointly by the FAA, the range safety organizations at federal launch sites, and the launch operator.	Launch operators, the FAA, and the range safety organizations at the federal ranges should derive failure probabilities jointly. Given an overall launch vehicle failure probability of 0.10, meeting the total Ec requirement of 30×10^{-6} will be impossible for most orbital missions flown by this category of vehicles. Also, what method will be used to determine the empirical failure probability? What is the definition of a failure? Why completely ignore engineering reliability?
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (6) (iii) For a launch vehicle with 30 or more flights, a launch operator shall use the empirical failure probability determined from the actual flight history.	(iii) For a launch vehicle with 30 or more flights, a launch operator shall use the ~~empirical~~ failure probability ~~determined from the actual flight history.~~ established jointly by the FAA, the range safety organizations at federal launch sites, and the launch operator.	Launch operators, the FAA, and the range safety organizations at the federal ranges should derive failure probabilities jointly. It is extremely unlikely that empirical failure probabilities, based only on flight history, will produce a total mission Ec less than 30×10^{-6} for this category of vehicles. Also, what method will be used to determine the

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		empirical failure probability? What is the definition of a failure? Why completely ignore engineering reliability?
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (6) (iv) For a launch vehicle with a previously established failure probability that undergoes a modification to a stage, that could affect the reliability of that stage, the launch operator shall apply the previously established failure probability to all unmodified stages and the failure probability requirements of (i) through (iii) of this paragraph to the modified stage.	(iv) For a launch vehicle with a previously established failure probability that undergoes a modification to a stage, that could **negatively** affect the reliability of that stage, the launch operator shall apply the previously established failure probability to all unmodified stages and the failure probability requirements of (i) through (iii) of this paragraph to the modified stage.	Design modifications that can be demonstrated as improvements to the stage reliability, e.g., added redundancy, should not force the stage failure probability to be increased. Note that failure probability cannot immediately be reduced for demonstrated improvements to stage reliability when basing failure probability purely on launch history. Incorporating engineering reliability into the calculation of failure probability would help correct this situation.
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (10) A debris risk analysis must account for current population density data obtained from a current population database for the region being evaluated or by estimating the current population using traditional population growth rate equations applied to the most current historical data available. A debris risk analysis must account for the population density of population centers whose grid dimensions on Earth's surface do not exceed 1° latitude by 1° longitude. A debris risk analysis must account for any city with population equal to or greater than 25,000 as an individual population center.	(10) **A debris risk analysis must utilize the population database and population growth rate equations available from the FAA or the applicable range safety organization at the launch site.**	Since differences in population data can significantly affect the Ec calculation, a specific population database and specific population growth rate equations should be specified and provided to launch operators.

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64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (11) For a launch vehicle that uses a flight termination system, a debris risk analysis must account for the collective risk to any populations outside the flight control lines in the area surrounding the launch site during flight, including people who will be at any public launch viewing area during flight. A launch operator shall use the screening methodology provided in § B417.7 of appendix B of this part to identify any populations for which the launch operator shall perform debris risk analysis. For such populations, in addition to the constraints listed in paragraphs (b)(1) through (b)(10) of this section, a launch operator's debris risk analysis must account for the following:	(11) For a launch vehicle that uses a flight termination system, a debris risk analysis must account for the collective risk to any populations outside the flight control lines in the area surrounding the launch site during flight, including people who will be at any public launch viewing area during flight. A launch operator shall use the screening methodology provided in § B417.7 of appendix B of this part to identify any populations for which the launch operator shall perform debris risk analysis. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.** For such populations, in addition to the constraints listed in paragraphs (b)(1) through (b)(10) of this section, a launch operator's debris risk analysis must account for the following:	This paragraph pertains to analyses performed exclusively by range safety personnel at existing ranges in support of launch operations. Developing the capability to perform this task would be a major burden to the launch operator.
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (11) (i) The probability of a launch vehicle failure that would result in debris impact in the areas outside the flight control lines.	Recommend revision by joint FAA/Industry committee	This paragraph pertains to analyses performed exclusively by range safety personnel at existing ranges in support of launch operations. Developing the capability to perform this task would be a major burden to the launch operator.
64018 **§ 417.227 Debris risk analysis.**		

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
(b) Debris Risk Analysis Constraints. (11) (ii) The failure rate of the launch operator's flight safety system. A launch operator may use a flight safety system failure rate of 0.002 if the flight safety system is in compliance with the flight safety system requirements of subpart D of this part. For an alternate flight safety system approved in accordance with § 417.107(a)(3), the launch operator shall demonstrate the validity of the probability of failure on a case-by-case basis through the licensing process.	Recommend revision by joint FAA/Industry committee	This paragraph pertains to analyses performed exclusively by range safety personnel at existing ranges in support of launch operations. Developing the capability to perform this task would be a major burden to the launch operator.
64018 **§ 417.227 Debris risk analysis.** (b) Debris Risk Analysis Constraints. (11) (iii) Current population density data for the areas being evaluated that are outside the flight control lines. This data shall be determined based on the most current census data and projections for the day and time of flight.	Recommend revision by joint FAA/Industry committee	This paragraph pertains to analyses performed exclusively by range safety personnel at existing ranges in support of launch operations. Developing the capability to perform this task would be a major burden to the launch operator.
64018 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. The products of a launch operator's debris risk analysis to be submitted in accordance with § 417.203(c) must include the following:	(c) Debris risk analysis products. **For launches from federal ranges, the launch operator debris risk analysis products must be submitted to the range safety organization per the requirements of that organization, with copies available to the FAA. For launches from non-federal ranges,** the products of a launch operator's debris risk analysis to be submitted in accordance with § 417.203(c) must include the following:	The existing range safety organizations at federal launch sites should continue to perform their current functions. Copies of launch operator flight safety submittals to the range safety organization should be available to the FAA.
64018		

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
§ 417.227 Debris risk analysis. (c) Debris risk analysis products. (1) A debris risk analysis report that provides the analysis input data, probabilistic risk determination methods, sample computations, and text or graphical charts that characterize the public risk to geographical areas for each launch.	(1) A debris risk analysis report that provides the analysis input data, probabilistic risk determination methods, sample computations, and text or graphical charts that characterize the public risk to geographical areas for each launch, **or series of similar launches**.	For similar, or identical missions, the downrange debris risk analysis may not need to be performed more than once, especially if extra conservatism is incorporated in the analysis to bound any anticipated differences within the similar group of launches.
64018 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (2) Geographic data showing the launch vehicle nominal, five-sigma left-crossrange and five-sigma right-crossrange instantaneous impact point ground traces; all exclusion zones relative to the instantaneous impact point ground traces; and populated areas included in the debris risk analysis.	(2) Geographic data showing the launch vehicle nominal **instantaneous impact point trace, the maximum left-crossrange and maximum right-crossrange bounding limits for populated areas included in the debris risk analysis,** ~~all exclusion zones relative to the instantaneous impact point ground traces:~~ and populated areas included in the debris risk analysis. **For launches from non-federal ranges, all exclusion zones relative to the instantaneous impact point ground traces must also be submitted.**	The 5-sigma limit for populated areas considered in the analysis is replaced with the actual limit for populated areas used in the analysis. The actual limit is derived from the total Ec not changing significantly by the inclusion of more populated areas located further crossrange from the nominal instantaneous impact point trace. The results of analyses performed by range safety organizations at federal launch sites do not have to be submitted to the FAA by the launch operator.
64018 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (3) A discussion of each launch vehicle failure scenario addressed in the analysis and the probability of occurrence, which may vary with flight time, for each failure scenario. This information must include a failure scenario where a launch vehicle flies within normal limits until some malfunction causes spontaneous breakup or results in a commanded flight termination. For a launch that employs a	Recommend revision by joint FAA/Industry committee	The underlined words refer to an analysis performed by the range safety organization, or their subcontractors, at federal ranges. Attempting to perform the analysis would put a major burden on the launch operator.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
flight safety system, this information must also describe the most likely launch vehicle failure scenario and probability of occurrence for a random attitude failure as described in § B417.7(e) of appendix B of this part.		
64018 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (4) A population model applicable to the launch overflight regions that contains the following: area identification, location of the center of each population cell by geodetic latitude and longitude, total area, and number of persons in each population cell.	(4) **Data from the supplied** population model applicable to the launch overflight regions that contains the following: area identification, location of the center of each population cell by geodetic latitude and longitude, total area, and number of persons in each population cell.	Since differences in population data can significantly affect the Ec calculation, a specific population database and specific population growth rate equations should be specified and provided to launch operators.
64018 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (5) A description of the launch vehicle, including general information concerning the nature and purpose of the launch and an overview of the launch vehicle, including a scaled diagram of the general arrangement and dimensions of the vehicle. A launch operator's debris risk analysis products may reference other documentation submitted to the FAA containing this information. The launch operator shall identify any changes in the launch vehicle description from that submitted during the licensing process according to § 415.109(e). The description must include:	(5) A description of the launch vehicle, including general information concerning the nature and purpose of the launch and an overview of the launch vehicle, including a scaled diagram of the general arrangement and dimensions of the vehicle. A launch operator's debris risk analysis products may reference other documentation submitted to the FAA**, or range safety organizations at federal launch sites,** containing this information. The launch operator shall identify any **significant** changes in the launch vehicle description from that submitted during the licensing process according to § 415.109(e). The description must include:	Descriptive documentation previously submitted by launch operators to range safety organizations at federal launch sites should be acceptable. This also clarifies that any minor changes to the launch vehicle that are unrelated to any safety analysis do not have to continuously be documented.
64019 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products.		

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
(7) (vi) Maximum impact point deviations as a function of failure time during destruct system delays. Burn rate as a function of ambient pressure.	Recommend revision by joint FAA/Industry committee	This is not included in the current launch operator hazards analysis for downrange locations; it is more critical for launch area failures, which are accounted for in the analyses performed by the range safety organization at the launch site. Additional work is required to perform this task.
64019 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (8) A launch vehicle's launch and failure history, including a summary of past vehicle performance. For a new vehicle with little or no flight history, a launch operator shall provide summaries of similar vehicles. The data shall include the launches that have occurred; launch date, location, and direction; the number that performed normally; behavior and impact location of each abnormal experience; the time, altitude, and nature of each malfunction; and descriptions of corrective actions taken, including changes in vehicle design, flight termination, and guidance and control hardware and software.	Recommend revision by joint FAA/Industry committee	Launch operators do not have a contractual requirement to maintain one database containing all the information listed in this paragraph. The launch history databases maintained for company information contain some of the data requirements listed in the paragraphs. It would be a very costly undertaking to modify the existing databases for the older launch vehicles that may be similar to the newer launch vehicles.
64019 **§ 417.227 Debris risk analysis.** (c) Debris risk analysis products. (9) Debris risk analysis products. A discussion of the analysis performed for any populations outside the flight control lines in accordance with paragraph (b)(11) of this section.	Recommend revision by joint FAA/Industry committee	The range safety personnel at existing federal ranges perform this analysis exclusively in support of launch operations. Developing the capability to perform this task would be a major burden to the launch operator.
64019 **§ 417.229 Toxic release hazard analysis.**		

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
For each launch, a launch operator shall perform a toxic release hazard analysis to determine any potential public hazards from any toxic release that will occur during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap. A launch operator shall perform a toxic release hazard analysis using the methodologies contained in appendix I of this part. A launch operator shall use the results of the toxic release hazard analysis to establish for each launch, in accordance with § 417.113(b), flight commit criteria that protect the public from a casualty caused by any potential toxic release. The public includes any members of the public on land and any waterborne vessels and aircraft that are not operated in direct support of the launch.	For each launch, a launch operator shall perform a toxic release hazard analysis to determine any potential public hazards from any toxic release that will occur during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap. A launch operator shall perform a toxic release hazard analysis using the methodologies contained in appendix I of this part. A launch operator shall use the results of the toxic release hazard analysis to establish for each launch, in accordance with § 417.113(b), flight commit criteria that protect the public from a casualty caused by any potential toxic release. The public includes any members of the public on land and any waterborne vessels and aircraft that are not operated in direct support of the launch. **For launches from existing federal ranges, the range safety organization at the launch site shall perform this analysis using the methods that have been established at the federal launch site.**	The range safety personnel at existing federal ranges, or their subcontractors, perform this analysis exclusively in support of launch operations. Launch operators do not have the resources to develop the capability to perform this analysis. It is suggested that the appropriate technical community review and approve any technical data the FAA requires a launch operator to use for this analysis, since the use of this data could lead to overly conservative analysis results that could, in turn, significantly reduce launch availability.
64019 **§ 417.231 Distant focus overpressure explosion hazard analysis.** (a) General. A launch operator shall perform a distant focus overpressure blast effects hazard analysis to demonstrate that the potential public hazard resulting from impacting explosive debris will not cause windows to break with related injuries. A launch operator shall evaluate potential distant focus overpressure blast effects hazards in accordance with the requirements of this section, which require a launch operator to employ either the deterministic analysis requirements of paragraph (b) of this section or the probabilistic analysis requirements of paragraph (c) of this section.	(a) General. A launch operator shall perform a distant focus overpressure blast effects hazard analysis to demonstrate that the potential public hazard resulting from impacting explosive debris will not cause windows to break with related injuries. A launch operator shall evaluate potential distant focus overpressure blast effects hazards in accordance with the requirements of this section, which require a launch operator to employ either the deterministic analysis requirements of paragraph (b) of this section or the probabilistic analysis requirements of paragraph (c) of this section. **For launches from existing federal ranges, the range safety organization at the launch site shall perform this analysis using the methods that have been established at the**	The range safety personnel at existing federal ranges perform this analysis exclusively in support of launch operations. Launch operators do not have the resources to develop the capability to perform this analysis. It is suggested that the appropriate technical community review and approve any technical data the FAA requires a launch operator to use for this analysis, since the use of this data could lead to overly conservative analysis results that could, in turn, significantly reduce launch availability.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
	federal launch site.	
64021 **§ 417.233 Conjunction on launch assessment.** (a) General. A licensee shall obtain a conjunction on launch assessment performed by United States Space Command. A licensee shall implement any launch waits in a planned launch window identified by the conjunction on launch assessment during which flight must not be initiated, in order to maintain a 200-kilometer separation from any inhabitable orbiting object in accordance with § 417.107. A licensee may request a conjunction on launch assessment be performed for other orbital objects to meet mission needs or to accommodate other satellite owners or operators.	(a) General. **For launches from existing federal ranges, the range safety organization at the launch site shall be responsible for determining the conjunctions on launch assessment for any inhabitable orbiting object in accordance with existing requirements, processes, and methodologies used at the federal range. Obtaining conjunctions on launch assessment for other orbital objects shall be achieved, if desired, by the existing processes and methodologies currently established by launch operators launching from federal ranges. For launches from non-federal ranges,** a licensee shall obtain a conjunction on launch assessment. **United States Space Command may perform the analysis.** A licensee shall implement any launch waits in a planned launch window identified by the conjunction on launch assessment during which flight must not be initiated, in order to maintain a 200-kilometer separation from any inhabitable orbiting object in accordance with § 417.107. A licensee may request a conjunction on launch assessment be performed for other orbital objects to meet mission needs or to accommodate other satellite owners or operators.	The task of obtaining conjunctions on launch assessment of inhabitable objects is already established at federal launch sites by the resident range safety organization. Launch operators have also established procedures to obtain conjunctions on launch assessment for other orbital objects, when desired. Therefore, there is no need for FAA regulation of the conjunction on launch assessment analyses for launches at federal ranges. There is some question as to whether or not United States Space Command has the resources to perform, rather than just oversee or support, conjunction analysis for all commercial launches from non-federal ranges.
64021 **§ 417.233 Conjunction on launch assessment.** (b) Conjunction on launch assessment constraints. (2) A licensee shall obtain a conjunction on launch assessment performed by United States Space Command 6 hours before the beginning of a launch window.	(2) A licensee shall obtain a conjunction on launch assessment ~~performed by United States Space Command~~ 6 hours before the beginning of a launch window.	There is some question as to whether or not United States Space Command has the resources to perform, rather than just oversee or support, conjunction analysis for all commercial launches from non-federal ranges.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
64022 **§ 417.233 Conjunction on launch assessment.** (b) Conjunction on launch assessment constraints. (4) For every 90 minutes, or portion of 90 minutes, that pass between the time United States Space Command last determined the state vectors of the orbiting objects, a licensee shall expand each launch window wait by subtracting 15 seconds from the start of the launch window wait and adding 15 seconds to the end of the launch window wait. A launch operator shall incorporate the resulting launch window waits into its flight commit criteria established in accordance with § 417.113.	(4) For every 90 minutes, or portion of 90 minutes, that pass between the time United States Space Command last determined the state vectors of the **inhabitable** orbiting objects, a licensee shall expand each launch window wait by subtracting 15 seconds from the start of the launch window wait and adding 15 seconds to the end of the launch window wait. A launch operator shall incorporate the resulting launch window waits into its flight commit criteria established in accordance with § 417.113.	Padding the launch window wait is conservative, but acceptable for the inhabitable orbital objects. However, padding the launch window wait is not advised for the other orbital objects, since the extra conservatism will unnecessarily decrease, or eliminate, the launch window.
64022 **§ 417.233 Conjunction on launch assessment.** (c) Information required. A launch operator shall prepare a conjunction on launch assessment worksheet for each launch using a standardized format that contains the input data required by this paragraph. An example conjunction on launch assessment worksheet is provided in figure 417.233-1. A launch operator licensee shall submit the input data to United States Space Command for the purposes of completing a conjunction on launch assessment. A launch operator license applicant shall submit the input data to the FAA as part of the license application process according to § 415.115.	Recommend revision by joint FAA/Industry committee	The sample worksheet does not contain enough information to be applicable for all trajectories. It would be more useful if the worksheet referred to a more comprehensive document, like the Launch Collision Avoidance Support Package (LCASP).

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
Part 417,Sub Part D – Flight Safety System		
§ 417.301 General.	(Entire section deleted)	This section duplicates parts of other sections and contains information that belongs in other sections. Requirements should be moved as appropriate and this section should be deleted.
(a) A launch operator shall use a flight safety system that provides a means of preventing a launch vehicle and its hazards, including any payload hazards, from reaching the public in the event of a launch vehicle failure during flight. Requirements that define when a launch operator must employ a flight safety system are provided in § 417.107(a).	(a) Deleted	Definition covered in § 417.3. Definition of when a launch operator must employ a flight safety system in § 417.107(a). OSC Comments Risk mitigation not risk avoidance. (a) A launch operator shall use a flight safety system that provides a means of **mitigating the risk to the public** ~~preventing a launch vehicle and its hazards, including any payload hazards, from reaching the public~~ in the event of a launch vehicle failure during flight.
(b) A flight safety system must consist of a flight termination system, a command control system, and the support systems defined in this subpart, including all associated hardware and software unless the requirements of § 417.107(a)(3) apply. A flight safety system also includes the functions of any personnel who operate flight safety system hardware and software. A launch operator shall satisfy each requirement of this subpart, including all requirements contained in referenced appendices, by meeting the requirements or by using an alternate method approved by the FAA through the licensing process. If a flight safety system does not satisfy all the requirements of this subpart, the requirements of § 417.107(a)(3) apply. The FAA will approve an alternate method if a launch operator provides a clear and convincing demonstration that its proposed method provides an equivalent level of	(b) Deleted	Definition covered in § 417.3. Recommend that FAA approval of alternate methods be covered under new § 417.TBD.

safety to that required by this subpart. A launch operator shall obtain FAA approval of any proposed alternate method before its license application or application for license modification will be found sufficiently complete to initiate review pursuant to § 413.11 of this chapter.		
(c) A launch operator's test program, required by § 417.115, must demonstrate the ability of a flight safety system to meet the design margins and reliability requirements of this subpart and the ability of the flight safety system to function without degradation in performance when subjected to non-operating and operating environments. The test program must satisfy the requirements of § 417.115 and include tests of the flight termination system and command control system as required by §§ 417.315, 417.317 and 417.325. The test program must include tests of the support systems required by § 417.327 and the equipment and instrumentation associated with the flight safety system, including real-time computers, display systems, consoles, telemetry, command control, tracking systems, and video systems. The cause of any test failure must be determined, corrective actions implemented, and additional testing performed to demonstrate that the test criteria are satisfied before flight.	(c) Deleted	Covered in rewrite of § 417.315. Command control system and support systems covered under new advisory circular.
(d) Any change to a licensee's flight safety system design or flight safety system test program that was not coordinated during the licensing process must be submitted to the FAA for approval as a license modification prior to flight.	(d) Deleted	Recommend that this be covered in a new section § 415. TBD or § 417.TBD Flight Safety System Approval Process
(e) Prior to the flight of each launch vehicle, a licensee shall confirm to the FAA in writing that its flight safety system is as described in its license application, including all applicable application amendments and license modifications, and complies with all terms of the license and the requirements of this part.	(e) Deleted	Recommend that this be covered in a new section § 415. TBD or § 417.TBD Flight Safety System Approval Process
(f) Upon review of a proposed launch, the FAA may identify and impose additional requirements needed	(f) Deleted	Requirement for FAA approval of test plans covered in proposed rewrite of § 417.315

identify and impose additional requirements needed to address unique issues presented by a flight safety system, including its design, operational environments, and testing.		proposed rewrite of § 417.315 OSC Comments Clarification of when additional requirements may be imposed. (f) ~~Upon review of a proposed launch~~, **As part of the requirements tailoring process,** the FAA may identify and impose additional requirements needed to address unique issues presented by a flight safety system, including its design, operational environments, and testing **where the risk to the public of the proposed launch would otherwise exceed allowable values.**
§ 417.303 Launch vehicle flight termination system functional requirements.	**§ 417.303 Launch vehicle flight termination system functional requirements.**	(Re-ordered and revised for clarity)
(a) A launch operator shall use a flight termination system as part of a flight safety system. A flight termination system consists of all hardware and software onboard a launch vehicle needed to accomplish all flight termination functions in accordance with this section.	**(a) The following functional requirements shall be met for stages requiring flight termination systems to meet acceptable risk criteria.**	Definition is covered in § 417.3. OSC Comments Flight termination should only be required when the flight safety analysis indicates that termination ability is needed to meet the criteria for acceptable public risk.
(b) Once initiated, a flight termination system must render each stage and any other propulsion system, including any propulsion system that is part of a payload that has the capability of reaching a populated or other protected area, non-propulsive, without significant lateral or longitudinal deviation in the impact point. A flight termination system must terminate flight in each thrusting stage and propulsion system. Any stage or propulsion system not thrusting at the time the flight termination system is initiated must be rendered incapable of becoming propulsive.	(b) Once initiated, a flight termination system must render each stage and any other propulsion system, including any propulsion system that is part of a payload that has the capability of reaching a populated or other protected area, non-propulsive, without significant lateral or longitudinal deviation in the impact point. ~~A flight termination system must terminate flight in each thrusting stage and propulsion system. Any stage or propulsion system not thrusting at the time the flight termination system is initiated must be rendered incapable of becoming propulsive.~~	Deleted words are redundant to first sentence.

	(c) A flight termination system must provide for flight termination of any inadvertently or prematurely separated stage or strap-on motor capable of reaching a populated or other protected area before orbital insertion. ~~Each stage or strap-on motor that does not possess its own complete command destruct system in accordance with § 417.309 must be equipped with an inadvertent separation destruct system that complies with the requirements of § 417.311.~~	Was (h). Requirement for ADS / ISDS covered under § 417.311.
(c) The flight termination of one stage must not sever interconnecting flight termination system circuitry or ordnance of another stage until the flight termination of the other stage has been initiated.		Moved to (f)
(d) A flight termination system must destroy the pressure integrity of all solid propellant stages and strap-on motors. A flight termination system must terminate all thrust, or any residual thrust must cause a solid propellant stage or strap-on motor to tumble without significant lateral or longitudinal deviation in the impact point.	(d) Acceptable as is	No change recommended
(e) A flight termination system must cause dispersion of any liquid propellant, whether by rupturing the propellant tank or other equivalent method, and initiate burning of any toxic liquid propellant.	(e) Acceptable as is	No change recommended
(f) A flight termination system must not detonate any solid or liquid propellant.	(f) *A flight termination system must not detonate any solid or liquid propellant.*	A final Industry recommendation could not be reached. A requirement to demonstrate that this requirement is met would be a serious cost impact. If the FAA accepts current propellants and propellant dispersal methods as acceptable without demonstration there may not be an issue. Boeing Comments We do not know if our current propellants would be detonated by our current destruct charges. Alliant and Thiokol would need to produce data that propellants will not detonate, or tests would need to be performed. Make this a goal, not a requirement.

	(g) The flight termination of one stage must not sever interconnecting flight termination system circuitry or ordnance of another stage until the flight termination of the other stage has been initiated.	Was (c)
(g) A flight termination system must include a command destruct system that is initiated by radio command and implemented in accordance with § 417.309. The FAA will approve another method, such as an autonomous flight termination system, if a launch operator provides a clear and convincing demonstration, through the licensing process, that its proposed method provides an equivalent level of safety.	(g) Deleted	Requirement for command destruct system covered under § 417.309. Recommend that FAA approval of alternate methods be covered under new § 417.TBD.
(h) A flight termination system must provide for flight termination of any inadvertently or prematurely separated stage or strap-on motor capable of reaching a populated or other protected area before orbital insertion. Each stage or strap-on motor that does not possess its own complete command destruct system in accordance with § 417.309 must be equipped with an inadvertent separation destruct system that complies with the requirements of § 417.311.	(h) Moved to (c)	
§ 417.305 Flight termination system reliability.	**§ 417.305 Flight termination system ~~reliability~~ design.**	**Section expanded to cover general design requirements for flight termination systems**
	(a) **<u>General.</u> Guidance on the design of reliable flight termination systems is provided in FAA advisory circular _____.**	Added new paragraph with reference to new FAA advisory circular on FTS design. The EWR 127-1 requirements, upon which this Subpart is based, provide detailed design solutions developed over a period of more than thirty years. While it is important that these lessons learned be retained, these design solutions should not be codified as law. First, these requirements have historically been implemented on a best effort basis, with specific tailoring negotiated between the range user and the safety wings for each program. Discussion of both the recommended solutions and the traditional exceptions is more appropriate for an advisory circular. Second, these solutions focus on the

		use of traditional, ground-based flight safety systems using redundant Command Destruct and Inadvertent Separation Systems. No guidance is provided for other design solutions including autonomous on-board systems or the use of space-based assets for telemetry, tracking, and command.
(a) Reliability design. A flight termination system must have a reliability design of 0.999 at a confidence level of 95 percent. A launch operator shall conduct system reliability analyses according to § 417.329 to demonstrate whether a flight termination system has the required reliability design.	**(b)** ~~Reliability design. A flight termination system must have a reliability design of 0.999 at a confidence level of 95 percent. A launch operator shall conduct system reliability analyses according to § 417.329 to demonstrate whether a flight termination system has the required reliability design.~~ (Four rewrite options are suggested below.)	NPRM wording is unacceptable without modification and clarification. This wording represents a significant change from the current practice at the Federal ranges. A reliability of 0.999 at confidence factor of 95 percent can only be demonstrated through a very large number of tests. The Industry feels that the reliability number is of limited value. While it is useful for making reliability comparisons of different architectures, it is only a qualitative indicator of system reliability due to limitations inherent in the way these analyses are performed (e.g. limited data on current electronic piece-parts, doesn't consider quality of workmanship, etc.). (Deleted cross-reference to analysis requirements covered under § 417.329.)
	Option 1 Delete reliability requirement and corresponding § 417.327 analysis requirement	Option 1 evaluation. Deletion of a number that has historically been a goal would have no impact on public safety if the FAA also maintains the existing approach of specifying detailed implementation (e.g. redundancy, independence, single point failure tolerance, testing, etc.).
	Option 2 Continue to express as a goal of 0.999 with 95% confidence as worded in EWR 127-1. **(b) Reliability goal. The overall flight termination system reliability goal shall be a minimum of 0.999 at the 95% percent.** Corresponding § 417.327 analysis requirement **(1) Describe how the flight termination system meets the reliability design goal of 0.999 at a confidence level of 95 percent.**	Option 2 Evaluation. Maintaining the reliability number as a goal would carry over an existing practice that has resulted in a perfect safety record. If the use of the word "goal" in a legal document is unacceptable to the FAA, it could be moved to the proposed advisory circular as guidance.

	Option 3 Express as a hard requirement with a confidence factor of 50 percent. **(b) Reliability. A flight termination system must have a minimum reliability of 0.999 at a confidence level of 50 percent.** Corresponding § 417.327 analysis requirement (1) **Describe how the flight termination system meets the minimum reliability requirement of 0.999 at a confidence level of 50 percent. Failure rates shall be defined using standard reliability data sources including MIL-HDBK-217 (Reliability Prediction of Electronic Equipment) and the Reliability Analysis Center NPRD (Non-electronic Parts Reliability Database) Report.**	Option 3 Evaluation. A confidence factor of 50 percent is typical of what would be obtained by reliability calculations using industry standard techniques such as those described in MIL-HDBK-217.
	Option 4 Show an equivalent calculated confidence factor of 95%. Allow mathematical scaling of the 50% confidence factor using binomial distribution approximation or similar method. **(b) Reliability. A flight termination system must have a minimum reliability of 0.999 at an equivalent calculated confidence level of 95 percent.** Corresponding § 417.327 analysis requirement (1) **Describe how the flight termination system meets the minimum reliability requirement of 0.999 at an equivalent calculated confidence level of 95 percent. Failure rates shall be defined using standard reliability data sources including MIL-HDBK-217 (Reliability Prediction of Electronic Equipment) and the Reliability Analysis Center NPRD (Non-electronic Parts Reliability Database) Report. The result shall be defined as a point estimate at an approximate 50% confidence value. The point estimate shall**	Option 4. The use of mathematical conversions to estimate various confidence factors is an established technique used by industry when test sample size is limited. If rigid adherence to this number is anticipated, the Industry recommends that this estimated reliability number be the primary requirement and that detailed implementation requirements (e.g. redundancy, independence, single point failure tolerance, testing, etc.) be deleted. This would allow the Industry to reduce hardware costs by eliminating redundant hardware where the reliability number was still met. Note that this approach would eliminate much of Subpart D.

	then be converted to a 95% confidence level using a binomial distribution approximation or equivalent method.	
(b) Single fault tolerant. A flight termination system, including monitoring and checkout circuits, must not have a single failure point that would inhibit functioning of the system or produce an inadvertent output. Exceptions to this requirement apply to certain components that are identified in this subpart and that meet the design and test requirements in appendixes D and E of this part.	**(c)** Single fault **tolerance**. **To the maximum extent practical,** ~~A~~ flight termination systems, including monitoring and checkout circuits, **shall be designed to preclude** ~~must not have a~~ **any** single failure points that would inhibit functioning of the system or produce an inadvertent output **that would endanger the public**.	Was (b) Title changed for consistency. Added "To the maximum extent practical" to better reflect current practice. The new advisory circular on FTS design should include an in-depth discussion of traditionally approved exceptions including, but not limited to: - Logic units - Ordnance devices such as lanyard pull initiators Boeing Comments Our system is not protected against spontaneous initiation of any ordnance device since that is considered non-credible. Complex voting logic system would need to be designed. Clearly this is not the intent of this paragraph. Specifically note that spontaneous ordnance device initiation is not credible and is not covered by this or any other requirement in this document. OSC Comments Inadvertent functioning of the flight termination system is a mission success issue and not related to protection of the public.
(c) Redundancy. A flight termination system must utilize redundant component strings in accordance with the following:	**(d)** Redundancy. A flight termination system must utilize redundant component strings. ~~in accordance with the following:~~ **R**edundant components shall be structurally, electrically, and mechanically separated and mounted in different orientations ~~on different axes~~ **to the maximum extent practical.**	Was (c). Added "to the maximum extent practical" to better reflect current practice. Combined (c)(1) with (c). Added "to the maximum extent practical" to better reflect current practice. Words "on different axes" deleted due to the great amount confusion that has been caused by this wording in the past. For most vehicles there are limitations to the number of axes that a box can be mounted in. Batteries are often orientation sensitive. The new advisory circular on FTS design should include an in-depth discussion of traditionally approved redundancy exceptions including, but not limited to: - A single linear shaped charge may be used if the charge initiates at both ends, and the initiation

		source for one end is independent of the initiation source used for the other end. - A single destruct charge may be used if.... - A single safe arm device may be used if it contains dual initiators, and the initiation sources are independent. - Passive components such as antennas and radio frequency couplers are not required to be physically redundant if they satisfy the single point of failure requirements.
(1) Redundant components shall be structurally, electrically, and mechanically separated and mounted in different orientations on different axes.	(1) Deleted	Combined with new (d) <u>Boeing Comments</u> Our destruct components are not currently mounted per this requirement Significant component and system redesign, in some cases impossible to comply. Make this a goal, not a requirement. Indicate that system simplicity need also be considered in judging the extent to implement. <u>OSC Comments</u> Industry needs clarification of the meaning of different orientations and axes. Many launch vehicles currently mount redundant component of the same motor dome or skirt, but at different radial locations. If this meets the intent of the requirement, then Industry recommends this requirement be reworded to clarify this meaning. If not, then the impact of this requirement to industry may include extensive redesign, environments modifications, and re-qualification.
(2) A flight termination system need not use redundant linear shaped charges, if, when employing a single linear shaped charge, the charge initiates at both ends, and the initiation source for one end is independent of the initiation source used for the other end.	(2) Deleted	
(3) Passive components such as antennas and radio frequency couplers are not required to be physically	(3) Deleted	

redundant if they satisfy the requirements of appendix D of this part.		
(d) System independence. A flight termination system must not share any power sources, cabling, or any other component with any other launch vehicle system. With the exception of any telemetry monitor signal and any engine shut-down output signal, a flight termination system must operate independently of all other vehicle systems.	**(e)** System independence. A flight termination system must not share any power sources~~, cabling, or any other component~~ with any other launch vehicle system. ~~With the exception of any telemetry monitor signal and any engine shut-down output signal.~~ **To the maximum extent practical,** a flight termination system must operate independently of all other vehicle systems.	Was (d). Deleted "cabling, or any component". Current practice is to run FTS wiring in the same cables or wire bundles as other flight critical vehicle wiring. Elimination of this practice would actually result in a greater chance of damage to a smaller dedicated FTS wire bundle, and would stand a greater chance of damage in most vehicle breakup scenarios. Also, avionics components are often used in conjunction with the command destruct systems or automatic destruct systems to accomplish FTS functions. Added words "to the maximum extent practical" to better reflect actual practice. The new advisory circular on FTS design referenced in (a) should include an in-depth discussion of exceptions, including but not limited to: - Arming and safing interfaces - Telemetry interfaces - Engine shut-down interfaces - A single tri-band antenna may be used for FTS, tracking, and telemetry. - FTS batteries may, with certain limitations, be used to power telemetry and tracking systems Boeing Comments Our vehicle guidance system is used to are used to safe our ISDS prior to GEM separation as well as to safe the CRDs. OSC Comments Sharing of cable harnessing does not measurably reduce independence of the flight termination system. Inadvertent separation destruct systems must be disabled prior to the appropriate staging events. This disabling function does not require independence from other vehicle systems.
(e) Components and parts. A licensee is responsible for	**(f) Electronic piece parts. The launch operator**	Was (e) Components and parts. Deleted cross-

the overall design of a flight termination system and shall ensure that all flight termination system components satisfy the requirements of appendix D of this part and all electronic piece parts used in a flight termination system component satisfy the requirements of appendix F of this part. A launch operator shall ensure that each flight termination system component and electronic piece part has written performance specifications that contain the particulars of how the component or piece part satisfies the requirements of appendixes D and F as related to the specific design of the flight termination system that contains the component or piece part.	**shall establish an Electronic Parts Control Program for all electronic piece parts used in safety critical circuits within flight termination system components. Guidance on parts programs for flight termination systems is available from FAA advisory circular _____**	references and references to appendices. Added requirement for parts program (similar to current practice). Added reference to new FAA advisory circular. Boeing Comments Require upscreened parts only for components that are required to function in flight. As an example, the electronic parts used in the motor drive and monitoring circuits for safe and arm devices do not meet the same piece part requirements as parts used in the firing circuits.
(f) Testability. The design of a flight termination system and associated ground support and monitoring equipment shall provide for preflight testing performed in accordance with § 417.317.	(f) Deleted	Deleted entire paragraph with cross-reference. This is a "do good work" requirement, should go without saying.
(g) Software and firmware. A launch operator shall ensure that each software safety critical function associated with a flight termination system is identified, and that all associated computing systems, software, or firmware is designed, compiled, analyzed, tested, and implemented in accordance with § 417.123 and appendix H of this part. The requirements of appendix H also apply to any computing system, software, or firmware that must operate properly to ensure that the flight safety official has the accurate vehicle performance data needed to make a flight termination decision.	(g) Software and firmware. A launch operator **shall prepare a software development plan that identifies** ~~ensure that~~ each software safety critical function associated with a flight termination system ~~is identified~~, and **documents the processes to be used to design, compile, analyze, test and implement** ~~that~~ all associated computing systems, software, or firmware. **Guidance on design of safety critical computing systems and software is provided in FAA advisory circular_____.** ~~is designed, compiled, analyzed, tested, and implemented in accordance with § 417.123 and appendix H of this part. The requirements of appendix H also apply to any computing system, software, or firmware that must operate properly to ensure that the flight safety official has the accurate vehicle performance data needed to make a flight termination decision.~~	Software and firmware. Added requirement for a software development plan. Replaced references to § 417.123 and appendix H with references to a new FAA advisory circular. Deleted requirements for software used for LV tracking. These should be moved to the advisory circular for support systems.
(h) Component storage, operating, and service life. All flight termination system components must have a specified storage life, operating life, and service life. Service life is the total time that a component spends in storage and after installation on the launch	(h) Component storage, operating, and service life. All flight termination system components must have a specified storage life, operating life, and service life. ~~Service life is the total time that a component spends in storage and after installation on the launch vehicle~~	Deleted definitions (covered in § 417.3). Deleted duplicate requirement for age surveillance testing (covered in § 417.315).

vehicle through the end of flight. The storage or service life of a component must start upon completion of the component's acceptance testing. Operating life must start upon activation of the component or installation of the component on a launch vehicle, whichever is earlier. A flight termination system component must function without degradation in performance when subjected to the full length of its specified storage life, operating life, and service life. A launch operator shall ensure that each component used in a flight termination system does not exceed its storage, operating, or service life before flight. A launch operator shall ensure that age surveillance testing, in accordance with appendix E of this part, is performed to verify or extend a component's storage, operating, or service life.	~~through the end of flight. The storage or service life of a component must start upon completion of the component's acceptance testing. Operating life must start upon activation of the component or installation of the component on a launch vehicle, whichever is earlier.~~ A flight termination system component must function **within performance specifications** ~~without degradation in performance~~ when subjected to the full length of its specified storage life, operating life, and service life. A launch operator shall ensure that each component used in a flight termination system does not exceed its storage, operating, or service life before flight. **Component life may be extended by performing age surveillance tests on a periodic basis.** ~~A launch operator shall ensure that age surveillance testing, in accordance with appendix E of this part, is performed to verify or extend a component's storage, operating, or service life.~~	
	(i) Configuration management and control. A launch operator shall ensure that a flight termination system component's manufactured parts, materials, processes, quality controls, and procedures are ~~standardized~~ **documented** and maintained in accordance with the launch operator's configuration management and control plan ~~submitted during the licensing process according to § 415.119(e).~~ A launch operator shall ensure that subsequent production items are ~~identical to~~ **representative of** the components subjected to qualification testing. If there is a **significant** change in the design of a qualified component, including any **significant** change in a component's parts, ~~the component must be re-qualified in accordance with appendix E of this part~~. **the launch operator shall re-evaluate the qualification status of the component, and present the qualification plan to the FAA for approval. Depending on the extent of the change, the FAA may approve limited delta**	Moved from § 415.315. Deleted cross-reference to § 415.119(e). Modified re-qualification requirement to require a re-evaluation of qualification status with added discussion that limited test options may be available to better reflect current practice. Boeing Comments Requalification after changing a component is currently negotiated with range safety. Many design changes are minor in magnitude, and do not warrant requalification per the standard qualification table for completely new components. Requirement as written would result in significant recurring re-qualification costs as designs have incremental modifications.

	qualification testing or qualification based on similarity to testing performed on similar components.	
§ 417.307 Flight termination system environment survivability.		
(a) General. The design of a flight termination system and its components, including all mounting hardware, cables and wires, must provide for the system and each component to function without degradation in performance when subjected to dynamic environment levels greater than those that it will experience during environmental stress screening tests, ground transportation, storage, launch processing, system checkout, and flight up to the point that the launch vehicle could no longer impact any populated or other protected area, or when subjected to dynamic environment levels greater than those that would cause structural breakup of the launch vehicle.	(a) General. The design of a flight termination system and its components, including all mounting hardware, cables and wires, must provide for the system and each component to function **within performance specifications** ~~without degradation in performance~~ when subjected to dynamic environment levels greater than those that it will experience during environmental stress screening tests, ground transportation, storage, launch processing, system checkout, and flight up to the point that the launch vehicle could no longer impact any populated or other protected area, or when subjected to dynamic environment levels **typical of** ~~greater than~~ those that **might be experienced during** ~~would cause~~ structural breakup of a ~~the~~ launch vehicle.	Real requirement is to perform within specification. Breakup environment rewritten in terms of "typical" versus loads predicted for a specific vehicle under a given failure scenario. Traditionally, the ranges have accepted that the minimum environments and qualification margins adequately envelope typical breakup loads. Boeing Comments We have never attempted to define all the environments that would cause vehicle breakup. Requirement could result in significant analysis effort and related costs. Due to significant uncertainty, conservative analysis would yield unacceptably high requirements. Recommend deletion of requirement unless better definition of analysis requirements is identified. This change would be required in multiple locations in document. Given the significant acoustic liftoff environments, allow that max flight environment envelopes breakup environment.
(b) Maximum predicted environments. A launch operator shall determine, based on analysis, modeling, testing, or flight data, all maximum predicted environments for the non-operating and operating environments that a flight termination system is to experience. The non-operating and operating environments must include, but need not be limited to, thermal range, vibration, shock, acceleration, acoustic, and other environments where applicable to a launch, such as humidity, salt fog, dust, fungus, explosive atmosphere, and electromagnetic energy. The specific environments that apply to the design of flight termination system components are identified in appendix D of this	(b) Maximum predicted environments. A launch operator shall determine, based on analysis, modeling, testing, or flight data, all maximum predicted environments for the non-operating and operating environments that a flight termination system is to experience. The non-operating and operating environments **to be addressed** must include, but need not be limited to, **temperature,** ~~thermal range~~, vibration, shock, acceleration, acoustic, and other environments where applicable to a **specific** launch **vehicle**, such as humidity, salt fog, dust, fungus, explosive atmosphere, and electromagnetic energy. ~~The specific environments that apply to the design of flight termination system~~	Maximum temperature, vibration, shock, acceleration, acoustic environments should be predicted. However, acceleration and acoustic environments are frequently not tested since they are typically enveloped by random vibration.

part. A launch operator shall determine each maximum predicted environment in accordance with the following:	~~components are identified in appendix D of this part~~. A launch operator shall determine each maximum predicted environment in accordance with the following:	
(1) If there are fewer than three samples of flight data, a launch operator shall add no less than a 3 dB margin for vibration, 4.5 dB for shock, and plus and minus 11°C for thermal range to each maximum predicted environment identified through analysis.	(1) If there are fewer than three samples of flight data, a launch operator shall add **uncertainty margins for the vibration, shock, and thermal environments the system is predicted to experience from launch through end of flight safety crew responsibility. FAA advisory circular _____ provides guidance relative to uncertainty margins that have traditionally been applied for these environments.** ~~no less than a 3 dB margin for vibration, 4.5 dB for shock, and plus and minus 11°C for thermal range to each maximum predicted environment identified through analysis~~.	
(2) For a new launch vehicle or for a launch vehicle for which there is no empirical data available or empirical data for fewer than three flights, a launch operator shall monitor launch vehicle flight environments with telemetry to verify each maximum predicted environment. A launch operator shall ensure that each maximum predicted environment for any future launch is adjusted to reflect the flight data obtained through monitoring. A launch operator's post-launch report, submitted in accordance with § 417.117(h), must contain the results of any flight environment monitoring performed to verify the maximum predicted environments.	(2) For a new launch vehicle or for a launch vehicle for which there is no empirical data available or empirical data for fewer than three flights, a launch operator shall monitor **representative** launch vehicle flight environments ~~with telemetry~~ to verify each maximum predicted environment. A launch operator shall ensure that ~~each~~ maximum predicted environments for ~~any~~ future launches ~~is~~ are adjusted to reflect the **actual** flight data ~~obtained through monitoring~~. ~~A launch operator's post-launch report, submitted in accordance with § 417.117(h), must contain the results of any flight environment monitoring performed to verify the maximum predicted environments.~~	LM Comments We do not measure each environment for each component. We will typically add a few measurements in each general area for environments such as vibration, shock, pressure, and temperature. These are used to represent the environments for all the components in a general area.
(3) A launch operator shall monitor each transportation, storage, launch processing, and system checkout environment, and adjust the associated maximum predicted environments to reflect the true environments.	(3) A launch operator shall **characterize** ~~monitor each~~ transportation, storage, launch processing, and system checkout environments, and adjust the associated maximum predicted environments to reflect the true environments.	Boeing Comments We do not currently monitor shipping environments for most items. Requirement could result in significant monitoring expense with no benefit since most items can easily be packaged to prevent damage. LM Comments Where it is critical, some components are drop tested in

		their packaging as part of qualification. OSC Comments Strict interpretation of this paragraph would require monitoring of multiple environments (shock, thermal, vibe, etc) of each packaged flight termination system component every time it is shipped, handled, stored. It is sufficient to characterize the transportation, storage, processing, and checkout environments, without continuous monitoring.
(4) The launch operator shall notify the FAA of any change to any maximum predicted environment.	(4) The launch operator shall notify the FAA of any change to any maximum predicted environment.	
§ 417.309 Command destruct system.	**§ 417.309 Command destruct system.**	**§ 417.309 Command destruct system.**
(a) A flight termination system must include a command destruct system that is initiated by radio command and meets the redundancy and other component requirements provided in appendix D of this part. Redundant radio command receiver decoders must be installed on or above the last propulsive launch vehicle stage or payload capable of reaching a populated or other protected area before orbital insertion.	(a) A flight termination system must include a command destruct system that is initiated by radio command **unless the launch operator has obtained FAA approval of an alternate method of flight termination.** ~~and meets the redundancy and other component requirements provided in appendix D of this part.~~	Clarification regarding use of alternate methods. Deleted unnecessary references. Moved second sentence to new paragraph (b)
	(b) ~~Redundant radio command receiver decoders~~ **Radio frequency components of the command destruct system** must be installed on or above **the last stage requiring command destruct capability as determined by the flight safety analysis results.** ~~propulsive launch vehicle stage or payload capable of reaching a populated or other protected area before orbital insertion.~~	Clarification – All RF components (not just the receivers) need to be on this stage. Redundancy requirement covered in § 417.305 (d) OSC Comments Flight termination should only be required when the flight safety analysis indicates that termination ability is needed to meet the criteria for acceptable public risk. The current designs of the Athena, Pegasus and Taurus vehicles do not include FTS on the upper stage due to the low risk posed by these small rocket motors. This requirement should not force industry to install the FTS on the upper stage, unless the flight safety analysis indicates that the upper stage poses unacceptable risk to

		the public. Redesign of the Athena, Pegasus and Taurus vehicles to include FTS on the upper stage would be extremely costly and would directly impact payload capability.
(b) The initiation of a command destruct system must result in accomplishing all flight termination system functions in accordance with § 417.303.	(c) The initiation of a command destruct system must result in accomplishing all flight termination system functions in accordance with § 417.303.	Was (b)
(c) A command destruct system must operate with a radio frequency input signal that has an electromagnetic field intensity of 12 dB below the intensity provided by a command control system transmitter over 95 percent of the radiation sphere surrounding a launch vehicle at any point along the launch vehicle's trajectory.	(d) A command destruct system must operate with a radio frequency input signal that has an electromagnetic field intensity of **9** ~~12~~ dB below the intensity provided by a command control system transmitter over 95 percent of the radiation sphere surrounding a launch vehicle at any point along the launch vehicle's trajectory **from launch through the end of flight safety crew responsibility.**	Was (c). 12 dB minimum link margin changed to 9 dB to match existing requirements for Atlas II/III and Delta II vehicles. It is also our understanding that the new command systems being put in under the RSA program may have lower output power than current systems. Added clarification. Boeing Comments The requirement for 12 dB margin should not exist after the vehicle is out of flight safety crew responsibility Not possible to meet at all points along the vehicle trajectory. Reword to specify requirement applies while the vehicle is in flight safety crew responsibility. Change requirement from 12 dB to 9 dB
(d) The design of a command destruct system must provide for the command destruct system to survive the breakup of the launch vehicle to the point that all flight termination functions would be accomplished in accordance with § 417.303. Otherwise, the stage containing the command destruct system must also include an inadvertent separation destruct system implemented in accordance with § 417.311. A launch operator shall perform a breakup analysis in accordance with § 417.329 to demonstrate the survivability of a command destruct system.	(e) The design of a command destruct system must **either** provide for the command destruct system to survive the breakup of the launch vehicle to the point that all flight termination functions would be accomplished in accordance with § 417.303, **or** ~~Otherwise~~, the stage containing the command destruct system must also include an automatic or inadvertent separation destruct system implemented in accordance with § 417.311. ~~A launch operator shall perform a breakup analysis in accordance with § 417.329 to demonstrate the survivability of a command destruct system.~~	Was (d). Improved wording. Requirement for analysis covered under § 417.329
(e) A command destruct system must receive and process a valid arm command before accepting a destruct command and destroying the launch vehicle. For any liquid propellant, a command destruct system must non-destructively shut down any thrusting liquid engine as a prerequisite for destroying the launch vehicle.	(f) A command destruct system must receive and process a valid **FTS ARM** ~~arm~~ command before accepting **an FTS DESTRUCT** ~~a destruct~~ command and destroying the launch vehicle. ~~For any liquid propellant, a command destruct system must non-destructively shut down any thrusting liquid engine as a prerequisite for destroying the~~	Was (e). Clarification. Second sentence moved to new (g)

destroying the launch vehicle.	~~launch vehicle.~~	
	(g) **If required by the flight safety analysis, the FTS ARM command shall cause the command destruct system to** ~~for any liquid propellant, a command destruct system must non-destructively~~ shut down any thrusting liquid engine as a prerequisite for destroying the launch vehicle.	(g) Improved wording. An FTS commanded shutdown could conceivable result in a highly LO2 rich fuel mixture which could burn a hole in the engine housing. OSC Comments Shut down of liquid propulsion systems should only be required when the flight safety analysis indicates that it is needed to meet the criteria for acceptable public risk. Small liquid propulsion systems which are typical of small to medium spacecraft should not require the FTS to inhibit ignition. These stages pose neglibile risk to the public.
§ 417.311 Inadvertent separation destruct system.	**§ 417.311 Automatic / inadvertent separation destruct systems.**	
(a) Each stage or strap-on motor capable of reaching a populated or other protected area before orbital insertion, and which does not possess its own complete command destruct system, including command destruct receivers and associated radio frequency hardware, must be equipped with an inadvertent separation destruct system. An inadvertent separation destruct system is an automatic destruct system that uses mechanical means to trigger the destruction of a stage. If a command destruct system on a stage does not satisfy the requirement of § 417.309(d) that the command destruct system survive breakup of the launch vehicle, a launch operator must also use an inadvertent separation destruct system on that stage.	(a) Each stage or strap-on motor capable of reaching a populated or other protected area before orbital insertion, and which does not possess its own complete command destruct system, including command destruct receivers and associated radio frequency hardware, must be equipped with an inadvertent separation destruct system. ~~An inadvertent separation destruct system is an automatic destruct system that uses mechanical means to trigger the destruction of a stage. If a command destruct system on a stage does not satisfy the requirement of § 417.309(d) that the command destruct system survive breakup of the launch vehicle, a launch operator must also use an inadvertent separation destruct system on that stage.~~	ADS / ISDS requirement is covered under §417.309. ADS and ISDS definitions covered under §417.3. Boeing Comments Our Delta II 40" GEMs do not have an ISDS system at A41 due to canted nozzles, and hazard analysis. Add to paragraph: "ISDS is not required if hazard analysis shows that the stage or strap on motor cannot reach any protected area.
(b) The initiation of an inadvertent separation destruct system must result in accomplishing all flight termination system functions required by § 417.303 and that apply to the stage or strap on motor on which it is installed.	(b) The initiation of an inadvertent separation destruct system must result in accomplishing all flight termination system functions ~~required by § 417.303 and~~ that apply to the stage or strap on motor on which it is installed.	Deleted cross reference.

(c) An inadvertent separation destruct system must be activated by a device that senses launch vehicle breakup or premature separation of the stage or strap-on motor on which it is located.	(c) Acceptable as is	No change recommended
(d) An inadvertent separation destruct system must be located to survive during launch vehicle breakup and to ensure its own activation. A launch operator shall perform a flight termination system survivability analysis that accounts for breakup of the launch vehicle and the timing of planned launch vehicle staging events. The analysis shall be used to determine the method of activation and location of an inadvertent separation destruct system that will ensure its survivability and activation during breakup of the launch vehicle.	(d) An inadvertent separation destruct system must be located to survive during launch vehicle breakup and to ensure its own activation~~. A launch operator shall perform a flight termination system survivability analysis that accounts for breakup of the launch vehicle and the timing of planned launch vehicle staging events. The analysis shall be used to determine the method of activation and location of an inadvertent separation destruct system that will ensure its survivability and activation during breakup of the launch vehicle.~~	Requirement for analysis covered under § 417.329. Boeing Comments Some break-up modes will by definition damage a portion of the FTS. Some breakup modes will effect the same results as FTS operation. Requirement cannot or need not be met in some cases. Impossible to meet. Allow that some catastrophic failure modes will inherently damage the FTS, and some will effect the same results as the FTS. Require that system design best meet reliability, simplicity, and survivability goals. It would be difficult if not impossible to prove that all vehicle breakup scenarios do not damage the FTS. Add "Only one of the two redundant legs of the FTS needs to survive breakup of the vehicle, and only if the vehicle breakup does not perform the basic requirements of the FTS."
(e) An electrically initiated inadvertent separation destruct system must have a dedicated power source that supplies the energy to initiate the destruct ordnance.	(e) ~~An electrically initiated inadvertent separation destruct system must have a dedicated power source that supplies the energy to initiate the destruct ordnance.~~	Requirement for dedicated power source covered under new § 417.305 (e).
§ 417.313 Flight termination system safing and arming.	**§ 417.313 Flight termination system safing and arming.**	**§ 417.313 Flight termination system safing and arming.**
(a) General. The design of a flight termination system must provide for safing and arming of all flight termination system ordnance through the use of ordnance initiation devices or arming devices, also referred to as safe and arm devices, that provide a removable and replaceable mechanical barrier or other positive means of interrupting power to each of the ordnance firing circuits to prevent inadvertent initiation of ordnance	(a) General. The design of a flight termination system must provide for safing and arming of all flight termination system ordnance through the use of ordnance initiation devices or arming devices, also referred to as safe and arm devices, that provide a ~~removable and replaceable~~ mechanical barrier or other positive means of interrupting power to each of the ordnance firing circuits to prevent inadvertent initiation of ordnance	Real requirement is positive means of interrupting power. Removable and replaceable could be interpreted to mean a key. Mechanical would include safe arm devices. Boeing Comments The Delta ISDS and ADS are armed manually on the

initiation of ordnance.	initiation of ordnance.	pad, and do not use S&A devices for arming. Would need to add ordnance interrupters, which are not specifically allowed by this paragraph but meet the intent. Permit arming and safing of FTS either by S&A's, ordnance interrupters, or manual means provided that the operation is performed using procedures which maximize personnel safety.
(b) Flight termination system arming. The design of a flight termination system must provide for each flight termination system ordnance initiation device or arming device to be armed prior to arming any launch vehicle or payload propulsion ignition circuits. For a launch where propulsive ignition occurs after first motion of the launch vehicle, the design of a flight termination system must provide an ignition interlock that prevents the arming of any launch vehicle or payload propulsion ignition circuits unless all flight termination system ordnance initiation devices and arming devices are armed.	(b) Flight termination system arming. The design of a flight termination system must provide for each flight termination system ordnance initiation device or arming device to be armed prior to arming any launch vehicle or payload propulsion ignition circuits. For a launch where propulsive ignition occurs after first motion of the launch vehicle, the design of a flight termination system must provide an ignition interlock that prevents the arming of any launch vehicle or payload propulsion ignition circuits unless all flight termination system ordnance initiation devices and arming devices are armed.	Boeing Comments GEM ignition and separation systems are connected before FTS is armed. There are not designed-in interlocks to prevent ignition arming before FTS arming. If connection is considered arming, would require detonators be replaced by S&A devices, and manual LPI arming to be replaced with ordnance interrupters, with associated software interlocks in ground systems Consider arming to be electronic enabling, not ordnance connection. Permit procedural and visual verification of armed FTS to satisfy intent of requirement.
(c) Preflight safing. The design of a flight termination system must provide for remote and redundant safing of all flight termination system ordnance initiation devices and arming devices before launch and in case of launch abort or recycle operations.	(c) Preflight safing. The design of a flight termination system must **provide multiple ways of safing prior to launch, at least one of which shall be remote. Manual safing may be used in lieu of meeting the requirement for remote safing if safing is controlled procedurally with limited personnel exposure.** ~~for remote and redundant safing of all flight termination system ordnance initiation devices and arming devices before launch and in case of launch abort or recycle operations.~~	Boeing Comments Mechanical Automatic Destruct System and GEM Inadvertent Separation Destruct System cannot be remotely safed (manual safing with pins) Would require incorporation of remote arming devices and associated wire harnesses and monitoring circuits. Permit manual arming/safing of mechanical FTS subsystems. Orbital Comments Pegasus is not compliant with this requirement. Current mechanical FTS subsystems, typically ISDS and in some instances Safe and Arms, do not permit remote safing.
(d) In-flight safing. If flight termination system ordnance is to be safed after a stage or strap-on motor is spent, attains orbit, or can no longer reach any populated or other protected area, the flight termination system safing design must provide for the following:	(d) In-flight safing. If flight termination system ordnance is to be safed **during flight** ~~after a stage or strap-on motor is spent, attains orbit, or can no longer reach any populated or other protected area~~, the flight termination system safing design must provide for the following:	Deleted words covered in new §417.313 (d) (2)

(1) Any onboard launch vehicle hardware or software used to automatically safe flight termination system ordnance must be single fault tolerant against inadvertent safing. An automatic safing design must satisfy the following:	(1) Any onboard launch vehicle hardware or software used to automatically safe flight termination system ordnance must be single fault tolerant against inadvertent safing **or the probability of inadvertently safing the flight termination system must be less than TBD**. ~~An automatic safing design must satisfy the following:~~	Current practice allows use of non fault-tolerant guidance computers to safe FTS if two parameters are used and the probability of inadvertent safing is acceptably low. LM Comments A joint industry FAA, safety wing discussion is needed to develop an acceptable probability number
(i) Any automatic safing must depend on at least two independent parameters, such as time of flight or altitude. The safing criteria for each independent parameter must ensure that the flight termination system on a stage or strap-on-motor can only be safed once the stage or strap-on motor attains orbit or can no longer reach a populated or other protected area.	**(2)** Any automatic safing must depend on at least two independent parameters~~, such as~~ **(e.g.** time of flight, **propellant depletion, acceleration,** ~~**or**~~ altitude, **etc.) or be single fault tolerant against inadvertent safing.** .The safing criteria for each independent parameter must ensure that the flight termination system on a stage or strap-on-motor can only be safed once the stage or strap-on motor attains orbit or can no longer reach a populated or other protected area.	Was (i). Added propellant depletion, acceleration Boeing Comments Level of independence is unclear. Boeing RIFCA measures time using three different processors. Does this constitute at least two independent parameters? Could result in possible redesign of RIFCA if parameters cannot be redundant streams of the same parameter. Rewrite to simply state that automatic safing must be single fault tolerant to inadvertent safing.
(ii) An automatic safing design must ensure that all flight termination system ordnance initiation devices and arming devices remain armed during flight until the safing criteria for at least two independent parameters are met.	**(i)** An automatic safing design must ensure that all flight termination system ordnance initiation devices and arming devices remain armed during flight until the safing criteria for at least two independent parameters are met.	Was (ii).
(iii) If a launch operator proposes to establish any single safing criterion as a value that may be achieved before normal thrust termination of the associated stage or strap-on motor, a launch operator shall demonstrate to the FAA, through the licensing process, that the greatest remaining thrust, assuming a three-sigma high engine performance, can not result in the stage or strap-on motor reaching a populated or other protected area.	**(ii)** If a launch operator proposes to establish any single safing criterion as a value that may be achieved before normal thrust termination of the associated stage or strap-on motor, a launch operator shall demonstrate to the FAA~~, through the licensing process,~~ that the greatest remaining thrust, assuming a three-sigma high engine performance, can not result in the stage or strap-on motor reaching a populated or other protected area.	Was (iii). FAA approval process covered in TBD
(2) If a command destruct system is to be safed by radio command, the command control system used for in-flight safing must be single fault tolerant against inadvertent safing. A launch operator shall implement operational procedures to ensure that	(2) Deleted	Command control system requirements moved to new advisory circular

launch support personnel do not safe a flight termination system by radio command until the launch vehicle attains orbit or can no longer reach any populated or other protected area.		
(e) Safe and arm monitoring. The design of a flight termination system must provide for remote monitoring of the safe and arm status of each flight termination system ordnance initiation device and arming device. Safe and arm monitoring circuits must comply with appendix D of this part.	(e) Acceptable as is	No change recommended
§ 417.315 Flight termination system testing.	**§ 417.315 Flight termination ~~system~~ component testing.**	Section rewritten to cover only component level tests. System level test requirements covered in § 417.317.
(a) General. A launch operator shall use flight termination system components that satisfy the qualification, acceptance, and age surveillance test requirements provided in appendix E of this part and any other test requirements established during the licensing process. In addition, a flight termination system and its components shall be subjected to preflight tests in accordance with § 417.317.	(a) Deleted	Intent covered in new (a)
(b) Test plans. For each launch, a launch operator shall implement written test plans and procedures that specify the test parameters, including pass/fail criteria, for each test and the testing sequence required by appendix E of this part for the applicable component. A launch operator shall also implement test plans for the preflight tests required by §417.317. Upon review of a proposed launch, the FAA may identify and require additional testing needed to address any unique flight termination system design or operational environment.	(b) Deleted	Intent covered in new (a) Boeing Comments FAA approval of FTS test plans will increase cost and result in potential schedule impacts. FAA should delegate this work to the 45th. OSC Comments Clarification is needed regarding when additional requirements may be imposed. Additional requirements should only be imposed if the proposed launch does not meet the top level Ec requirement. If the Ec is met, and therefore public safety is assured, no additional testing/analysis/etc is needed. (b) ~~Upon review of a proposed launch~~, **As part of the requirements tailoring process,** the FAA may identify and require additional testing needed to address any unique flight termination system design

		or operational environment **where the risk to the public of the proposed launch would otherwise exceed allowable values.**
(c) Performance variation. All performance parameters measured during component testing shall be documented for comparison to previous and subsequent tests to identify any performance variations that may indicate potential workmanship or defects that could lead to a failure of the component during flight.	(c) Deleted	Intent covered in new (a). (Deleted words "workmanship or")
(d) Testing of piece parts. All electronic piece parts used in a flight termination system or a flight termination system component must be tested in accordance with appendix F of this part.	(d) Deleted	Intent covered in new §417.305 (f).
(e) Visual inspection. Visual inspections for workmanship and physical damage must be performed before and after each test.	(e) Deleted	Delete. Boeing Comments Cover in advisory circular
(f) Test reports. A launch operator shall prepare test reports for each launch. A test report must document all flight termination system test results and test conditions. Also, any analysis performed in lieu of testing shall be documented in a test report. The test results must be traceable to each applicable system and component using serial numbers or other identification. A test report must include any data that represents "family characteristics" to be used for comparison to subsequent tests of components and systems. Any test failure or anomaly, including any variation from an established performance baseline, must be documented with a description of the failure or anomaly, each corrective action taken, and all results of additional tests. Each test report must include a signed statement by each person performing the test and any analysis, attesting to the accuracy and validity of the results.	(f) Deleted	Moved to §417.317 (i). (Signature requirements changed to be match current practice) Redundant with § 417.9 OSC Comments Delete requirement
(1) Qualification test reports. A launch operator shall submit all qualification test reports to the FAA no	(1) Deleted	Intent covered in new (b). (6-month requirement deleted) Redundant with § 417.9

submit all qualification test reports to the FAA no later than six months prior to the first flight attempt. For subsequent launches of the same launch vehicle, a launch operator shall submit qualification test reports for any changes to the flight termination system.		deleted) Redundant with § 417.9 Boeing Comments Qualification test report required 6 months before flight Up to six month schedule slip if qualification report not complete in time Allow later submittal of qual test report if test is not completed within six months of launch
(2) Acceptance, age surveillance, and preflight test reports. A launch operator shall submit a summary of each acceptance and age surveillance test no later than 30 days prior to the first flight attempt for each launch. The summary must identify when and where the tests were performed and provide the results. Complete acceptance, age surveillance, and preflight test reports shall be made available to the FAA upon request. A launch operator shall immediately report any failure of a preflight test to the FAA. The resolution of a preflight test failure must be approved by the FAA through the licensing process prior to flight.	(2) Deleted	Intent covered in new (c) and new (d). (Requirement for summary reports for acceptance and age surveillance testing deleted - not per current practice). Failure notification also covered in § 417.317 (j). Boeing Comments Resolution of any preflight test failures through the formal FAA launch licensing process generates an excessive requirement in both time, paperwork and potential schedule impacts. Cost impacts if it occurs during vehicle processing on the ground would run $20,000 per day. Schedule impacts could result in delays of future missions. Provide an expedited on-site review and approval authority for failure analysis and resolution on the launch site, or delegate the responsibility and authority to the Range Safety and Base Commander as done presently.
(g) Redesign and retest. In the case of a redesign of a component due to a failure during testing, all previous tests applicable to the redesign shall be repeated unless the launch operator demonstrates that other testing achieves an equivalent level of safety.	(g) Deleted	Intent covered in new (b) and (c). Boeing Comments Requalification after changing a component is currently negotiated with range safety. Probable frequent requalification for insignificant changes. Change requirement to state that any changes must be evaluated to determine if requalification is required.
(h) Configuration management and control. A launch operator shall ensure that a flight termination system component's manufactured parts, materials, processes, quality controls, and procedures are standardized and maintained in accordance with the	(h) Deleted	Moved to §417.305 (i).

	be tested to ensure no leakage voltage is present following activation. A launch operator shall ensure that the time interval between preflight activation and testing of a battery and flight does not exceed the battery's operating life stand time capability.	
	(f) Launch site ordnance tests. The launch operator shall perform the following tests prior to installation of safe arm devices or exploding bridgewire firing units on the vehicle.	Moved from §417.317. Consolidated original requirements, deleting detailed implementation. Deleted arbitrary10-day limit. A test timeframe constraint should not be written as law without good justification. Actual number should be a time agreed to by the launch operator and the FAA based on actual design Original (f)(2) Deleted preflight testing (covered in §417.317). Failure notification promoted to its own section. Requirement for failure notification moved to §417.317 and changed to match current EWR 127-1 requirement
	(1) Preflight testing for safe and arm devices shall include visual checks for signs of physical defects and continuity and resistance checks of the electro-explosive device circuit in both the arm and safe position.	
	(2) Preflight testing for an exploding bridgewire firing unit must include verification of bridgewire continuity and high voltage static and dynamic gap breakdown voltage tests where applicable.	
§ 417.317 Flight termination system preflight testing.	**§ 417.317 Flight termination system ~~preflight~~ testing.**	Section rewritten to cover only system level tests performed after the components are installed on the vehicle. All component tests (including preflight testing) were moved to § 417.315. Tests for command control system moved to advisory circular.
(a) General. A launch operator shall conduct preflight flight termination system testing at the component level and the system level in accordance with this	(a) General. A launch operator shall **perform** ~~conduct preflight~~ flight termination system testing ~~at the component level and the system level~~ in accordance	Top requirement is to test systems in accordance with approved test plans and procedures.

section and the applicable requirements provided in § 417.315.	**with approved test plans and procedures.** ~~this section and the applicable requirements provided in § 417.315.~~	LM Comment For commercial launches from federal ranges, the FAA should delegate approval of test plans and procedures to the safety wings or other existing safety agency. Boeing Comments Specifies detailed FTS Testing requirements. Excruciating detail to be established by public law. Move to advisory to be used as guidance OSC Comments Test flow of fielded systems is proven safe and effective. No modifications are necessary. All fielded systems should be grandfathered.
(b) Preflight component tests. Preflight component tests shall be conducted at the launch site after qualification and acceptance testing to detect any change in performance that may have resulted from shipping, storage, or other environments that may have affected performance. Performance parameter measurements shall be made during preflight component tests and compared to the acceptance test performance baseline to identify any performance variations, including out-of-family data, which may indicate potential defects that could result in an in-flight failure. Preflight component tests shall be conducted in accordance with this section.	(b) Deleted	Intent covered in new § 417.315
(c) Batteries. Each flight termination system battery shall be tested as follows:	(c) Deleted	Battery activation and test covered in new § 417.315 (e) Boeing Comments Excruciating detail to be established by public law. Decrease detail and allow some variability since testing may change between batteries used or as designs change.
(1) The preflight activation and testing of a flight termination system battery prior to installation on a launch vehicle shall include:	(1) Deleted	
(i) Any acceptance testing not previously completed.	(i) Deleted	By definition, acceptance tests will be completed prior to delivery.

		delivery
(ii) Open circuit testing of each flight termination system battery and each battery cell.	(ii) Deleted	Individual battery cell measurements not available for current FTS potted monoblock batteries
(iii) Load testing of each completed battery assembly.	(iii) Deleted	
(iv) Testing of continuity and isolation of each connector.	(iv) Deleted	Performed prior to activation
(v) For manually activated batteries, the pin to case voltage shall be tested to ensure no electrolyte spillage during activation.	(v) Deleted	Intent is to verify that no leakage voltage is present following activation
(2) A launch operator shall ensure that the time interval between preflight activation and testing of a battery and flight does not exceed the battery's operating life stand time capability.	(2) Deleted	
(3) Battery activation processes and procedures shall be identical to those used during qualification testing.	(3) Deleted	Changed "identical" to "similar" for practicality
(4) The preflight testing of a nickel cadmium battery prior to installation shall satisfy the following requirements and in the following order:	(4) Deleted	Level of detail on NiCad battery testing is inappropriate to be written into law, should be moved to advisory circular. LM Comment Requirements should also consider manufacturers recommendations. Also, the addition of detailed requirements for NiCad batteries twenty plus years after NiCad batteries have been in existence shows that technology insertion in a regulatory document is difficult. How much more difficult will it be when it becomes a law? The requirements at the subpart level should be general enough to cover silver-zinc, NiCad, lithium, or any other battery used in space applications. An advisory circular would be a better place to provide guidance on detailed activation processes.
(i) The battery shall be initially charged at a rate equal to the battery amp hour capacity divided by 20 (C/20 rate) for 2 hours and then further charged at a C/10 rate for 15 hours.	(i) Deleted	
(ii) The battery shall then be discharged at a C/2 rate to 0.9 volts per cell bottom voltage, then discharged at	(ii) Deleted	

0.9 volts per cell battery voltage, then discharged at C/10 rate until the first cell reaches 0.1 volts.		
(iii) The battery shall then be discharged across a resistor with resistance in ohms equal to the number of cells in the battery times 10 divided by the battery amp hour capacity until the first battery cell reaches 0.05 volts.	(iii) Deleted	
(iv) The battery shall then be recharged at 20 +/- 5°C and at a C/10 rate for 16 hours.	(iv) Deleted	
(v) The battery shall then be subjected to 20°C capacity and overcharge testing for 3 cycles.	(v) Deleted	
(vi) The battery shall then be subjected to capacity retention and final impedance and pulse voltage determination at 20°C and then discharged at -10°C for 1 cycle.	(vi) Deleted	
(d) Preflight testing of a safe and arm device that has an internal electro-explosive device. An internal electro-explosive device in a safe and arm device shall undergo preflight testing in accordance with the following:	(d) Deleted	See § 417.315
(1) Preflight testing shall be performed no earlier than 10 calendar days before flight.	(1) Deleted	Boeing Comments Schedule limitations occasionally lead to 11-14 days between S&A checkout and the first launch attempt, violating requirement. Subsequent scrubs also would lead to violations. Schedules would need to be compressed in some cases to insure checkout within 10 days. This will occasionally conflict with 60 hour maximum workweek for launch site personnel. Permit checkout either 5 days prior to installation and 120 days prior to launch, or permit checkout within 15 days of first scheduled launch attempt and 120 days prior to actual launch. Orbital Comments Current Pegasus requirement is to bench test Safe and Arm devices at launch –120 days.

		LM Comments This is an excellent example of why the proposed requirements must go through a formal process of being validated. Industry should participate in this process. In our view there is no technical justification for having this time constraint. Ultimately, this type of requirement will result in heroic and unnecessary efforts on the part of both the regulatory agency and the launch operator when the time limit has expired. All such time constraints should be evaluated and rewritten to state the real requirement (if one exists) not an arbitrary time constraint. Incidentally, our currently approved EELV tailoring allows 21 days.
(2) Preflight testing must include visual checks for signs of physical defects.	(2) Deleted	
(3) Preflight testing must include safing and arming each device and performing continuity and resistance checks of the electro-explosive device circuit in both the arm and safe position.	(3) Deleted	
(e) Preflight testing for an external electro-explosive device. An external electro-explosive device in a safe and arm device shall undergo preflight testing in accordance with the following:	(e) Deleted	See § 417.315
(1) Preflight testing shall be performed no earlier than 10 calendar days before flight.	(1) Deleted	
(2) Preflight testing must include visual checks for signs of physical defects and resistance checks of the electro-explosive device.	(2) Deleted	
(f) Preflight testing for an exploding bridgewire firing unit. An exploding bridgewire firing unit must undergo preflight testing in accordance with the following:	(f) Deleted	See § 417.315
(1) Preflight testing shall be performed no earlier than 10 calendar days before flight.	(1) Deleted	
(2) Preflight testing must include verification of bridgewire continuity.	(2) Deleted	

bridgewire continuity.		
(3) Where applicable, preflight testing shall include high voltage static and dynamic gap breakdown voltage tests.	(3) Deleted	
(g) Preflight testing for command destruct receivers and other electronic components. Electronic components shall include any flight termination system component that contains piece part circuitry such as a command destruct receiver. A launch operator shall conduct preflight testing of a command destruct receiver or other electronic component in accordance with the following:	(g) Deleted	Deleted requirement for preflight component testing of CRDs or alternate acceptance testing within 180 calendar days of flight. Preflight testing has not been historically been performed for Atlas vehicles on the Eastern Range. The 180 day requirement is viewed by the Industry as arbitrary and not technically justifiable. Command Destruct Receivers should be acceptable if flown within their specified shelf life. Preflight system tests are adequate to identify latent defects.
(1) Preflight testing shall be accomplished no earlier than 180 calendar days prior to flight. If the 180-day period expires before flight, an installed electronic component must either be replaced by one that meets the 180-day requirement or tested in place in accordance with an alternate preflight test plan that must be approved by the FAA, through the licensing process, prior to its implementation.	(1) Deleted	Boeing Comments If the time limit between CRD bench test and launch is exceeded (usually due to unforeseen launch delays), we have been able to negotiate extensions on a case-by-case basis Possible one day launch delay Allow negotiation of requirement on a case-by-case basis
(2) Preflight testing must measure all performance parameters at ambient temperature. The test procedures must satisfy the requirements of appendix E of this part.	(2) Deleted	Boeing Comments The CRD bench test set does not have capability for measuring resistance or VSWR Requires purchase and use of additional test equipment Remove "all" before "performance" (2) Preflight testing must measure ~~all~~ **critical** performance parameters at ambient temperature. ~~The test procedures must satisfy the requirements of appendix E of this part.~~
(3) Acceptance tests may be substituted for the preflight tests if the acceptance tests are performed no earlier than 180 calendar days prior to flight.	(3) Deleted	
(h) Preflight subsystem and system level tests. A launch operator shall conduct preflight subsystem	(h) Acceptable as is	No change recommended

and system level tests of the flight termination system after its components are installed on a launch vehicle to ensure proper operation of the final subsystem and system configurations. Data obtained from these tests shall be compared for consistency to the preflight component tests and acceptance test data to ensure there are no discrepancies indicating a flight reliability concern. Preflight subsystem and system level tests shall be in accordance with the following:		
(1) Antennas and associated radio frequency systems shall be tested once installed in their final flight configuration to verify that the voltage standing wave ratio and any insertion losses are within the design limits.	(i) Acceptable as is	No change recommended
(2) A launch operator shall perform a system level radio frequency preflight test from each command control system transmitter antenna used for the first stage of flight to each command receiver no earlier than 90 days before flight to validate the final integrity of the radio frequency system. These tests shall include calibration of the automatic gain control signal strength curves, verification of threshold sensitivity for each command, and verification of operational bandwidth.	(2) A launch operator shall perform a system level radio frequency preflight test from each command control system transmitter antenna used for the first stage of flight to each command receiver ~~no earlier than 90 days before flight~~ to validate the final integrity of the radio frequency system. **The launch operator shall also perform functional testing of each command destruct receiver.** These tests shall include calibration of the automatic gain control signal strength curves, verification of threshold sensitivity for each command, and verification of operational bandwidth.	Deleted 90-day constraint. This timeframe is arbitrary - ok if used as guideline but not if as a law. Added sentence "The launch operator shall also perform functional testing of each command destruct receiver." To distinguish between open loop and system testing and document current practice. OSC Comments Use of command destruct antennas during testing 90 days prior to launch is impractical and provides zero benefit. The C/D transmitters will be de-configured and reconfigured multiple times from L-90 to launch. C/D transmitters will be used on day of launch interface testing with the launch vehicle. Calibration curves using C/D transmitters in open-loop configuration would be difficult to achieve due to ground effects. Calibration curves should only be generated using closed loop systems.
(3) A launch operator shall perform end-to-end tests on all flight termination system subsystems, including command destruct systems and inadvertent separation destruct systems. End-to-end tests shall be performed no earlier than 72 hours before the first flight attempt. If the flight is delayed more	(3) A launch operator shall perform end-to-end tests on all flight termination system subsystems, including command destruct systems and inadvertent separation destruct systems. ~~End-to-end tests shall be performed no earlier than 72 hours before the first flight attempt. If the flight is delayed more~~	Deleted 72-hour constraint. This timeframe is arbitrary - ok if used as guideline but not if as a law. Deleted requirement to repeat testing if launch is delayed more than 14 days. The 14-day requirement has no technical basis.

first flight attempt. If the flight is delayed more than 14 calendar days or the flight termination system configuration is broken or modified for any reason, such as to replace batteries, the end-to-end tests shall be repeated no earlier than 72 hours before the next flight attempt. A launch operator shall perform end-to-end tests with the flight termination system in its final onboard launch vehicle configuration except for the ordnance initiation devices. End-to-end tests must incorporate the following:	~~first flight attempt.~~ If ~~the flight is delayed more than 14 calendar days or~~ the flight termination system configuration is broken or modified for any reason, such as to replace batteries, the end-to-end tests shall be repeated ~~no earlier than 72 hours before the next flight attempt.~~ A launch operator shall perform end-to-end tests with the flight termination system in its final onboard launch vehicle configuration except for the ordnance initiation devices. End-to-end tests must incorporate the following:	
(i) A destruct initiator simulator that satisfies § 417.327 shall be installed in place of each flight initiator to verify that the command destruct and inadvertent separation destruct systems deliver the energy required to initiate flight termination system ordnance.	(i) **A destruct initiator simulator shall be installed in place of each flight initiator to verify that the command destruct and inadvertent separation destruct systems deliver the energy required to initiate flight termination system ordnance. This device must have electrical and operational characteristics matching those of the actual destruct initiator. A destruct initiator simulator must monitor the firing circuit output current, voltage, or energy, and latch on when the operating current, voltage, or energy for the initiating device is outputted from the firing circuit. Destruct simulators for low voltage initiators must provide a stray current monitoring device such as a fuse or automatic recording system capable of indicating a minimum of one tenth of the maximum no-fire current. This stray current monitoring device must be installed in the firing line.**	Moved words from § 417.327(i).
(ii) All flight termination systems shall be powered by the batteries that will be used for flight. A flight termination system battery shall not be recharged at any time during or after end-to-end testing. If the battery is recharged at any time before flight the entire end-to-end test shall be performed again.	(ii) Acceptable as is	No change recommended
(iii) All command destruct receiver commands shall be exercised <u>using the command control system transmitters in their flight configuration.</u>	(iii) **It is preferred that** all command destruct receivers ~~commands~~ shall be exercised using ~~the~~ **equivalent** command control system transmitters in ~~their~~ **a** flight-**like** configuration. **Use of signal generators**	The 72-hour tests do not exercise all commands open loop due to secure code requirements. <u>OSC Comments</u>

	~~by each person performing the test and any analysis, attesting to the accuracy and validity of the results.~~	Analysis results do not belong in test reports.
	(j) Failure Notification. A launch operator shall ~~immediately~~ report any failure of a preflight test to the FAA **verbally within 72 hours and then in writing within 14 calendar days of the date the failure is noted**. The resolution of ~~a~~ preflight test failures must be approved by the FAA ~~through the licensing process~~ prior to flight~~.~~	Was §417.315(f)(2). Changed immediate to 72 hours verbal and 14 days written to document current practice per EWR 127-1. Deleted reference to licensing process. LM Comments The proposed regulation should include documentation of the approval process for items such as this. Careful consideration should be given to the need resolve launch constraints quickly in order to preserve launch windows.
§ 417.319 Flight termination system installation procedures.	**§ 417.319 Flight termination system installation procedures.**	
(a) A launch operator shall implement written procedures to ensure that flight termination system components, including electrical components and ordnance, are installed on a launch vehicle in accordance with the flight termination system design. These procedures must ensure that:	(a) A launch operator shall implement written procedures to ensure that flight termination system components~~, including electrical components and ordnance.~~ are **correctly** installed ~~on a launch vehicle in accordance with the flight termination system design~~. These procedures must ensure that:	Deleted unnecessary words.
(1) All personnel involved are qualified for the task in accordance with § 417.105.	(1) All personnel involved are qualified for the ~~task~~ **tasks they are to perform** ~~in accordance with § 417.105.~~	Deleted unnecessary reference
(2) The installation of all flight termination system mechanical interfaces is complete.	(2) Acceptable as is	No change recommended
(3) Qualified personnel use calibrated tools to install ordnance when a specific standoff distance is necessary to ensure that the ordnance has the desired effect on the material it is designed to cut or otherwise destroy.	(3) ~~Qualified personnel use~~ **C**alibrated tools **are used** to install ordnance when a specific standoff distance is necessary to ensure that the ordnance has the desired effect on the material it is designed to cut or otherwise destroy.	Requirement for qualified personnel covered in (a)(1).
(b) Flight termination system installation procedures must include, but need not be limited to the following:	(b) Acceptable as is	No change recommended
(1) A description of each task to be performed, each facility to be used, and each and any hazard	(1) A description of each task to be performed, each facility to be used, and ~~each and~~ any hazards	Improved wording

involved.	involved.	
(2) A checklist of tools and equipment required.	(2) Acceptable as is	No change recommended
(3) A list of personnel required for performing each task.	(3) Acceptable as is	No change recommended
(4) Step-by-step directions written with sufficient detail for a qualified person to perform each task. The directions must identify any tolerances that must be met during the installation.	(4) Acceptable as is	No change recommended
(5) Steps for inspection of installed flight termination system components, including quality assurance oversight procedures.	(5) Acceptable as is	No change recommended
(6) A place for the personnel performing the procedure to initial or otherwise signify that each step is accomplished and for recording the outcome and any data verifying successful installation.	(6) A place for the personnel performing the procedure to initial or otherwise signify that each step is accomplished and for recording the outcome and any data verifying successful installation.	Boeing Comments Current checkout procedures do not include space behind each step for the personnel to initial that the step is accomplished Add space by each step in the procedure for personnel to initial. This make procedure cumbersome Allow current procedures and quality system
§ 417.321 Flight termination system monitoring.	**§ 417.321 Flight termination system monitoring.**	
(a) A launch operator shall ensure that the following data is available through monitoring to determine the status of a flight termination system prior to and during flight:	(a) ~~A launch operator shall ensure that data is available through monitoring to determine the~~ **The following parameters shall be included in the telemetry data stream to enable the** status of a flight termination system **to be monitored** prior to and during flight	Improved wording.
(1) The signal strength telemetry output voltage for the command destruct receiver.	(1) ~~The~~ Signal strength ~~telemetry output voltage~~ for ~~the~~ **each** command destruct receiver.	Improved wording.
(2) All command destruct receiver outputs commands.	(2) **Status of power to each command destruct receiver or automatic / inadvertent separation destruct system (ON/OFF)**	Clarification, added ADS / ISDS here deleted ISDS in (a)(9)
	(3) **Status of output commands for each** command destruct receiver **or automatic / inadvertent separation destruct system** ~~All command destruct receiver outputs commands.~~	Clarification, added ADS / ISDS here deleted ISDS in (a)(9)

(b) Monitor consoles must include all communications and monitoring capability necessary to ensure that the status of a flight termination system can be ascertained and relayed to the appropriate launch officials.	(b) Deleted	Monitor console requirements to be covered in the proposed advisory circular for Support Systems.
(d) A launch operator shall establish pass/fail flight commit criteria in accordance with § 417.113 for monitored flight termination system parameters to support launch abort decisions and to ensure a flight termination system is performing as required at the time of flight. The flight commit criteria shall be incorporated in a launch operator's launch plans as submitted to the FAA through the licensing process.	(c) A launch operator shall establish pass/fail flight commit criteria in accordance with § 417.113 for monitored flight termination system parameters to support launch abort decisions and to ensure a flight termination system is performing as required at the time of flight. The flight commit criteria shall be incorporated in a launch operator's launch plans as submitted to the FAA through the licensing process	This requirement is valid but seems out of place here.
§ 417.323 Command control system requirements.		
(a) General. A launch operator shall employ a command control system as part of a flight safety system. A command control system must consist of the flight safety system elements that ensure that a command signal will be transmitted if needed during the flight of a launch vehicle and received by the onboard vehicle flight termination system. A command control system, including all subsystems and support equipment, must satisfy the requirements of this section and must include, but need not be limited to the following:	(a) ~~General.~~ A launch operator shall employ ~~a~~ **an FAA approved** command control system as part of a flight safety system **for commercial launches from Non-Federal ranges. The launch operator is not required to oversee design, testing, or operation of command control systems used for federal ranges.** ~~A~~ **The** command control system must consist of the flight safety system elements that ensure that a command signal will be transmitted if needed during the flight of a launch vehicle and received by the onboard vehicle flight termination system. **Guidance on the design of command control systems is provided in FAA advisory circular TBD.** ~~A command control system, including all subsystems and support equipment, must satisfy the requirements of this section and must include, but need not be limited to the following:~~	Top requirement is to use an FAA approved command control system. Limited requirement to commercial launches from Non-Federal ranges. Added reference to new FAA advisory circular. See new 417.7 Note: The remainder of text in this section should be moved to new advisory circular. Note that references to the command control system throughout this document have been deleted. These will also need to be incorporated as appropriate in the new advisory circular when it is written.
(1) All flight termination system activation switches at a flight safety official console;	(1) Deleted	
(2) All intermediate equipment, linkages, and software;	(2) Deleted	
(3) Any auxiliary stations;	(3) Deleted	

(4) Each command transmitter and transmitting antenna; and	(4) Deleted	
(5) All support equipment that is critical for reliable operation such as power, communications, and air conditioning systems.	(5) Deleted	
(b) Compatibility. A launch operator's command control system must be compatible with the flight termination system onboard the launch operator's launch vehicle. A launch operator shall demonstrate compatibility through analysis and testing in accordance with § 417.315, § 417.325, § D417.15 of appendix D of this part, and § E417.19 of appendix E of this part.	(b) Deleted	
(c) Reliability design. A command control system must have a reliability design of 0.999 at a confidence level of 95 percent. A launch operator shall perform a system reliability analysis in accordance with § 417.329 to demonstrate whether a command control system satisfies this requirement. The reliability analysis must demonstrate the command control system's reliability when operating for the time period from completion of preflight testing and system verification performed in accordance with § 417.325(c) through initiation of flight and until the no longer endanger time determined in accordance with § 417.221(c). In addition, a launch operator's command control system must satisfy the following:	(c) Deleted	
(1) A command control system must not contain any single-failure-point that, upon failure, would inhibit the required functioning of the system or cause the transmission of an undesired flight termination message.	(1) Deleted	
(2) A command control system's design must ensure that the probability of transmitting an undesired or inadvertent command during flight is less than 1×10^{-7}.	(2) Deleted	
(d) Command control system delay time. A command control system's radio message delay time, from	(d) Deleted	

initiation of a flight termination command at the flight safety official console to transmission from the command transmitter antenna, must be sufficiently low to complete the transmission of the command destruct sequence of signal tones prior to an errant launch vehicle exiting the 3-dB point of the command antenna pattern.		
(e) Configuration management and control. The configuration of a command control system must be controlled in accordance with the launch operator's configuration management and control plan submitted during the licensing process according to § 415.119(e).	(4) Deleted	
(f) Electromagnetic interference. Each command control system component must be designed and qualified to function within the electromagnetic environment to which it will be exposed. A command control system must include electromagnetic interference protection to prevent any electromagnetic interference from inhibiting the required functioning of the system or causing the transmission of an undesired flight termination command. Electromagnetic interference protection must also be provided for any susceptible remote control data processing and transmitting systems that are part of the command control system.	(f) Deleted	
(g) Command transmitter failover. A command control system must include independent, redundant transmitter systems that automatically switch or "fail-over" from a primary transmitter to a secondary transmitter when a condition exists that indicates potential failure of the primary transmitter. The switch must be automatic and provide all the same command control system capabilities through the secondary transmitter system. The secondary transmitter system must respond to any transmitter system configuration and radio message orders established for the launch. A launch operator shall establish and implement fail-over criteria that trigger automatic switching from the primary	(g) Deleted	

transmitter system to the secondary system during any period of flight up to the no longer endanger time. A launch operator's fail-over criteria must account for each of the following transmitter performance parameters and failure indicators:		
(1) Low transmitter power,	(1) Deleted	
(2) Center frequency shift,	(2) Deleted	
(3) Tone deviation,	(3) Deleted	
(4) Out of tolerance tone frequency,	(4) Deleted	
(5) Out of tolerance message timing,	(5) Deleted	
(6) Loss of communication between central control and transmitter site,	(6) Deleted	
(7) Central control commanded status and site status disagree,	(7) Deleted	
(8) Transmitter site fails to respond to a configuration or radiation order within a specified period of time, and	(8) Deleted	
(9) Tone imbalance.	(9) Deleted	
(h) Radio carrier illumination. A command control system must be capable of providing the radiated power density that a flight termination system would need to activate during flight and in accordance with § 417.309(c). A launch operator shall ensure that manual or automatic switching between transmitter systems, including fail-over, does not result in the radio carrier being off the air long enough for the airborne flight termination system to be captured by some other unauthorized transmitter. This includes any loss of carrier and any simultaneous multiple radio carrier transmissions from two transmitter sites during switching.	(h) Deleted	
(i) Command control system monitoring and control. A command control system must be capable of being controlled and monitored from the flight	(i) Deleted	

safety official console and the transmitter sites in accordance with § 417.327(g). A command control system's design must allow for real-time selection of a transmitter, transmitter site, communication circuits, and antenna configuration. A launch operator shall establish procedures for sending commands from the transmitter sites in the event of a failure of the flight safety official console.		
(j) Transmitter system. A command control transmitter system must:	(j) Deleted	
(1) Transmit signals that are compatible with the airborne flight termination system in accordance with § D417.15 of appendix D of this part.	(1) Deleted	
(2) Ensure that commands transmitted to a flight termination system have priority over any other commands transmitted.	(2) Deleted	
(3) Employ an authorized radio carrier frequency and bandwidth.	(3) Deleted	
(4) Not transmit a signal that could interfere with other airborne flight termination systems on other launch vehicles that may operate from the same launch site. A launch operator shall coordinate with any launch site operator and other launch operators to ensure this requirement is met.	(4) Deleted	
(5) Transmit an output bandwidth that is consistent with the signal spectrum power used in the launch operator's link analysis performed in accordance with § 417.329(h).	(5) Deleted	
(6) Not transmit other frequencies that could degrade the airborne flight termination system's performance. Any spurious signal levels must be at least 60 dB below the radio frequency output signal level from the transmitter antenna.	(6) Deleted	
(7) Ensure that all requirements of this section are satisfied during application and removal of tone frequencies.	(7) Deleted	

(k) Command control system antennas. A command control system antenna or system of antennas must provide command signals to a flight termination system throughout normal and non-nominal launch vehicle flight regardless of launch vehicle orientation and must satisfy the following:	(k) Deleted	
(1) An antenna must have a beam-width that allows sufficient reaction time to complete the transmission of the command destruct sequence of signal tones prior to an errant launch vehicle exiting the 3-dB point of the antenna pattern. The beam-width and associated reaction time must account for the pointing accuracy of the antenna. The antenna beam-width must encompass the normal flight trajectory boundaries for the portion of flight that the antenna is scheduled to support.	(1) Deleted	
(2) Each antenna must be located to achieve line of site between the antenna and the launch vehicle during the portion of flight that the antenna is scheduled to support.	(2) Deleted	
(3) An antenna system must provide a continuous omni-directional radio carrier illumination pattern that covers the launch vehicle's flight from the launch point to no less than an altitude of 50,000 feet above sea level unless the launch operator demonstrates, clearly and convincingly, through the licensing process that an equivalent level of safety can be achieved with a steerable antenna for that portion of flight.	(3) Deleted	
(4) An antenna must radiate circularly polarized radio waves that are compatible with the flight termination system antennas on the launch vehicle.	(4) Deleted	
(5) A steerable antenna must be controlled manually at the antenna site or by remote slaving data from a launch vehicle tracking source.	(5) Deleted	
(6) A steerable antenna must be capable of supplying the required power density in accordance with paragraph (h) of this section to the flight		

(3) When a component is replaced or redesigned, all previous acceptance and preflight tests shall be repeated.	(3) Deleted	
(4) Modifications to command control system hardware and software shall be validated with end to end regression testing.	(4) Deleted	
(5) Compatibility of the command control system with a launch vehicle's onboard flight termination system shall be tested independently and as part of preflight testing.	(5) Deleted	
(b) Acceptance testing. All new or modified command control system hardware and software must undergo acceptance testing to verify that the system meets the functional and performance requirements in § 417.323. Acceptance testing shall include system interface validation, integrated system-wide validation, and must satisfy the following:	(b) Deleted	
(1) All new or modified command control system hardware and software shall be validated using a system acceptance test plan. A system acceptance test plan shall include testing of the new components or subsystems, system interface validation, and integrated system wide validation. The system acceptance test plan and the results of the acceptance testing shall both be reviewed by and signed as accurate by the launch operator's launch safety official.	(1) Deleted	
(2) A launch operator shall ensure that a failure modes and effects analysis is performed for the design of each new system and any modification to an existing system.	(2) Deleted	
(3) Computing systems and software testing must satisfy the requirements of § 417.123 and appendix H of this part.	(3) Deleted	
(4) A launch operator shall ensure that testing is performed to measure and validate the command control system performance parameters contained	(4) Deleted	

in § 417.323.		
(c) Preflight testing. A command control system shall undergo preflight testing in coordination with preflight testing of an associated flight termination system and must satisfy the requirements of § 417.317. In addition, preflight tests of a command control system to be performed in preparation for the coordinated flight termination system tests must satisfy the following requirements:	(c) Deleted	
(1) Auto carrier tests. A launch operator shall verify that, for any auto carrier switching system, the switching algorithm selects the proper transmitter site and the auto carrier switching system enables the selected site. This test may be conducted simultaneously with any theoretical data run. This test shall be performed no earlier than four hours before a scheduled flight time.	(1) Deleted	
(2) Command transmitter switching tests. A launch operator shall perform an open loop end-to-end verification test of each element of a command control system from the flight safety official console to each command transmitter site to verify the integrity of the overall system. A launch operator shall ensure that successful verification is performed for each flight safety official console and remote command transmitter site combination. The verification must be initiated by transmitting all functions programmed for the launch from the flight safety control console. The verification shall be concluded at each command transmitter site by operator confirmation that the proper function commands were received. This test may be performed simultaneously with the independent radio frequency open loop validation required by paragraph (c)(3) of this section. A launch operator shall conduct switching tests in accordance with the following:	(2) Deleted	

(i) The verification shall be conducted as close to the planned flight time as operationally feasible and must be repeated in the event that the command control system configuration is broken or modified before launch.	(i) Deleted	
(ii) All measurements will be repeated for each flight safety official console and remote command site combination, for all strings and all operational configurations of cross-strapped equipment.	(ii) Deleted	
(3) Independent radio frequency open loop verification tests. A launch operator shall perform an open loop end-to-end verification of each element of a command control system from the flight safety official console to each command transmitter site to quantitatively verify the quality of the transmitted information. This verification must be performed for each flight safety official console and remote command transmitter site combination. The verification shall be initiated by transmitting all functions programmed for the launch from the flight safety control console. The verification shall be concluded, at each command site, by measuring all applicable parameters received and transmitted with analysis equipment that does not physically interface with any elements of the operational command control system. This verification may be performed simultaneously with the switching tests required by paragraph (c)(2) of this section. A launch operator shall conduct open loop end-to-end verification tests in accordance with the following:	(3) Deleted	
(i) The verification shall be conducted as close to the planned launch time as operationally feasible and must be repeated in the event that the command control system configuration is broken or modified before launch.	(i) Deleted	
(ii) Test equipment must be capable of validating transmission of the required parameters.	(ii) Deleted	
(iii) All measurements shall be repeated for each flight safety official console and remote command	(iii) Deleted	

transmitter site combination, for all strings and all operational configurations of cross-strapped equipment.		
(iv) The test code used for arm and destruct shall include at least one occurrence of each tone programmed for the specific mission.	(iv) Deleted.	
(v) The testing must verify that all critical command control system performance parameters are within their performance specifications. These parameters include, but need not be limited to:	(v) Deleted	
(A) Transmitter power output,	(A) Deleted	
(B) Center frequency stability,	(B) Deleted	
(C) Tone deviation,	(C) Deleted	
(D) Tone frequency,	(D) Deleted	
(E) Message timing,	(E) Deleted	
(F) Status of communication circuits between the flight safety official console and any supporting command transmitter sites,	(F) Deleted	
(G) Status agreement between the flight safety official console and any supporting command transmitter sites,	(G) Deleted	
(H) Fail-over conditions, and	(H) Deleted	
(I) Tone balance.	(I) Deleted	
(d) Test reports. A launch operator shall prepare test reports on command control system testing for each launch. A test report must document all command control system test results and test conditions. Also, any analysis performed in lieu of testing shall be documented in the test report. The test results must be traceable to each applicable system and component using serial numbers or other identification. Any test failure or anomaly, including any variation from an established performance baseline, must be documented with a description of the failure or anomaly, each	(d) Deleted	

corrective action taken, and all results of additional tests. A test report must identify any test failure trends. Each test report must include a signed statement by each person performing the test and any analysis, attesting to the accuracy and validity of the results. A launch operator shall submit an acceptance-test report summary to the FAA no later than 30 days prior to the first flight attempt. Any failure of a preflight test shall be reported to the FAA immediately. Resolution of all failures must be documented and approved by the FAA through the licensing process prior to flight.		
§ 417.327 Support systems.		§ 417.337 created for LV Tracking. §417.339 created for LV Telemetry. Remainder of text pertaining to ground support systems should be moved to advisory circular.)
(a) General. A flight safety system must consist of compatible launch vehicle tracking, visual data source, telemetry, communications, data display, and data recording systems that support the flight safety official. Each support system must have written performance specifications that contain the particulars of how the system functions and satisfies the requirements of this section. For each launch, a launch operator shall perform tests of each support system to ensure it functions in accordance with its performance specifications.	(a) General. **Required flight safety support systems include ground systems used for launch vehicle tracking and telemetry, visual tracking, communications, data display, timing and data recording as well as the flight safety official's console. Flight safety systems for commercial launches from Non-Federal ranges must also include FAA-approved ground systems to support the flight safety system crew. Flight safety support systems, subsystems, and components used for Non-Federal ranges must be validated in accordance with FAA-approved test plans and procedures. The launch operator is not required to oversee design, testing, or operation of support systems used for federal ranges. Guidance on the design and test of these flight safety support systems is provided in FAA advisory circular TBD.** ~~General. A flight safety system must consist of compatible launch vehicle tracking, visual data source, telemetry, communications, data display, and data recording systems that support the flight safety official. Each support system must have written performance specifications that contain the particulars of how the~~	Top requirement is to use approved flight safety support systems, validated in accordance with FAA-approved test plans and procedures. Limited requirement to commercial launches from Non-Federal ranges. Added reference to new FAA advisory circular. See new 417.7

	~~system functions and satisfies the requirements of this section. For each launch, a launch operator shall perform tests of each support system to ensure it functions in accordance with its performance specifications.~~	
(b) Launch vehicle tracking. A flight safety system must include a launch vehicle tracking system that provides continuous launch vehicle position and status data to the flight safety official from liftoff through the time that the launch vehicle reaches orbit or can no longer reach any protected area. A launch vehicle tracking system for a launch that employs a flight safety system must satisfy the following requirements:	(b) Deleted	Launch vehicle tracking moved to new § 417.337 to facilitate separation of ground systems requirements from LV requirements.
(1) A tracking system must consist of two sources of valid launch vehicle position data. The two data sources must be independent of one another, and at least one source must be independent of any system or component associated with determining or measuring vehicle position or performance used to aid the vehicle guidance system unless the launch operator demonstrates, clearly and convincingly, through the licensing process that another approach, such as the use of redundant vehicle guidance units, provides an equivalent level of safety for the launch.	(1) Moved to new § 417.337	
(2) All ground tracking systems and components must be compatible with the tracking system components onboard the launch vehicle.	(2) Deleted	
(3) When a flight safety system uses radar as an independent tracking source, the vehicle must have a tracking beacon onboard the launch vehicle unless the launch operator provides a clear and convincing demonstration through the licensing process that any skin tracking maintains a tracking margin of no less than six dB above noise throughout the period of flight that the radar is used and that the flight control lines and flight safety limits account for the larger tracking errors associated with skin tracking.	(3) Moved to new § 417.337	

(4) Tracking system data must be provided to the flight safety official through the flight safety data display system at the flight safety official console.	(4) Deleted	
(5) A tracking system must verify the accuracy of any launch vehicle tracking data provided to the flight safety official during flight. A tracking source that is independent of any system used to aid the launch vehicle guidance system shall validate launch vehicle guidance data before a flight safety official uses the launch vehicle guidance data as a source of tracking data in the flight termination decision process.	(5) Deleted	
(c) Visual tracking. A flight safety system must include launch vehicle observers stationed at program and back azimuth positions to provide flight status data to the flight safety official at liftoff and during the early seconds of flight. A launch operator shall ensure that each launch vehicle observer meets the requirements of § 417.331(i) and § 417.331(j). Skyscreens or other visual data sources operated by a launch vehicle observer may be used as part of a launch operator's flight safety system.	(c) Deleted	
(d) Telemetry system. A flight safety system must include a telemetry system that provides continuous, accurate flight safety data during preflight operations, lift-off, and during flight until the launch vehicle reaches orbit or can no longer reach any populated or other protected area. A telemetry system must meet the following requirements:	(d) Deleted	Launch vehicle telemetry moved to new § 417.339 to facilitate separation of ground systems requirements from LV requirements.
(1) An onboard telemetry system must monitor and transmit data to the flight safety official console regarding the following:	(1) Deleted	
(i) Inertial measurement data from vehicle guidance and control.	(i) Deleted	
(ii) Vehicle flight performance data, including motor chamber pressure and thrust vector control data.	(ii) Deleted	
(iii) Status of onboard tracking system components.	(iii) Deleted	

(iv) All flight termination system monitoring data in accordance with §417.321.	(iv) Deleted	
(2) A telemetry receiving system must acquire, store, and provide real time data to the flight safety official for any flight termination decision.	(2) Deleted	
(3) A telemetry system must provide data to the flight safety official at the flight safety official console through the flight safety data processing system.	(3) Deleted	
(e) Communications system. A flight safety system must include a communications network that connects all flight safety functions with all launch control centers and any down range tracking and command transmitter sites. A flight safety system must provide for recording all data and voice communications channels during launch countdown and flight.	(e) Deleted	
(f) Flight safety data processing, display, and recording system. A flight safety system must include a flight safety data processing system that processes data for display and recording to support the flight safety official's monitoring of the launch. A flight safety data processing system must:	(f) Deleted	
(1) Receive vehicle status data from tracking and telemetry, evaluate the data for validity, and provide valid data for display and recording.	(1) Deleted	
(2) Perform any reformatting of the data as appropriate and forward it to display and recording devices.	(2) Deleted	
(3) Display real-time data against background displays of the nominal trajectory and flight safety limits established in accordance with the flight safety analysis required by subpart C of this part.	(3) Deleted	
(4) Display and record raw input and processed data at 0.1-second intervals.	(4) Deleted	
(5) Record the timing of when flight safety system commands are input by the flight safety official or other flight safety crewmembers.	(5) Deleted	

(g) Flight safety official console. A flight safety system must include a flight safety official console that contains the flight safety displays and controls used by a flight safety official. A flight safety official console must provide for monitoring and evaluating launch vehicle performance, provide for communications with other flight safety and launch personnel, and must contain the controls for initiating flight termination.	(g) Deleted	
(1) Data displayed on a flight safety official console must include, but need not be limited to, the following:	(1) Deleted	
(i) Instantaneous vacuum impact point or drag corrected debris footprint by tracking and telemetry state vectors.	(i) Deleted	
(ii) Present launch vehicle position and velocities as a function of time.	(ii) Deleted	
(iii) Vehicle status data from telemetry, including yaw, pitch, roll, and motor chamber pressure.	(iii) Deleted	
(iv) Flight termination system battery levels and receiver gain in relation to receiver sensitivity.	(iv) Deleted	
(v) Displays of nominal trajectory, flight safety limits, minimum time to endanger, no longer endanger time, and any overflight gate through a flight control line as determined by the launch operator's flight safety analysis performed in accordance with subpart C of this part.	(v) Deleted	
(vi) Displays of any video data to be used by the flight safety official such as video from optical program and flight line cameras.	(vi) Deleted	
(2) A flight safety official console must allow a flight safety official to turn a command transmitter on and off, manually switch from primary to backup transmitter antenna and switch between any transmitter sites. These functions shall be accomplished through controls at the flight safety official console or through communications links at	(2) Deleted	

the console between the flight safety official and command transmitter support personnel.		
(3) A flight safety official console must include a means of identifying to a flight safety official when the console has primary control of a command transmitter system.	(3) Deleted	
(4) A flight safety official console must provide a means of readily identifying whenever an automatic fail-over of the system transmitters has occurred.	(4) Deleted	
(5) A flight safety official console must be dedicated to the flight safety system and must not rely on time or equipment shared with other systems.	(5) Deleted	
(6) A flight safety official console's inherent delay from message initiation to transmission of the message leading edge must be no more than 55 milliseconds.	(6) Deleted	
(7) All data transmissions links between the console and each transmitter and antenna must consist of two or more complete and independent duplex circuits. These circuits must be routed so that they are physically separated from each other to eliminate any potential single failure point in the command control system in accordance with § 417.323(c)(1).	(7) Deleted	
(8) A launch operator shall employ hardware and procedural security provisions for controlling access to the flight safety official console and other related hardware. These security provisions must ensure no person or system can initiate a flight safety system transmission, either deliberately or inadvertently, unless the transmission is ordered by the flight safety official.	(8) Deleted	
(9) There must be two independent means for the flight safety official to initiate arm and destruct messages. The location and functioning of the controls must provide a flight safety official easy access to the controls and prevent inadvertent activation.	(9) Deleted	

(10) A flight safety official console must include a digital countdown for use in implementing the flight termination rules in accordance with § 417.113 that apply data loss flight times, earliest destruct time, and no longer endanger time determined in accordance with § 417.221. A launch operator shall also provide a manual method of applying the data loss flight times in the event that a flight safety system malfunction prevents the flight control official from viewing a digital countdown of the data loss flight times.	(10) Deleted	
(h) Support equipment calibration. A launch operator shall calibrate its support systems and any equipment used to test flight safety system components to ensure that measurement and monitoring devices that support a launch provide accurate indications.	(h) Deleted	
(i) Destruct initiator simulator. A launch operator shall use a destruct initiator simulator to simulate a destruct initiator during the flight termination system preflight tests required by § 417.317. This device must have electrical and operational characteristics matching those of the actual destruct initiator. A destruct initiator simulator must:	(i) Deleted	Moved to § 417.317 to consolidate requirements.
(1) Monitor the firing circuit output current, voltage, or energy, and latch on when the operating current, voltage, or energy for the initiating device is outputted from the firing circuit.	(1) Deleted	Moved to § 417.317 to consolidate requirements. Boeing Comments The S&A cannot monitor these parameters. Perhaps monitor these parameters elsewhere in the system.
(2) Remain connected throughout ground processing until the electrical connection of the actual initiators is accomplished.	(2) Deleted	Not per current practice
(3) Include an interlock capability that permits the issuance of destruct commands by test equipment only if the simulator is installed and connected to the firing lines.	(3) Deleted	Not per current practice Boeing Comments The S&A cannot monitor these parameters. Perhaps monitor these parameters elsewhere in the system.

		OSC Comments Unnecessary requirement. Adds complexity to the system. Current processing practices and application of destruct simulators adequately control all hazards. Delete Requirement.
(4) For low voltage initiators, provide a stray current monitoring device such as a fuse or automatic recording system capable of indicating a minimum of one tenth of the maximum no-fire current. This stray current monitoring device must be installed in the firing line.	(4) Deleted	Moved to § 417.317 to consolidate requirements.
(j) Timing system. A launch operator's flight safety system must include a timing system synchronized with the United States Naval Observatory, Washington DC. A launch operator shall use this system to time tag data; initiate first motion signals; synchronize flight safety system instrumentation, including countdown clocks; and time tag recordings of required data and voice communication channels during countdown and flight.	(j) Deleted	
§ 417.329 Flight safety system analysis.		
(a) General. A launch operator shall perform each system analysis defined by this section to verify that a flight termination system, a command control system, and their components meet the reliability requirements of this subpart. These analyses must be performed following standard industry system safety and reliability analysis methodologies. (Guidelines for performing system safety and reliability analyses may be obtained in FAA Advisory Circular AC 431A, draft available 4/21/99). For each analysis, a launch operator shall prepare an analysis report that documents how the analysis was performed and the findings in accordance with this section.	(a) General. **For all new or significantly modified equipment,** a launch operator shall perform ~~each~~ **analyses as required** ~~each system analysis defined by this section~~ to verify that a flight termination system~~, a command control system,~~ and its ~~their~~ components meet the ~~reliability~~ requirements of this subpart. These analyses must be performed following standard industry system safety and reliability analysis methodologies. (Guidelines for performing system safety and reliability analyses may be obtained in FAA Advisory Circular AC 431A, draft available 4/21/99). For each analysis, a launch operator shall prepare an analysis report that documents how the analysis was performed and the findings in accordance with this section.	(a) Deleted command control system. Analysis for command control system could be covered in § 417.323 or § 417.325 (if title changed to Command system testing and analysis). LM Comment This is a good example of how a document can be used as a guideline. This approach should be used wherever there are detailed guidelines to avoid writing specific implementation into law. Note that Industry has not reviewed this referenced document. Boeing Comments Identifies 11 specific types of analyses to be performed to verify safety of flight safety system. EWR 127-1 does

		not require all 11 of these specific analyses to verify safety of flight safety system. Some of these analyses are not currently being performed due to limited benefit or overlap with other analyses currently performed. Additional cost would be incurred to procure analytical tools and train analysts. Instead of the using the FAA's 11 specified analyses, document and allow the use of heritage analysis methodologies to verify safety of flight safety systems. The Delta II and III launch systems do not comply with many of the subparagraph requirements (i.e. sneak circuit analysis, bent pin analysis). Potential loss of launch approval due to non-compliance with requirements. The Delta II and III launch systems do not comply with many of the subparagraph requirements (i.e. sneak circuit analysis, bent pin analysis). Performing analyses on fielded, proven systems will be costly and may require modifications to the launch vehicle to if no deviations are allowed to the requirements. Modify requirement to allow existing systems that have been approved by Federal range safety to be exempt from these requirements. OSC Comments Fielded systems should be grandfathered. FTS reliability analyses allow designs to be evaluated during development so reliability can be optimized. Performing these analyses, and levying these design requirements provides no benefit to systems that have proven safe and reliable based upon the launch industry's record.
(b) System reliability analysis. A launch operator shall prepare a reliability analysis for the flight termination system and the command control system that demonstrates the analytical reliability of these systems. This analysis shall account for the probability of a flight safety system anomaly	(b) System reliability analysis. A launch operator shall prepare a reliability analysis for the flight termination system ~~and the command control system~~ that demonstrates the analytical reliability of these systems. This analysis shall account for the probability of a flight safety system anomaly	(b) Deleted command control system. LM Comments Reliability analysis of Command Control System (CCS) will only be performed for Commercial Launch sites. Federal Ranges will be responsible for their own CCS

occurring and its effects as determined by the fault tree analysis; failure modes, effects, and criticality analysis; and the sneak circuit analysis required by paragraphs (c), (d), and (i) of this section. A launch operator's flight termination system and command control system reliability analysis report must:	occurring and its effects as determined by the fault tree analysis; failure modes, effects, and criticality analysis; and/**or** the sneak circuit analysis required by paragraph~~s (c), (d), and (i)~~ **(e)** of this section. A launch operator's flight termination system ~~and command control system~~ reliability analysis report must:	Federal Ranges will be responsible for their own CCS. Reference comments to Paragraphs (c) and (d) below.
(1) Describe how the flight termination system and command control system meet the reliability design requirement of 0.999 at a confidence level of 95 percent.	See discussion of options in §417.305	
(2) Provide each reliability model used.	(2) Provide each reliability model used.	
(3) Provide computations on actual or predicted reliability for all subsystems and components.	(3) Provide computations on actual or predicted reliability for all subsystems and components.	
(4) Describe the effects of storage, transport, handling, maintenance, and operating environments on component reliability.	(4) Describe the effects of ~~storage, transportation, handling, maintenance, and~~ operating environments on component reliability.	Changed "transport" to "transportation". Reliability number is adjusted to account for flight environments. The effects of storage, transport, handling, and maintenance are not addressed (considered as benign). These environments are accounted for in qualification and acceptance testing.
(5) Describe the interface between the launch vehicle systems and the flight termination system.	(5) Describe the interface between the launch vehicle systems and the flight termination system.	
(c) Fault tree analysis. A launch operator shall perform a fault tree analysis to identify flight termination system paths and command control system paths that could permit an undesired event that would cause the flight safety system to fail to function. A launch operator shall include the probability of occurrence of any undesired event as part of each system's reliability design determination.	(c) ~~Fault tree analysis. A launch operator shall perform a fault tree analysis to identify flight termination system paths and command control system paths that could permit an undesired event that would cause the flight safety system to fail to function. A launch operator shall include the probability of occurrence of any undesired event as part of each system's reliability design determination.~~	Deleted words "and command control system paths". LM Comments A fault tree analysis (FTA) and a failure modes effects and criticality analysis (FMECA) identify failure modes and mechanisms within a given design. Requiring completion of both analysis would be a duplication of effort. Delete paragraphs (c) and (d) and combine under paragraph (e) Single failure point analysis.
(d) Failure modes effects and criticality analysis. A launch operator shall perform a failure modes effects and criticality analysis based on failures identified by a fault tree analysis to determine and document all possible failure modes and their	(d) ~~Failure modes effects and criticality analysis. A launch operator shall perform a failure modes effects and criticality analysis based on failures identified by a fault tree analysis to determine and document all possible failure modes and their~~	Deleted words "command control system". LM Comments A fault tree analysis (FTA) and a failure modes effects and criticality analysis (FMECA) identify failure modes

effects on flight termination system and command control system performance. The results of a failure modes effects and criticality analysis shall be used as input to the flight safety system reliability analysis. A failure modes effects and criticality analysis must:	~~effects on flight termination system and command control system performance. The results of a failure modes effects and criticality analysis shall be used as input to the flight safety system reliability analysis. A failure modes effects and criticality analysis must:~~	and mechanisms within a given design. Requiring completion of both analysis would be a duplication of effort. Delete paragraphs (c) and (d) and combine under paragraph (e) Single failure point analysis.
(1) Identify all failure modes and their probability of occurrence.	(1) Identify all failure modes and their probability of occurrence.	LM Comments The wording of this requirement implies that a certain probability of occurrence is acceptable. This limit should be specified in § 417.305
(2) Identify single point failure modes.	(2) Identify single point failure modes.	LM Comments The wording of this requirement implies that a certain probability of occurrence is acceptable. This limit should be specified in § 417.305
(3) Identify areas of design where redundancy is required pursuant to § 417.305.	(3) Identify areas of design where redundancy is required ~~pursuant to § 417.305~~.	Deleted words "pursuant to § 417.305" to match recommendation in § 417.305
(4) Identify functions, including redundancy, which are not or cannot be tested.	(4) Identify functions, including redundancy, which are not or cannot be tested.	
(5) Provide input to reliability modeling and predictions.	(5) Provide input to reliability modeling and predictions.	
(6) Include any potential system failures due to hardware, software, test equipment, or procedural or human errors.	(6) Include any potential system failures due to hardware, software, test equipment, or procedural or human errors.	
(e) Single failure point analysis. A launch operator shall perform a single failure point analysis to verify that no single failure can cause inadvertent flight termination system activation or disable the flight termination system or command control system.	(e) Single failure point analysis. A launch operator shall perform a single failure point analysis to ~~verify that no single failure can cause inadvertent flight termination system activation or disable the flight termination system or command control system.~~ **identify flight termination system paths and command control system paths that could permit an undesired event that would cause the flight safety system to fail to function. A launch operator shall estimate the probability of occurrence of any undesired event as part of each system's reliability design determination.** ~~A launch operator shall include the probability of~~	Deleted words "or command control system".

	~~occurrence of any undesired event as part of each system's reliability design determination.~~**The launch operator may use fault tree analyses, failure modes, effects, and criticality analyses, or other equivalent industry standard methods to meet this requirement.**	
(f) Fratricide analysis. A launch operator shall perform a fratricide analysis to verify that flight termination of a stage will not sever interconnecting flight termination system circuitry or ordnance to other stages until flight termination on the other stages has been initiated.	(f) Fratricide analysis. A launch operator shall perform a fratricide analysis to verify that flight termination of a stage will not sever interconnecting flight termination system circuitry or ordnance to other stages until flight termination on the other stages has been initiated.	
(g) Bent pin analysis. A launch operator shall perform a bent pin analysis for each component to verify that any single short circuit occurring as a result of a bent electrical connection pin shall not result in inadvertent system activation or inhibiting the proper operation of the flight termination system or command control system.	(g) Bent pin analysis. A launch operator shall perform a bent pin analysis for each component to verify that any single short circuit occurring as a result of a bent electrical connection pin shall not result in inadvertent system activation or inhibiting the proper operation of the flight termination system ~~or command control system~~.	Deleted words "or command control system".
(h) Radio frequency link analysis. A launch operator shall perform a radio frequency link analysis of the onboard flight termination system and command control system. This analysis must verify that the system is capable of reliable operation with signals, at the input to the receiver, having electromagnetic field intensity of 12dB below the intensity provided by the command transmitter in accordance with appendix D of this part. A link analysis must include path losses due to plume or flame attenuation, aspect angle, vehicle trajectory, ground system radio frequency characteristics, worst-case power loss due to antenna pointing inaccuracies, and any other attenuation factors. Guidelines for performing a radio frequency link analysis are provided in Range Commanders Council Standard 253 and may be obtained from the FAA.	(h) Radio frequency link analysis. A launch operator shall perform a radio frequency link analysis of the onboard flight termination system ~~and command control system~~. This analysis must verify that the system is capable of reliable operation with signals, at the input to the receiver, having electromagnetic field intensity of ~~12~~ 9 dB below the intensity provided by the command transmitter ~~in accordance with appendix D of this part~~. A link analysis must include path losses due to plume or flame attenuation, aspect angle, vehicle trajectory, ground system radio frequency characteristics, worst-case power loss due to antenna pointing inaccuracies, and any other attenuation factors. Guidelines for performing a radio frequency link analysis are provided in Range Commanders Council Standard 253 and may be obtained from the FAA.	Deleted words "and command control system". 12 dB minimum link margin changed to 9 dB to match existing requirements for Atlas II/III and Delta II vehicles. For Eastern Range launches, the link margins near the launch pad are typically much better than 12 dB, however we have concerns that we might not make 12 dB when the vehicle is nearing the end of coverage from Antigua. It is also our understanding that the new command systems being put in under the RSA program may have lower output power than current systems. Deleted words "in accordance with appendix D of this part". Appendix D does not cover this subject.
(i) Sneak circuit analysis. A launch operator shall perform a sneak circuit analysis to identify latent paths of an unwanted command that could, when all	(i) Deleted	Not generally performed per current practice

components are otherwise functioning properly, cause the occurrence of undesired, unplanned, or inhibited functions that could cause a flight termination system or command control system anomaly. The probability of such an anomaly occurring must be incorporated into each system's reliability determination in the system reliability analysis required by paragraph (b) of this section.		
(j) Software and firmware analysis. A launch operator shall analyze any flight safety system software or firmware that performs a software safety critical function to ensure reliable operation in accordance with appendix H of this part.	(j) Software and firmware analysis. A launch operator shall analyze any flight safety system software or firmware that performs a software safety critical function to ensure reliable operation ~~in accordance with appendix H of this part~~. **Guidance on software and firmware analysis is provided in TBD advisory circular.**	
(k) Flight termination system battery capacity analysis. A launch operator shall perform an analysis to demonstrate that a flight termination system battery has a total amp hour capacity equal to 150% of the capacity that the flight termination system requires to operate during flight plus the capacity needed for load and activation checks, preflight and launch countdown checks, and any potential launch hold time. For a launch vehicle that uses any solid propellant, the battery capacity must allow for an additional 30-minute hang-fire hold time. The battery analysis must also demonstrate each flight termination system battery's ability to meet the charging temperature and current control requirements of appendix D of this part.	(k) Flight termination system battery capacity analysis. A launch operator shall perform an analysis to demonstrate that a flight termination system battery has a total amp hour capacity **greater than or** equal to 150% of the capacity that the flight termination system requires to operate during flight plus the capacity needed for load and activation checks, preflight and launch countdown checks, and any potential launch hold time. For a launch vehicle that uses any solid propellant, the battery capacity must allow for an additional 30-minute hang-fire hold time. The battery analysis must also demonstrate each flight termination system battery's ability to meet the charging temperature and current control requirements ~~of appendix D of this part~~.	
(l) Flight termination system survivability analysis. A launch operator shall perform a flight termination system survivability analysis that accounts for breakup of the launch vehicle, with and without a commanded flight termination. The analysis shall be used to determine the design and location of the flight termination system components and subsystems. A flight termination system survivability analysis must account for:	(l) Flight termination system survivability ~~analysis~~ **assessment**. A launch operator shall perform a flight termination system survivability analysis that accounts for **expected** breakup of the launch vehicle~~, with and without a commanded flight termination~~. The analysis shall be used to determine the optimum ~~design and~~ location of the flight termination system components ~~and subsystems~~. A flight termination system	Boeing Comments We have never done this analysis, and don't know the results. Some failure modes are no doubt catastrophic and the system won't survive. This should be on a best effort basis. LM Comments Determining approximately where a launch vehicle

survivability analysis must account for:	survivability analysis must account for:	might break is do-able. Based on this we can try to optimize the location of FTS components within the equipment mounting constraints of our vehicles. Determining worst-case static acceleration or shock loads is not feasible. We are uncertain as to what was meant by the words "with and without a commanded flight termination". If this is intended to cover fratricide, this is already covered in (f) above. OSC Comments Breakup of a launch vehicle is a complex process that is dependent upon many variables. This analysis should be designed to predict a most likely breakup scenario.
(1) Breakup of the launch vehicle due to aerodynamic loading effects at high angle of attack trajectories during early stages of flight.	(1) Acceptable as is	No change recommended
(2) An engine hard-over nozzle induced tumble during various phases of flight for each stage.	(2) Acceptable as is	No change recommended
(3) The timing of launch vehicle staging and other events that, when they occur, can result in damaging flight termination system hardware or inhibit the functionality of flight termination system components or subsystems, including any inadvertent separation destruct system.	(3) Acceptable as is	No change recommended
~~§ 417.331 Flight safety system crew roles and qualifications.~~	~~§ 417.331 Flight safety system crew roles and qualifications.~~	Delete entire section. Move words to advisory circular. Top-level requirement per suggested rewrite of § 417.105 adequately addresses personnel qualifications.
(a) General. Flight safety system hardware must be operated by a flight safety system crew made up of a flight safety official and support personnel possessing the qualifications required by and carrying out the roles defined by this section. A launch operator shall ensure that its flight safety system crewmembers meet the qualification requirements of this section unless the launch operator demonstrates clearly and convincingly through the licensing process that an alternate approach provides an equivalent level of safety. A	(a) Deleted	Boeing Comments Too specific and includes requirements that current personnel and future personnel who "move up" may not meet. Also increases certification documentation requirements. Qualification of Flight Safety Officials creates a requirement that can only be met by a small number of individuals who are currently government employees located on federal launch ranges. New launch facilities

launch operator shall document each flight safety system crew position description and maintain documentation on individual crew qualifications, experience, and training as part of the personnel certification program required by § 417.105. A flight safety system crewmember may perform the roles of more than one position required by this section for a launch, provided that all the requirements of each role and related tasks are accomplished.		cannot meet these requirements for qualified personnel at the top level (16 launches required) and contractors for commercial launches on federal launch ranges will require government personnel to perform these functions in order to meet the requirements. Government unlikely to turn over responsibility to operate their consoles to contractor personnel at federal launch ranges, requiring the Launch Operator to contract for their services. Have the government continue to provide operators and safety officials for all launches out of federal ranges or initiate a training program to train and qualify range safety console operators from industry to operate the consoles for commercial launches. LM Comments These subsections should be deleted. The requirement for the launch operator's operations organization should be contained in the license and agreed with during the licensing process. The definitions are too restrictive and the qualifications do not allow the operator to propose alternative uses of personnel. The rules for the safety organization restrict the operator to use only previously government range personnel for their safety roles and require the inclusion of positions only used by government ranges. Each launch operator should propose an organization that meets the intent of the rules governing safety and supply personnel names and qualifications to support this organization. The license should specify that the operator perform the launch with the approved organization and any changes will be subject to review by the FAA. The guidelines that the FAA wishes the contractor to use can be included in subsequent, non-binding documentation and the review process will allow the FAA and the contractor to mutually agree on the correct make-up and qualifications for the launch crew.
(b) Flight safety system crew qualifications. In addition to the qualifications required for specific flight safety system crew positions, all flight safety system	(b) Deleted	

crewmembers shall have at least four years experience in safety or a related discipline. The four years of experience must include all of the following:		
(1) Two years of experience in launch vehicle or missile operations, aircraft operations, missile or aircraft range operations, or weapons controller operations, while performing duties and functions that require critical real time decision-making.	(1) Deleted	
(2) Knowledge and experience in communications systems and procedures, including both voice and data.	(2) Deleted	
(3) Knowledge and experience in computers, graphical data systems, radar and telemetry real-time data, and flight termination systems.	(3) Deleted	
(4) Training to become familiar with the launch site, launch vehicle, and all applicable flight safety system functions, equipment, and procedures related to a launch before being called upon to support that launch. Each member of the flight safety system crew shall undergo a preflight readiness training program that includes hands-on exercises and simulations of multiple launch scenarios and launch vehicle failure modes.	(4) Deleted	
(c) Senior flight safety official role. A launch operator shall designate a senior flight safety official that reports directly to the launch safety director identified in § 417.103, oversees the training and certification of flight safety system crewmembers, defines crew needs for specific launches, and supervises crew performance as follows:	(c) Deleted	
(1) A senior flight safety official shall, during the flight of a launch vehicle, oversee in person the flight safety official's decisions with respect to the flight safety system, including initiation of flight termination. A senior flight safety official may perform as a backup for the flight safety official.	(1) Deleted	

(2) A senior flight safety official shall certify each member of the flight safety system crew for each launch. A senior flight safety official shall develop and implement a certification program that includes:	(2) Deleted	
(i) Mission specific training programs to ensure team readiness.	(i) Deleted	
(ii) Dynamic launch simulation exercises of system failure modes designed to test crew performance, flight termination criteria, and flight safety data displays.	(ii) Deleted	
(3) A senior flight safety official shall certify each member of the flight safety system crew as fully qualified when the crewmember is able to perform the functions of a specific crew position for each launch. The senior flight safety official shall:	(3) Deleted	
(i) Verify that a candidate crewmember meets the qualification, training, and performance requirements of the position.	(i) Deleted	
(ii) Identify and implement any additional training, exercises, and refresher training needed to ensure that a crewmember is qualified for each launch.	(ii) Deleted	
(d) Senior-flight safety official qualifications. A senior flight safety official shall be a qualified flight safety official as described by paragraph (f) of this section with no fewer than three years of flight safety system crew experience. In addition, a senior flight safety official for a specific launch shall have supported or been the flight safety official on at least one prior launch of that or an equivalent launch vehicle.	(d) Deleted	
(e) Flight safety official role. A launch operator shall designate a flight safety official for each launch who shall:	(e) Deleted	
(1) Monitor the flight of the vehicle by means of real-time displays of tracking data, including present position and any instantaneous impact point or	(1) Deleted	

debris footprint.		
(2) Monitor video information, telemetry data, and communications from other flight safety system crewmembers who advise the flight safety official on the status of their task.	(2) Deleted	
(3) Initiate any required flight termination in accordance with the flight termination rules established in accordance with § 417.113.	(3) Deleted	
(f) Flight safety official qualifications. In addition to the qualifications required by paragraph (b) of this section, a flight safety official shall have the following knowledge, experience and training:	(f) Deleted	
(1) A bachelors degree in engineering, mathematics, physics or other scientific discipline with equivalent mathematics and physics requirements or equivalent technical experience and education.	(1) Deleted	
(2) Knowledge of the application of safety support systems such as position tracking sources, digital computers, displays, command destruct, communications, and telemetry.	(2) Deleted	
(3) Knowledge of the electrical functions of a flight termination system and understanding of the principles of radio frequency transmission and attenuation.	(3) Deleted	
(4) Knowledge of the behavior of ballistic and aerodynamic vehicles in-flight under the influence of aerodynamic forces.	(4) Deleted	
(5) Experience in missile, space, or aircraft operations requiring real-time decisions in response to changing conditions.	(5) Deleted	
(6) Experience as a certified telemetry safety official as defined in paragraph (g) of this section for at least one launch.	(6) Deleted	
(7) Experience as a certified back azimuth observer as defined in paragraph (i) of this section for at least	(7) Deleted	

one launch.		
(8) Experience as a certified program observer as defined in paragraph (i) of this section for at least one launch.	(8) Deleted	
(9) Experience, for at least one launch, as an observer of a qualified flight termination system safety official as defined in paragraph (k) of this section.	(9) Deleted	
(10) Experience as an observer and assistant to a qualified flight safety analyst as defined in paragraph (m) of this section on all preparations for at least one launch.	(10) Deleted	
(11) Training on all the components that are involved in the calculation and production of the flight safety displays and the computations of probability of impact and expected casualty. This training shall include the interrelationships and sensitivity of the results to changes in each of the components.	(11) Deleted	
(g) Telemetry safety official role. A launch operator shall designate a telemetry safety official for each launch. The safety official shall monitor real-time safety telemetry data from the launch vehicle and advise the flight safety official when normal planned events occur and when any anomalous condition occurs.	(g) Deleted	
(h) Telemetry safety official qualifications. In addition to the qualifications required by paragraph (b) of this section, a telemetry safety official shall have the following knowledge, experience, and training:	(h) Deleted	
(1) A working knowledge of telemetry data displays such as strip chart recorders and digital readout systems. A telemetry safety official must know the purpose of each telemetry parameter displayed, know the nominal operating range of each parameter, and recognize anomalous conditions as they occur.	(1) Deleted	
(2) Experience, for at least one launch, as an observer of a qualified telemetry safety official	(2) Deleted	

of a qualified telemetry safety official.		
(3) Experience performing as a telemetry safety official during training simulations that involve playback of telemetry data on at least three nominal and two failure mission scenarios.	(3) Deleted	
(4) Experience as a telemetry safety official, under the supervision of a qualified telemetry safety official, for at least one launch.	(4) Deleted	
(i) Launch vehicle observer role. A launch operator shall designate back azimuth and program launch vehicle observers to establish and remain in visual contact with the launch vehicle during the early portion of flight when the tracking sensors are unable to provide position and predicted impact data to the flight safety official. Vehicle observers shall be in direct communication with, and advise the flight safety official when the launch vehicle engines ignite, the launch vehicle lifts off the pad, and when the launch vehicle pitches over and proceeds downrange. A flight safety system crew shall include, but is not limited to, the following launch vehicle observers:	(i) Deleted	
(1) Back azimuth observer. An observer located 180 ± 10 degrees behind the projected launch azimuth.	(1) Deleted	
(2) Program observer. An observer located along a line that passes through the launch point and that is perpendicular within ± 10 degrees to the projected launch azimuth.	(2) Deleted	
(j) Launch vehicle observer qualifications. In addition to the qualifications required by paragraph (b) of this section, any observer at the back azimuth location and any observer at the program location shall have the following qualifications:	(j) Deleted	
(1) Training in failure modes and how failures would appear to the observer from the observer's location at the time of flight.	(1) Deleted	

(2) Experience observing a qualified launch vehicle observer at the location, for at least one launch.	(2) Deleted	
(3) Experience for at least two launches performing as a launch vehicle observer at the location, under the supervision of a launch vehicle observer qualified at that location.	(3) Deleted	
(k) Flight termination system safety official role. A launch operator shall designate a flight termination system safety official for each launch. This person shall monitor the proper installation and testing of the onboard flight termination system prior to flight and determine whether the command control system and the flight termination system are in the proper configuration and functioning properly immediately before flight. A flight termination system safety official shall provide real-time command control system support to the flight safety official during flight of a launch vehicle. The flight termination system safety official shall also coordinate with other flight safety system crewmembers in the development of mission rules, perform vehicle trajectory analysis, determine public protection lines and flight safety limits, and perform the flight safety system analyses required by § 417.329.	(k) Deleted	
(l) Flight termination system safety official qualifications. In addition to the qualifications required by paragraph (b) of this section, a flight termination system safety official shall have the following knowledge, experience and training:	(l) Deleted	
(1) A degree in engineering. A candidate flight termination system safety official may substitute equivalent technical experience and education in lieu of a degree.	(1) Deleted	
(2) Technical education, training, and experience in electronics, including command transmitters, antennas, and receivers/decoders.	(2) Deleted	
(3) Technical education, training, or experience in ordnance handling, ordnance safety, and	(3) Deleted	

effectiveness of ordnance devices.		
(4) Experience as an observer of a fully qualified flight termination system official for at least two launches.	(4) Deleted	
(5) Experience as a flight termination system safety official, under the supervision of a qualified flight termination system safety official, for at least one launch.	(5) Deleted	
(m) Flight safety analyst role. A launch operator shall designate a flight safety analyst for each launch. This person shall analyze whether a launch vehicle requires a flight termination system, evaluate flight safety data, establish flight safety hazard areas, prepare a flight safety plan in accordance with § 415.115, develop flight commit criteria and flight termination rules, establish and display flight safety limits, perform public safety analyses, and develop flight safety system crew training scenarios in coordination with the senior flight safety official.	(m) Deleted	
(n) Flight safety analyst qualifications. In addition to the qualifications required by paragraph (b) of this section, a flight safety analyst shall have the following knowledge, experience, and training:	(n) Deleted	
(1) A degree in engineering, mathematics, physics or other scientific discipline with equivalent mathematics and physics requirements.	(1) Deleted	
(2) Knowledge of orbital mechanics and aerodynamics.	(2) Deleted	
(3) Training on all components that are involved in the calculation and production of the range safety displays and the calculation of probability of impact and expected casualties. This training shall include the interrelationships and sensitivity of the results to changes in each of the components.	(3) Deleted	
(4) Experience as an observer and assistant to a qualified flight safety analyst on all the preparations for at least one launch.	(4) Deleted	
(5) Experience as a flight safety analyst under the supervision of a qualified flight safety analyst, on all	(5) Deleted	

supervision of a qualified flight safety analyst, on all the preparations for at least two launches.		
§§ 417.332 – 417.400 [Reserved]		
§ 417.337 Launch Vehicle Tracking Systems.		Words moved from § 415.327(b) to facilitate separation of vehicle requirements from range requirements. It may make sense to combine this section and §417.321.
Words moved from § 415.327(b)	(a) ~~Launch vehicle tracking~~. **General**. A flight safety system must include a launch vehicle tracking system that provides **near** continuous launch vehicle position and status data to the flight safety official from liftoff through the **end of flight safety crew responsibility as determined by the flight safety analysis.** ~~time that the launch vehicle reaches orbit or can no longer reach any protected area~~. A launch vehicle tracking system for a launch that employs a flight safety system must satisfy the following requirements:	LM Comments Some dropouts are expected due to plume attenuation, staging events, etc. This would be particularly true if GPS is used for tracking instead of C-Band Tracking. OSC Comments Redundant tracking is only required during the time that flight safety has command destruct capability on the launch vehicle. This time is determined by the flight safety risk analysis.
Words moved from § 415.327(b)(1)	(1) A tracking system must consist of two sources of valid launch vehicle position data. The two data sources must be independent of one another, and at least one source must be independent of any system or component associated with determining or measuring vehicle position or performance used to aid the vehicle guidance system unless the launch operator demonstrates, clearly and convincingly, ~~through the licensing process~~ that another approach, such as the use of redundant **or fault-tolerant vehicle guidance systems** ~~units~~, provides an equivalent level of safety for the launch. **A common power source (including, but not limited to the main vehicle battery) may be used to power both tracking sources at the launch operator's discretion.**	Deleted words "through the licensing process". Added words "or fault-tolerant vehicle guidance systems" to cover EELV concepts. OSC Comments Requirement for two sources of tracking is only valid during the time that flight safety has command destruct capability on the launch vehicle. This time is determined by the flight safety risk analysis. A shared power system simplifies the design of the vehicle avionics and tracking systems. Industry commonly designs vehicles in this configuration with proven track records.
Words moved from § 415.327(b)(2)	(2) When a flight safety system uses radar as an independent tracking source, the vehicle must have	It may be practical at some point to reference the RCC Standard for tracking as a guidance document.

	a tracking beacon onboard the launch vehicle unless the launch operator provides a clear and convincing demonstration through the licensing process that any skin tracking maintains a tracking margin of no less than six dB above noise throughout the period of flight that the radar is used and that the flight control lines and flight safety limits account for the larger tracking errors associated with skin tracking.	However, this would require further Industry review of the RCC document as well as a better understanding of how it would be applied.
§ 417.337 Launch Vehicle Telemetry System.		Words moved from § 415.327(d) to facilitate separation of vehicle requirements from range requirements.
(a) Telemetry system. A flight safety system must include a telemetry system that provides continuous, accurate flight safety data during preflight operations, lift-off, and during flight until the launch vehicle reaches orbit or can no longer reach any populated or other protected area. A telemetry system must meet the following requirements:	(a) ~~Telemetry system~~. **General**. A flight safety system must include a telemetry system that provides continuous, accurate flight safety data during preflight operations, lift-off, and during flight until the launch vehicle reaches orbit or can no longer reach any populated or other protected area. **The following data must be included in the launch vehicle telemetry stream**: ~~A telemetry system must meet the following requirements:~~	Improved wording. The Industry does not view this document to impose requirements on the vehicle telemetry system other than what data is to be provided. For example, as written there are no design, test, or analysis requirements for telemetry.
(1) An onboard telemetry system must monitor and transmit data to the flight safety official console regarding the following:	~~(1) An onboard telemetry system must monitor and transmit data to the flight safety official console regarding the following:~~	Requirement in this section should be limited to vehicle telemetry system. Flight safety console requirements should be covered in §417.327.
(i) Inertial measurement data from vehicle guidance and control.	**(1)** Inertial measurement data from vehicle guidance and control.	
(ii) Vehicle flight performance data, including motor chamber pressure and thrust vector control data.	**(2)** Vehicle flight performance data, including motor chamber pressure and thrust vector control data.	
(iii) Status of onboard tracking system components.	**(3)** Status of onboard tracking system components **as applicable**.	Need clarification of what is meant by "status of onboard tracking system components". Existing vehicle systems do not typically have telemetry status for the C-Band system. Some of the proposed wording in the RCC GPS Tracking Standard would require independent batteries for tracking with telemetry status for battery voltage, current, power changeover switches, etc. The Atlas vehicle telemetry and tracking systems are powered from the Centaur main vehicle battery through separate fuses. The Industry would view a requirement to use separate batteries for tracking and telemetry as excessive.

(iv) All flight termination system monitoring data in accordance with §417.321.	**(4)** All flight termination system monitoring data in accordance with §417.321.	

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
§ Part 417, Subpart E—Ground Safety		
Page 64036 **417.401 Scope.** This subpart contains public safety requirements that apply to launch processing and post-launch operations at a launch site in the United States. The ground safety requirements in this subpart apply to all activities performed by, or on behalf of, a launch operator at a launch site in the United States. A licensed launch site operator must satisfy the requirements of part 420 of this chapter. Launch processing and post-launch operations at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.	**For a licensed launch from a federal launch range where there is a federal range safety organization overseeing the safety of each licensed launch, the requirements contained in this subpart do not apply.** This subpart contains public safety requirements that apply to launch processing and post-launch operations at a **non-federal** launch site in the United States. The ground safety requirements in this subpart apply to all activities performed by, or on behalf of, a launch operator at a launch site in the United States. ~~A licensed launch site operator must satisfy the requirements of part 420 of this chapter Launch processing and post-launch operations at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.~~	Federal launch sites should be governed by their own launch requirements. Don't include launch site operator requirements here.
Page 64036 **§ 417.403 General.** (a) *Public safety.* A launch operator shall ensure that all hazard controls are in place to protect the public from any and all hazards associated with its launch processing at a launch site in the United States. (b) *Ground safety analysis.* A launch operator shall perform and document a ground safety analysis in accordance with § 417.405. (c) *Ground safety plan.* A launch operator shall implement the ground safety plan it submitted during the license application process according to § 415.117 of this chapter and in accordance with the launch plan requirements of § 417.111 and § 415.119 of this chapter. A launch operator shall ensure that its ground safety plan is readily available to the FAA, including	(a) *Public safety.* A launch operator shall ensure that all hazard controls are in place to protect the public from ~~any and all~~ **the identified potential** hazards associated with its launch processing at a launch site in the United States. ~~(b) *Ground safety analysis.* A launch operator shall perform and document a ground safety analysis in accordance with § 417.405.~~ (c) *Ground safety plan.* A launch operator shall implement the ground safety plan it submitted during the license application process. ~~according to § 415.117 of this chapter and in accordance with the launch plan requirements of § 417.111 and § 415.119 of this chapter. A launch operator shall ensure that its ground~~	Identifying "any and all" hazards is unrealistic. Since Ground safety analyses are defined in 417.405 then delete this part here. Define what the Ground safety plan is in one location. It is now in both 415.117 and here. Put the specific requirements for a ground safety plan in 415.117 and refer back to that section here.

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
safety plan is readily available to the FAA, including any FAA safety inspector at the launch site, and to personnel involved in operations at the launch site that could endanger the public. A launch operator shall keep current its ground safety plan for each launch and shall submit any change to the FAA no later than 15 days before the change is implemented. A launch operator shall submit any change that is material to public health and safety to the FAA for approval as a license modification in accordance with § 415.73 of this chapter. Any change that involves the addition of a hazard that could affect the public or the elimination of any previously identified hazard control for a hazard that still exists constitutes a material change. (d) *Local agreements* (e) *Launch operator's exclusive use of a launch site.* For a launch that is to be conducted from a launch site exclusive to its own use, a launch operator shall satisfy the requirements of this subpart and applicable requirements of part 420, including the requirements contained in §§ 420.31-420.37 and subpart D of part 420	~~chapter.~~ A launch operator shall ensure that its ground safety plan is **current for each launch.** ~~readily available to the FAA, including any FAA safety inspector at the launch site, and to personnel involved in operations at the launch site that could endanger the public. A launch operator shall keep current its ground safety plan for each launch. and shall submit any change to the FAA no later than 15 days before the change is implemented. A launch operator shall submit any change that is material to public health and safety to the FAA for approval as a license modification in accordance with § 415.73 of this chapter. Any change that involves the addition of a hazard that could affect the public or the elimination of any previously identified hazard control for a hazard that still exists constitutes a material change~~. (e) *Launch operator's exclusive use of a launch site.* For a launch that is to be conducted from a launch site exclusive to its own use, a launch operator shall **continue to demonstrate its ability to protect and ensure public safety**. ~~satisfy the requirements of this subpart and applicable requirements of part 420 of this chapter, including the requirements contained in §§ 420.31 through 420.37 and subpart D of part 420.~~	Specific requirements should be contained within subpart 417 and not referenced to other subparts, documents, etc.
Page 64037 **§ 417.405 Ground safety analysis** (a) A launch operator shall perform a ground safety analysis for all its launch vehicle hardware and launch processing at a launch site in the United States. This analysis must identify each potential public hazard, any and all associated causes, and any and all hazard controls that a launch operator will implement to keep each hazard from reaching the public. A launch operator's ground safety analysis must demonstrate whether its launch vehicle hardware and launch processing create public hazards. A launch operator shall incorporate any launch site operator's hardware	(a) **For a licensed launch of an established launch vehicle from an existing federal launch site using existing procedures where there is a federal range safety organization overseeing the safety of each licensed launch, the requirements contained in this part do not apply. For new launch systems**, a launch operator shall perform a ground safety analysis for all its launch vehicle hardware and launch processing at a launch site in the United States. This analysis must identify each potential public hazard, ~~any and all~~ associated causes, and ~~any and all~~ hazard controls that a	Only new systems should be subjected to this requirement since reassessing all the systems for an existing launch vehicle would cost prohibitive. Identifying "any and all" hazards, causes or controls is

FAA NPRM Paragraph	Suggested Change or Comment	Rationale
systems and operations into a ground safety analysis where these items are involved in ensuring public safety for the launch operator's launch vehicle and launch processing.	launch operator will implement to keep each hazard from reaching the public. A launch operator's ground safety analysis must demonstrate whether its launch vehicle hardware and launch processing create public hazards. A launch operator shall **list any of the launch site operator's** hardware systems and operations **that the launch operator is depending on for conducting their launch. For existing launch systems existing range safety approved documentation will be acceptable.** ~~into a ground safety analysis where these items are involved in ensuring public safety for the launch operator's launch vehicle and launch processing.~~	unrealistic. The launch operator should not be responsible for conducting safety analyses on the launch site operators equipment and operations. Existing launch systems should not be required to change their already approved safety operations.
Page 64037 **§ 417.405 Ground safety analysis** (b) A ground safety analysis must be prepared by a technically competent person who oversees and integrates the sub-analyses performed by engineers or other technical personnel who are the most knowledgeable of each ground system and operation and any associated hazards. This individual shall possess each of the following qualifications: (1) An engineering or other similar technical degree. (2) At least 30 hours of training in the discipline of system safety. (3) At least ten years of technical work experience, with at least five of those years involved in launch vehicle ground operations that provided a broad-based familiarity with ground processing safety hazards and the precautions needed to prevent mishaps. (4) A background in reviewing complex technical documentation. (5) The communication skills necessary to translate complex technical documentation into clear explanations and figures and to produce a ground safety analysis report.	(b) A ground safety analysis must be prepared by a technically competent person. ~~who oversees and integrates the sub-analyses performed by engineers or other technical personnel who are the most knowledgeable of each ground system and operation and any associated hazards. This individual shall possess each of the following qualifications:~~ **Delete subs to (b)**	The level of detail in this requirement is unnecessary and should be deleted. The launch operators have a vested interest in making sure that the persons performing their safety analyses are qualified to do so.

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(c) A launch operator shall ensure that personnel performing a ground safety analysis or preparing a ground safety analysis report have the support of the launch operator's entire organization and that any supporting documentation is maintained and available upon request.	(c) A launch operator shall ensure that ~~personnel performing a ground safety analysis or preparing a ground safety analysis report have the support of the launch operator's entire organization and that~~ any supporting documentation is maintained and available upon request.	This requirement is nebulas and very open to interpretation. If the plan is acceptable then this requirement is not needed.
Page 64037 **§ 417.405 Ground safety analysis** (d) A launch operator shall begin a ground safety analysis by identifying all the systems and operations to be analyzed. A launch operator shall define the extent of each system and operation being assessed to ensure there is no miscommunication as to what the hazards are, and who, in the launch operator's organization or other organization supporting the launch, is responsible for controlling those hazards. A launch operator shall ensure that the ground safety analysis accounts for each launch vehicle system and operation involved in launch processing, even if only to show that no public hazard exists. (e) A ground safety analysis need not account for potential hazards of a component if the launch operator demonstrates that no hazard to the public exists at the system level. A ground safety analysis need not account for an operation's individual task or subtask level if the launch operator demonstrates that no hazard to the public exists at the operation level. For any hazard that is confined within the boundaries of a launch operator's facility not to be a hazard to the public, the launch operator must provide verifiable controls that ensure the public will not have access to the associated hazard area while the hazard exists. (f) A launch operator shall identify all hazards of each launch vehicle system and launch processing operation	**Delete (d)-(f) and subs**	These are good practices but they should not be placed into law since that makes them requirements and they cannot change to meet unique situations. Requirements for analysis are established in 417.405.a above and should be limited to potential public safety hazards. Potentially incredible number of hazard analyses since a launch vehicle is by nature hazardous. If a hazard is non-credible then it makes no sense to try to identify it. By definition non-credible hazards are non-credible.

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in accordance with the following: (1) System hazards shall include explosives and other ordnance, solid and liquid propellants, and toxic and radioactive materials. Other system hazards include, but are not limited to, asphyxiants, cryogens, and high pressure. System hazards generally exist even when no operation is occurring. (2) Operation hazards to be identified derive from an unsafe condition created by a system or operating environment or an unsafe act. (3) All hazards, both credible and non-credible, shall be identified. The probability of occurrence is not relevant with respect to identifying a hazard. (4) The ground safety analysis must provide a rationale for any assertion that no hazard exists for a particular system or operation.		
Page 64037 **§ 417.405 Ground safety analysis** (g) A launch operator shall categorize all hazards identified in accordance with the following: (1) *Public hazard.* A launch operator shall treat any hazard that extends beyond the launch location under the control of the launch operator as a public hazard. Public hazards include, but need not be limited to: (i) Blast overpressure and fragmentation resulting from an explosion. (ii) Fire and deflagration, including of hazardous materials such as radioactive material, beryllium, carbon fibers, and propellants. When assessing systems containing such materials, a launch operator shall assume that in the event of a fire, hazardous smoke will reach the public. (iii) Any sudden release of a hazardous material into the air, water, or ground	(g) A launch operator shall categorize all **potential public safety** hazards **according to their severity categories and probability levels.** ~~identified in accordance with the following~~: (1) *Public **safety** hazard.* A launch operator shall treat any **potential** hazard that extends beyond the launch location under the control of the launch operator as a public **safety** hazard. ~~Public hazards include, but need not be limited to:~~ (i) Blast overpressure and fragmentation resulting from an explosion (ii) Fire and deflagration, including of hazardous materials such as radioactive material, beryllium, carbon fibers, and propellants. When assessing systems containing such materials, a launch operator shall assume that in the event of a fire, hazardous smoke will	MIL-STD-882 as a guide is an accepted industry standard for all DOD systems and facilities, used to provide uniform requirements for developing and implementing a system safety program of sufficient comprehensiveness to identify hazards and manage controls to prevent mishaps. Instead of using the FAA's analysis categories, document and allow the use of heritage hazard analysis methodologies to verify safety of flight systems.

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air, water, or ground. Inadvertent ignition of a propulsive launch vehicle payload, stage, or motor. (2) *Launch location hazard.* A hazard that extends beyond individuals doing the work, but stays within the confines of the location under the control of the launch operator. The confines may be bounded by a wall or a fence line of a facility or launch complex, or by a fenced or unfenced boundary of an entire industrial complex or multi-user launch site. A launch location hazard may effect the public depending on public access controls. Launch location hazards that may effect the public include, but are not limited to, the hazards listed in paragraphs (g)(1)(i)-(iv) of this section and additional hazards in potentially unsafe locations accessible to the public such as: (i) Unguarded electrical circuits or machinery. (ii) Oxygen deficient environments. (iii) Falling objects. (iv) Potential falls into unguarded pits or from unguarded elevated work platforms. (v) Sources of high ionizing and non-ionizing radiation such as x-rays, radio transmitters, and lasers. (3) *Employee hazard.* A hazard only to individuals performing the launch operator's work and not a hazard to other people in the area. A launch operator is responsible for employee safety in accordance with other federal and local regulations. For any hazard determined to be an employee hazard, a launch operator's ground safety analysis must identify the hazard and demonstrate that there are no associated public safety issues. (4) *Non-credible hazard.* A hazard for which any possible adverse effect on people or property would be negligible and where the possibility of any adverse	reach the public. (iii) Any sudden release of a hazardous material into the air, water, or ground ~~(iv) Inadvertent ignition of a propulsive launch vehicle payload, stage, or motor~~ (2) *Launch location hazard* ***control***. ~~A hazard~~ **To eliminate or minimize the effect of potential launch site public safety hazards, the range user will establish and maintain access control authority of all personnel in these areas.** ~~that extends beyond individuals doing the work, but stays within the confines of the location under the control of the launch operator. The confines may be bounded by a wall or a fence line of a facility or launch complex, or by a fenced or unfenced boundary of an entire industrial complex or multi-user launch site. A launch location hazard may effect the public depending on public access controls. Launch location hazards that may effect the public include, but are not limited to, the hazards listed in paragraphs (g)(1)(i) through (iv) of this section and additional hazards in potentially unsafe locations accessible to the public such as:~~ **Delete subs to (2) and all of (3)-(4)**	Define authority to comply with responsibility and eliminate superfluous launch area definition. Launch operator is responsible for the safety of it employees. The Ground Safety Analysis will identify hazards and their controls. Requirements for analysis established in 417.405.a listed above and should be limited to potential public safety hazards If a hazard is non-credible then it makes no sense to try to identify it. By definition non-credible hazards are non-credible

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effect on people or property is remote. For any hazard determined to be non-credible, a launch operator's ground safety analysis must identify the hazard and demonstrate that it is non-credible.		
Page 64038 **§ 417.405 Ground safety analysis** (h) For each public hazard and launch location hazard, a ground safety analysis must identify all hazard causes. The analysis must account for conditions or acts or any chain of events that could result in a hazard. The analysis must account for the possible failure of any control or monitoring circuitry within hardware systems that could cause a hazard. (i) A ground safety analysis must identify the controls to be implemented by a launch operator for each hazard cause identified in accordance with paragraph (h) of this section. A launch operator's hazard controls shall include, but need not be limited to the use of engineering controls for the containment of hazards within defined areas and the control of public access to those areas. (j) All hazard controls selected by a launch operator must be verifiable in accordance with § 415.117(b)(3). If a hazard control is not verifiable, a launch operator may include it as an informational note on the hazard analysis form, if a verifiable control is also listed.	~~(h) For each public hazard and launch location hazard, a ground safety analysis must identify all hazard causes. The analysis must account for conditions or acts or any chain of events that could result in a hazard. The analysis must account for the possible failure of any control or monitoring circuitry within hardware systems that could cause a hazard.~~ ~~(i) A ground safety analysis must identify the controls to be implemented by a launch operator for each hazard cause identified in accordance with paragraph (h) of this section. A launch operator's hazard controls shall include, but need not be limited to the use of engineering controls for the containment of hazards within defined areas and the control of public access to those areas.~~ ~~(j) All hazard controls selected by a launch operator must be verifiable in accordance with § 415.117(b)(3). If a hazard control is not verifiable, a launch operator may include it as an informational note on the hazard analysis form, if a verifiable control is also listed.~~	Requirements for analyses are established in 417.405.a. listed above and should be limited to potential public safety hazards.
Page 64038 **§ 417.405 Ground safety analysis** (k) A licensee shall ensure the continuing accuracy of its ground safety analysis in accordance with the requirements of this paragraph. A launch operator shall document the results of its ground safety analysis in a ground safety analysis report as required during the license application process in accordance with § 415.117 and appendix B to part 415. The analysis of	(k) A licensee shall ~~ensure~~ **maintain** the ~~continuing~~ accuracy of **potential public safety hazards identified in the** ground safety analysis **by performing updates when new systems or configurations introduce new potential hazards.** ~~in accordance with the requirements of this paragraph. A launch operator shall document the results of its ground safety analysis in a ground safety~~	

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with § 417.417 (b) *Hazard control verification.* A launch operator shall implement a hazard tracking process to ensure that each hazard has a verifiable hazard control. Verification status shall remain "open" for an individual hazard control until the hazard control is verified to exist in a released drawing, report, procedure or similar document. (c) *Hazard control configuration* A launch operator shall institute a configuration control process for safety critical hardware and procedural steps to ensure that verified hazard controls and their associated documentation cannot be changed without coordination with the launch safety director. (d) *Inspections.* When a hazard exists, a launch operator shall conduct daily inspections of all related hardware, software, and facilities to ensure that all safety devices and other hazard controls are in place for that hazard, and that all hazardous and safety critical hardware and software is in working order and that no unsafe conditions exist. (e) *Procedures.* Each launch processing operation involving a public hazard or a launch location hazard must be conducted in accordance with written procedures that incorporate the hazard controls identified by the launch operator's ground safety analysis and as required by this subpart. The launch operator's launch safety director must approve such procedures. A launch operator shall maintain an "as-run" copy of these procedures, which includes any changes and provides historical documentation of start and stop dates and times that the procedure was run and any observations made during the operation. (f) *Hazardous materials* A launch operator shall implement procedures for the receipt, storage, handling, use, and disposal of hazardous materials, including toxic substances and any sources of ionizing radiation.	shall implement a hazard tracking process to ensure that each **potential public safety** hazard has a verifiable hazard control. Verification status shall remain ''open'' for an individual hazard control until the hazard control is verified to exist in a released drawing, report, procedure or similar document (c) *Hazard control configuration control.* A launch operator shall institute a configuration control process for safety critical hardware and procedural steps to ensure that verified hazard controls and their associated documentation **are maintained and** cannot be changed without coordination with the launch safety director. (d) *Inspections.* When a **potential public safety** hazard exists, a launch operator shall conduct ~~daily~~ **a periodic** inspections of all related hardware, software, and facilities to ensure that all safety devices and other hazard controls are in place for that hazard, and that all hazardous and safety critical hardware and software is in working order and that no unsafe conditions exist. (e) *Procedures.* Each launch processing operation involving a **potential** public hazard ~~or a launch location hazard~~ must be conducted in accordance with written procedures that incorporate the hazard controls identified by the launch operator's ground safety analysis. ~~and as required by this subpart.~~ The launch operator's launch safety director must approve such procedures. A launch operator shall maintain an ''as-run'' copy of these procedures, which includes any changes and provides historical documentation of start and stop dates and times that the procedure was run and any observations made during the operation. (f) *Hazardous materials.* A launch operator shall implement procedures for the receipt, storage, handling, use, and disposal of hazardous materials, including toxic substances and any sources of ionizing radiation. A launch operator shall implement procedures for responding to hazardous material emergencies and protecting the public in accordance with its emergency	hazards. Daily inspections as a rule are unnecessary. The period for inspection should be based on specific system and hazard control requirements. In some cases, systems will be used frequently and may require a corresponding frequent inspection. This should be determined on a case-by-case basis. Much more detailed than currently performed and some verifications would require power-up of systems that are not powered daily. Have personnel verify safety of systems being worked and train personnel to observe critical safety features while in the area The four requirements contained in this paragraph are: 1) Procedures for receipt, storage, handling, use and disposal of hazardous materials, including toxic substances and ionizing radiation; 2) Procedures for responding to hazardous material emergencies and protecting the public; 3) Performance of toxic release hazard analyses (in accordance with Appendix I); and 4) Application of toxic plume modeling techniques (in accordance with Appendix I) and ensure notifications and evacuations are accomplished. <u>Addressing each one individually:</u> Hazardous material receipt, storage, handling and use requirements are covered in depth in EPA and OSHA rules. Specifically, disposal of hazardous materials covered under 40 CFR (EPA) and State regulation, ionizing radiation by 29 CFR 1910.1096. In addition, at federal ranges, our Lease with the Air Force also requires us to manage our own hazardous wastes. Air Force real property instruments require the submission to the Government of "an approved plan for responding to hazardous waste, fuel, and other chemical

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A launch operator shall implement procedures for responding to hazardous material emergencies and protecting the public in accordance with its emergency response plan submitted through the licensing process according to § 415.119(b). These procedures must include identification of each hazard and its effects, actions to be taken in response to release of a hazardous material, identification of protective gear and other safety equipment that must be available in order to respond to a release, evacuation and rescue procedures, chain of command, communication both on-site and off-site to surrounding communities and local authorities. A launch operator shall perform a toxic release hazard analysis for any launch processing performed at the launch site in accordance with appendix I of this part. A launch operator shall apply toxic plume modeling techniques in accordance with appendix I and ensure that notifications and evacuations are accomplished to protect the public from any potential toxic release.	protecting the public in accordance with its emergency response plan. ~~submitted through the licensing process according to § 415.119(b) of this chapter. These procedures must include identification of each hazard and its effects, actions to be taken in response to release of a hazardous material, identification of protective gear and other safety equipment that must be available in order to respond to a release, evacuation and rescue procedures, chain of command, communication both on-site and off-site to surrounding communities and local authorities. A launch operator shall perform a toxic release hazard analysis for any launch processing performed at the launch site in accordance with appendix I of this part. A launch operator shall apply toxic plume modeling techniques in accordance with appendix I and ensure that notifications and evacuations are accomplished to protect the public from any potential toxic release.~~	spills...". Further, the plan "...shall complement but be independent of Air Force spill prevention and response plans..." thereby meeting the requirement to outline communication both on-site and off-site to surrounding communities and local authorities. Toxic release hazard analyses will be covered in the development of procedures to meet requirements of the first paragraph. Toxic plume modeling will be part of the procedural controls developed to meet these requirements. Launch constraints and/or notifications are part of the "GO/NO-GO" decision prior to committing to a launch attempt.
m hazard controls. (a) *General.* For each system that presents a public hazard, a launch operator shall implement hazard controls as identified by its ground safety analysis and in accordance with the requirements of this section. (1) A system must be no less than single fault tolerant to creating a public hazard unless other hazard control criteria are specified for the system by the requirements of this part, such as the requirements for structures and material handling equipment contained in paragraph (b) of this section. A system capable of creating a catastrophic public hazard, such as a liquid or solid stage inadvertently going propulsive or a release of a toxic substance that could reach the public, shall be no less than dual fault tolerant. Dual fault tolerance includes, but need not be limited to, switches, valves or	(a) *General.* For each system that presents a **potential** public **safety** hazard, a launch operator shall implement hazard controls as identified by its ground safety analysis and in accordance with the requirements of this section. (1) A system must be no less than single fault tolerant to creating a public hazard unless other hazard control criteria are specified for the system by the requirements of this part.~~, such as the requirements for structures and material handling equipment contained in paragraph (b) of this section.~~ A system capable of creating a catastrophic public hazard~~, such as a liquid or solid stage inadvertently going propulsive or a release of a toxic substance that could reach the public~~, shall be no less than dual fault tolerant.~~ Dual fault tolerance includes, but need not be limited to, switches, valves or similar components that prevent an unwanted transfer~~	Modify requirement to allow existing systems that have been approved by federal range safety and have existing approved safety packages to be exempt from these requirements. Keep examples out of requirements. Not needed if performance based. Put examples in an Advisory Circular.

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similar components that prevent an unwanted transfer or release of energy or hazardous materials. (2) Each hazard control used to provide fault tolerance must be independent from any other hazard control so that no single action or event can remove more than one inhibit. A launch operator must prevent inadvertent actuation of actuation devices such as switches and valves. (3) If a safety device or other item must function in order to control a public safety hazard, at least two fully redundant items shall be provided. No single action or event shall be capable of disabling both items. (4) Any computing systems and software used to control a public hazard must satisfy the requirements of § 417.123 and appendix H of this part. (b) *Structures and material handling equipment.* Any safety factor applied in the design of a structure or material handling equipment must account for static and dynamic loads, environmental stresses and expected wear. A launch operator shall inspect structures and material handling equipment to verify workmanship and proper operations and maintenance. A launch operator shall assess its structures and material handling equipment for potential single point failures that could endanger the public. Single point failures shall be eliminated or subject to specific inspection and testing that ensures proper operation. All single point failure welds must undergo both surface and volumetric inspection to verify no critical flaws. If, due to the geometry of a weld, a meaningful volumetric inspection cannot be performed, a launch operator shall implement other inspection techniques. In such a case, the launch operator shall demonstrate, clearly and convincingly, through the licensing process that its inspection processes accurately verifies the absence of any critical flaw. (c) *Pressure vessels and pressurized systems.* A	~~or release of energy or hazardous materials.~~ (2) Each hazard control used to provide fault tolerance must be independent from any other hazard control so that no single action or event can remove more than one inhibit. A launch operator must prevent inadvertent actuation of actuation devices ~~such as switches and valves~~. (3) If a safety device or other item must function in order to control a public safety hazard, at least two fully redundant items shall be provided. No single action or event shall be capable of disabling both items. **Delete (a)(4) and (b)-(f) and subs.**	Keep examples out of requirements. These details should not be law. If they are included they will discourage the use of new methods or approaches to solving the problems addressed by these sections. This NPRM should be performance based and not perpetuate the unneeded detailed requirements that EWR 127-1 presently has. Especially since the AF is in the process of rewriting EWR to make it a performance based document.

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launch operator shall apply the following hazard controls to any flight or ground pressure vessel, component, or system that will be pressurized during launch processing and whose failure, during launch processing, could endanger the public: (1) A pressure vessel, component, or system must be tested upon installation and before being placed into service, and periodically inspected to ensure that no critical flaw exists. (2) Any safety factor applied in the design of a pressure vessel, component, or system must account for static and dynamic loads, environmental stresses and expected wear. (3) Except for pressure relief and emergency venting, pressurized system flow-paths must be single fault tolerant to causing pressure ruptures and material releases that could endanger the public during launch processing. (4) Pressure relief and emergency venting capability must be provided to protect against pressure ruptures that could endanger the public. Pressure relief devices shall be sized to provide the flow rate necessary to prevent a rupture in the event a pressure vessel is exposed to fire. (d) *Electrical and mechanical systems.* A launch operator shall apply the following hazard controls to any electrical or mechanical system that could release electrical or mechanical energy that could endanger the public during launch processing: (1) Electrical and mechanical systems must be single fault tolerant to providing or releasing electrical or mechanical energy that could endanger the public. This requirement includes systems that generate ionizing or non-ionizing radiation. (2) Electrical systems and equipment used in areas where a flammable material may exist must be		

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hermetically sealed, explosion proof, intrinsically safe, purged or otherwise designed so as not to provide an ignition source. A launch operator shall assess each electrical system as a possible source of thermal energy and ensure that the electrical system could not act as an ignition source. (3) A launch operator shall prevent unintentionally conducted or radiated energy due to possible bent pins in a connector, a mismated connector, shorted wires, or unshielded wires within electrical power and signal circuits that interface with hazardous subsystems. (e) *Propulsion systems*. A propulsion system must be dual fault tolerant to inadvertently becoming propulsive. Propulsion systems must be single fault tolerant to inadvertent mixing of fuel and oxidizer. Each material in a propulsion system must be compatible with any other material that it may come into contact with during launch processing. This includes any material used to assemble and clean the system. Different sized fittings shall be used to prevent connecting incompatible systems. Hazard controls applicable to propellants and explosives are provided in § 417.417. (f) *Ordnance systems*. An ordnance system must be at least single fault tolerant to prevent inadvertent actuation if the public could be reached. Hazard controls applicable to ordnance are provided in § 417.417. In addition, an ordnance system must satisfy the following requirements: (1) All ordnance and electrical connections shall be kept disconnected until final preparations for flight. (2) An ordnance system must provide for safing and arming of all ordnance. An electrically initiated ordnance system must include ordnance initiation devices or arming devices, also referred to as safe and arm devices, that provide a removable and replaceable mechanical barrier or other positive means of		

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interrupting power to each ordnance firing circuit to prevent inadvertent initiation of ordnance. A mechanical safe and arm device must have a safing pin that locks the mechanical barrier in a safe position. A mechanical actuated ordnance device must also have a safing pin that prevents mechanical movement within the device. Specific safing and arming requirements for a flight termination system are provided in § 417.313. (3) An ordnance system must be protected from stray energy through grounding, bonding, or shielding. (4) Any monitoring or test circuitry that interfaces with an ordnance system must be current limited to protect against inadvertent initiation of ordnance. Equipment used to measure bridgewire resistance on electro-explosive devices must be special purpose ordnance system instrumentation with features that limit current.		
Page 64039 **§ 417.411 Safety clear zones for hazardous operations.** (a) For each operation involving a potential launch location hazard or public hazard, a launch operator shall define a safety clear zone within which any potential adverse effects of the hazard will be confined. A launch operator may employ a risk analysis to define a safety clear zone if, through the licensing process, the launch operator demonstrates clearly and convincingly an equivalent level of safety. A launch operator's safety clear zones must satisfy the following: (1) A launch operator shall establish a safety clear zone that accounts for the potential blast, fragment, fire or heat, toxic and other hazardous energy or material potential of the associated systems and operations. (2) Any time a launch vehicle is in a launch commandable configuration, the flight safety system shall be fully operational, on internal power, with the associated safety clear zone in effect and cleared.	(a) For each operation involving a potential ~~launch location hazard or~~ public **safety** hazard, a launch operator shall define a safety clear zone within which any potential adverse effects of the hazard will be confined. A launch operator may employ a risk analysis to define a safety clear zone. ~~if, through the licensing process, the launch operator demonstrates clearly and convincingly an equivalent level of safety. A launch operator's safety clear zones must satisfy the following:~~ ~~(1) A launch operator shall establish a safety clear zone that accounts for the potential blast, fragment, fire or heat, toxic and other hazardous energy or material potential of the associated systems and operations.~~ (2) Any time a launch vehicle is in a **final** launch commandable configuration, the ~~flight~~ safety system shall be fully operational on internal power, with the associated safety clear zone in effect and cleared.	Define establishment of clear zones of operations involving potential public safety hazards. Again keep analyses out of license so it is easier to update the analyses. Requirement to establish clear zones to protect the public is defined in 417.411.a above.

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associated safety clear zone in effect and cleared.		
Page 64040 **§ 417.413 Hazard areas.** (a) *General.* For each hardware system that presents a public hazard or launch location hazard, a launch operator shall define a hazard area within which any adverse effects will be confined should an actuation or other hazardous event occur. Whenever a hazard is present, a launch operator shall prohibit public access to any hazard area unless the requirements for public access of paragraph (b) of this section are met. (b) *Public access.* If visitors or other members of the public, such as individuals providing goods or services not related to the launch processing or flight of a launch vehicle, must have access to a launch operator's facility or launch location, a launch operator shall implement a process for authorizing public access on an individual basis. This process must ensure that each member of the public is briefed on all hazards within the facility and any related safety warnings, procedures, or rules that provide protection, or the launch operator shall ensure that each individual is accompanied at all times by a fully knowledgeable escort.	(a) *General.* ~~For each hardware system that presents a~~ **Operations that present a potential** public **safety** hazard **will require personnel limits, entry control, and control areas to be established**. ~~or launch location hazard, a launch operator shall define a hazard area within which any adverse effects will be confined should an actuation or other hazardous event occur. Whenever a hazard is present, a launch operator shall prohibit public access to any hazard area unless the requirements for public access of paragraph (b) of this section are met.~~ (b) *Public access.* If visitors or other members of the public~~, such as individuals providing goods or services not related to the launch processing or flight of a launch vehicle.~~ must have access to a launch operator's facility or launch location, a launch operator shall implement a process for authorizing public access on an individual basis. This process must ensure that each member of the public is briefed on all hazards within the facility and any related safety warnings, procedures, or rules that provide protection, or the launch operator shall ensure that each individual is accompanied at all times by a fully knowledgeable escort.	This NPRM should confine itself to public safety hazards. All other hazards are controlled under other regulations (OSHA, EPA, NRC) We believe that a better definition of public safety is: *Public safety* means, for a particular licensed launch, the safety of people and property that are not involved in supporting the launch. Personnel that serve the needs of the processing facility or launch site are not considered members of the public. Persons that serve the needs of the processing facility or launch site will still have to be trained on launch hazards or be escorted by a knowledgeable person but that will be part of the launch operators training and certification system.
Page 64040 **§ 417.413 Hazard areas.** (c) *Hazard controls during public access.* A launch operator shall implement procedural controls that preclude any hazardous operation from taking place while members of the public have access to the launch location and that system hazard controls are in place that preclude initiation of a hazardous event. Hazard controls that preclude initiation of a hazardous event	**Delete (c) and subs**	Requirement to establish hazardous controls to protect the public is defined in 417.413.a above. These details should not be part of law since they do not always apply to every situation or system. The OSHA, EPA, NRC, etc. requirements should be allowed to govern since they are the federal agencies that the launch operator must comply with.

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include, but need not be limited to, the following: (1) Lockout devices or other restraints must be used on system actuation switches or other controls to eliminate the possibility of inadvertent actuation of a hazardous system. (2) Ordnance systems must be physically disconnected from any power source, incorporate the use of safing plugs, or have safety devices in place that preclude inadvertent initiation. If the safety devices are electrically actuated, no activity involving the control circuitry for those safety devices shall be ongoing while the public has access to the hazard area. All safing pins on safe and arm devices and mechanically actuated devices must be installed. All explosive transfer lines, not protected by a safe and arm device or mechanically actuated device or equivalent, must be physically disconnected. (3) When systems or tanks are loaded with hypergols or other toxic materials, the system or tank must be closed and verified to be leak-tight with two verifiable closures, such as a valve and a cap, to every external flow path or fitting. Such a system must also be in a steady-state condition. A launch operator shall also visually inspect a propellant system to check for potential leak sources and problems. (4) Any pressurized system must not be above its maximum allowable working pressure or be in a dynamic state. If a pressurized system has valves that are electrically actuated, no activity involving this circuitry shall be ongoing while the public has access to the associated hazard area. Any launch vehicle system shall not be pressurized to more than 25% of its design burst pressure, when the public has access to the associated hazard area. (5) Any sources of ionizing or non-ionizing radiation, such as, x-rays, nuclear power sources, high-energy radio transmitters and radar and lasers must not be		

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present or must be verified to be inactive when the public has access to the associated hazard area. (6) Any physical hazards must be guarded to prevent potential physical injury to any visiting member of the public. Physical hazards include, but need not be limited to potential falling objects, personnel falls from an elevated position, and protection from potentially hazardous vents, such as pressure relief discharge vents. (7) Any safety device or safety critical system must be maintained and verified to be operating properly prior to permitting public access.		
Page 64040 § 417.415 Post-launch and post-flight-attempt hazard controls. (a) A launch operator shall implement procedures for controlling hazards and returning the launch facility to a safe condition after a successful launch. Procedural hazard controls must include, but need not be limited to, provisions for extinguishing any fires and re-establishing full operational capability of all safety devices, barriers and platforms, and access control. (b) A launch operator shall implement procedures for controlling hazards associated with a failed flight attempt where a solid or liquid launch vehicle engine start command was sent, but the launch vehicle did not liftoff. These procedures must include, but need not be limited to, the following: (1) Maintaining and verifying that any flight termination system remains operational until it is verified that the launch vehicle does not represent a risk of inadvertent liftoff. If an ignition signal has been sent to a solid rocket motor, there must be a waiting period of no less than 30 minutes during which the flight termination system must remain armed and active. During this time flight termination system batteries must maintain sufficient voltage and current	(a) A launch operator shall implement procedures for controlling hazards and returning the launch facility to a safe condition after a successful launch **an aborted launch or launch failure**. ~~Procedural hazard controls must include, but need not be limited to, provisions for extinguishing any fires and re-establishing full operational capability of all safety devices, barriers and platforms, and access control.~~ **Delete (b)-(c) and subs**	The details needed for each or the potential outcomes from a launch should not be part of law. They need to be worked out for each launch vehicle and launch site as part of the launch approval process.

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capacity for flight termination system operation and the flight termination system receivers must remain captured by the command control system transmitter's carrier signal. (2) Assuring that the vehicle is in a safe configuration, including its propulsion and ordnance systems. The flight safety system crew shall have access to the vehicle status. Safety devices shall be re-established and any pressurized systems shall be brought down to safe pressure levels. (3) Prohibiting launch complex entry until a pad safing team has performed all necessary safing tasks. (c) A launch operator shall implement procedural controls for hazards associated with an unsuccessful flight where the launch vehicle has a land or water impact. These procedures must include, but need not be limited to the following: (1) Provisions for extinguishing any fires. (2) Provisions for evacuation and rescue of members of the public, to include modeling the dispersion and movement of any toxic plume, identification of areas at risk, and communication with local government authorities. (3) Provisions to secure impact areas to ensure that all personnel are evacuated, that no unauthorized personnel enter, and to preserve evidence. (4) Provisions for ensuring public safety from any hazardous debris, such as plans for recovery and salvage of launch vehicle debris and safe disposal of any hazardous materials.		
Page 64041 **§ 417.417 Propellants and explosives** (a) A launch operator shall comply with the explosive safety criteria in 14 CFR Part 420	(a) A launch operator shall comply with the explosive safety criteria in **explosive safety regulations applicable to the launch site. For US launch sites DDESB and DOT are the governing agencies.** ~~14~~	Established requirements with DDESB. Do not try to summarize other agencies requirement here. Refer to them and let the launch operator meet those requirements as applicable. Putting detail requirements here as law will only cause duplication of

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safety criteria in 14 CFR Part 420 (b) A launch operator shall ensure compliance with the explosive site plan developed in accordance with 14 CFR Part 420 by ensuring that: (1) Only those explosive facilities and launch points addressed in the explosive site plan are used and only for their intended purpose. (2) The total net explosive weight for each explosive hazard facility and launch point must not exceed the maximum net explosive weight limit indicated on the explosive site plan for each location. (c) A launch operator shall implement procedures that ensure public safety for the receipt, storage, handling, inspection, test, and disposal of explosives. (d) A launch operator shall implement procedural system controls to preclude inadvertent initiation of propellants and explosives. These controls shall include, but need not be limited to, the following: (1) Ordnance systems must be protected from stray energy through methods of bonding, grounding, and shielding, and by controlling radio frequency radiation sources in a radio frequency radiation exclusion area. A launch operator shall determine the vulnerability of its electro-explosive devices and systems to radio frequency radiation and establish radio frequency radiation power limits or radio frequency radiation exclusion areas as required by the launch site operator or as needed to ensure safety. (2) Ordnance safety devices, as described in § 417.409, must remain in place until the launch complex is cleared as part of the final launch countdown. No members of the public shall be allowed back onto the complex until all safety devices are re-established. (3) Heat and spark or flame producing devices must not be allowed in an explosive or propellant facility	~~CFR part 420.~~ **Delete (b)-(d) and subs**	requirements and possible conflicts. The DOD Explosives Safety Board (DDESB) has established these requirements in the following documents: 1). DOD 6055.9 - DOD Ammunition and Explosive Safety Standard 2). Air Force Manual 91-201: Explosives Safety Standards

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without written approval and oversight, such as obtaining a hot work permit, from a launch operator's launch safety organization. (4) Static producing materials must not be allowed in close proximity to solid or liquid propellants, electro-explosive devices or systems containing flammable liquids. (5) Fire safety measures shall be used to preclude inadvertent initiation of propellants and explosives including, but not limited to, the elimination or reduction of flammable and combustible materials, elimination or reduction of ignition sources, fire and smoke detection systems, safe means of egress and timely fire suppression response. (6) A facility used to store or process explosives must include lightning protection to prevent inadvertent initiation of propellants and explosives due to lightning. (7) In the event of an emergency, a launch operator shall implement its emergency response plan, developed in accordance with § 415.119(b) and updated in accordance with § 417.111, to provide for the control of any propellant or explosive hazards.		

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APPENDIX A TO PART 417 – METHODOLOGIES FOR DETERMINING HAZARD AREAS FOR ORBITAL LAUNCH **A417.1 General** This appendix provides methodologies and equations for use in determining the hazard areas and public risk factors as part of the flight hazard area analyses required by § 417.225. A launch operator shall use the methodologies and equations provided in this appendix when performing the analyses unless a launch operator provides a clear and convincing demonstration that an alternative provides an equivalent level of safety.	This appendix provides methodologies and equations for use in determining the hazard areas and public risk factors as part of the flight hazard area analyses required by § 417.225. A launch operator shall use the methodologies and equations provided in this appendix when performing the analyses unless a launch operator provides a clear and convincing demonstration that an alternative provides an equivalent level of safety. **For launches from existing federal ranges, the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	Range safety personnel at existing launch sites already have methodologies in place, which they use to perform the analyses described in this appendix. These methodologies should be acceptable to the FAA, since they have successfully protected the public and property for many years. Launch operators do not have the resources to develop the capability to perform this analysis. It is unknown whether the proposed methodology is more conservative than that used at the federal ranges. If the proposed methodology is more conservative, there is a launch operator concern for the potential decrease in launch availability due to the more conservative methodology. In addition to the wording change, the FAA should consider publishing the appendix as an advisory circular and deleting the appendix from the NPRM. The advisory circular could then be referenced in the NPRM as a suggested methodology.

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64050 **APPENDIX B TO PART 417 – METHODOLOGY FOR PERFORMING DEBRIS RISK ANALYSIS** **B417.1 General** A launch operator's debris risk analysis required by § 417.227 must be in accordance with the analysis constraints contained in § 417.227 and shall be performed using the equations and methodologies for calculating expected casualty (E_C) contained in this appendix unless, through the licensing process, the launch operator provides a clear and convincing demonstration that an alternate method provides an equivalent level of safety. A launch operator shall compute the total E_C due to debris as the sum of the E_C due to all planned debris impacts determined according to § B417.3 and the E_C due to potential launch vehicle failure along the normal flight path, hereafter referred to as overflight E_C, determined in accordance with § B417.5. For a launch vehicle that uses a flight termination system, the total E_C due to debris must also account for risk to populations outside the flight control lines in accordance with to § B417.7.	A launch operator's debris risk analysis required by § 417.227 must be in accordance with the analysis constraints contained in § 417.227 and shall be performed using the equations and methodologies for calculating expected casualty (E_C) contained in this appendix unless, through the licensing process, the launch operator provides a clear and convincing demonstration that an alternate method provides an equivalent level of safety. A launch operator shall compute the total E_C due to debris as the sum of the E_C due to all planned debris impacts determined according to § B417.3 and the E_C due to potential launch vehicle failure along the normal flight path, hereafter referred to as overflight E_C, determined in accordance with § B417.5. For a launch vehicle that uses a flight termination system, the total E_C due to debris must also account for risk to populations outside the flight control lines in accordance with to § B417.7. **For launches from existing federal ranges, the range safety organization at the launch site shall determine the launch operator debris risk assessment requirements and perform debris risk assessment analysis in accordance with the requirements and methods currently existing at the federal launch site.**	Range safety personnel at existing launch sites perform debris risk analyses in the launch area. Launch operators do not have the resources to develop the capability to perform this analysis. Launch operators are typically required to perform debris risk assessment analysis for populated areas further downrange from the launch site, usually beginning at approximately 100 nautical miles downrange from the launch site. Downrange debris risk assessment models currently accepted by the range safety organizations at each launch site should be acceptable to the FAA. In addition to the wording change, the FAA should consider publishing the appendix as an advisory circular and deleting the appendix from the NPRM. The advisory circular could then be referenced in the NPRM as a suggested methodology.
64050 **B417.3 Planned Impact Ec** (a) General. A launch operator shall use the equations and methodologies contained in this section for calculating E_C for planned debris impacts.	(a) General. A launch operator shall use the equations and methodologies contained in this section for calculating E_C for planned debris impacts. **For launches at existing federal ranges, the range safety organization at the launch site shall determine the Ec analysis requirements for any**	Planned impacts from jettisoned bodies are typically located in isolated ocean areas. The range safety organization at the federal launch site should determine the analysis required to account for planned impacts that could affect populated areas.

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	determine the Ec analysis requirements for any planned debris impacts.	
64051 **B417.5 Methodology For Computing Overfight Ec** (a) General. A launch operator shall use the equations and methodologies contained in this section for calculating overflight E_C.	(a) General. A launch operator shall use the equations and methodologies contained in this section **or methodologies currently acceptable to range safety organizations at the existing launch sites,** for calculating overflight E_C.	Downrange debris risk assessment models currently accepted by the range safety organizations at each launch site should be acceptable to the FAA.
64051 **B417.5 Methodology For Computing Overfight Ec** (b) Input. (2) The failure probability of each launch vehicle stage and the overall launch vehicle failure probability determined in accordance with § 417.227(b)(6).	Recommend revision by joint FAA/Industry committee	The failure probabilities specified in § 417.227(b)(6) will significantly decrease launch availability at most ranges, and prohibit launches at the Eastern Range due to the total mission Ec limit of $30x10^{-6}$.
64052 **B417.7 Ec for Populations Outside Flight Control Lines** (a) General. For a launch vehicle that uses a flight termination system, a launch operator shall use the equations and methodologies contained in this section to identify any populations outside the flight control lines in the area surrounding the launch point that could be exposed to significant risk due to impacting launch vehicle debris. The risk to such populations must be accounted for in the launch operator's debris risk analysis in accordance with § 417.227(b)(11).	(a) General. For a launch vehicle that uses a flight termination system, a launch operator shall use the equations and methodologies contained in this section**, or methodologies currently acceptable to range safety organizations at the existing federal launch sites,** to identify any populations outside the flight control lines in the area surrounding the launch point that could be exposed to significant risk due to impacting launch vehicle debris. The risk to such populations must be accounted for in the launch operator's debris risk analysis in accordance with § 417.227(b)(11).	Range safety personnel at existing federal launch sites perform debris risk analyses in, or surrounding, the launch area. These analyses should be acceptable to the FAA.
64056 **B417.9 Alternative Debris Risk Analysis**		

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(a) A launch operator may elect to simplify a debris risk analysis by making conservative assumptions that would lead to an overestimation of the total E_C due to debris. The intent of such an analysis would be to show that the overestimated E_C does not exceed the public safety criteria required by § 417.107(b). Such an analysis must be approved by the FAA during the licensing process. In addition to the analysis products required by § 417.227, a launch operator shall submit the following with respect to an alternative analysis:	(a) A launch operator may elect to simplify a debris risk analysis by making conservative assumptions that would lead to an overestimation of the total E_C due to debris. The intent of such an analysis would be to show that the overestimated E_C does not exceed the public safety criteria required by § 417.107(b). Such an analysis must be approved by the FAA during the licensing process. **For launches at federal ranges, the range safety organization at the launch site shall approve this analysis, and the analysis will be acceptable to the FAA.** In addition to the analysis products required by § 417.227, a launch operator shall submit the following with respect to an alternative analysis:	Downrange debris risk assessment models currently accepted by the range safety organizations at each federal launch site should be acceptable to the FAA.
64056 **B417.9 Alternative Debris Risk Analysis** (b) (2) When computing overflight E_C, a launch operator may choose to analyze a worst case flight trajectory within the five-sigma corridor.	(2) When computing overflight E_C, a launch operator may choose to analyze a worst case flight trajectory. ~~within the five-sigma corridor.~~	The 5-sigma limit for populated areas considered in the analysis is replaced with the actual limit for populated areas used in the analysis. The actual limit is derived from the total Ec not changing significantly by the inclusion of more populated areas located further crossrange from the nominal instantaneous impact point trace.
64057 **B417.9 Alternative Debris Risk Analysis** (b) (4) A launch operator may choose to assume a worst case population density for the entire local launch area.	Recommend revision by joint FAA/Industry committee	Range safety personnel at existing federal launch sites perform debris risk analyses in, or surrounding, the launch area.
64057 **B417.9 Alternative Debris Risk Analysis** (c) A launch operator may employ an alternative	(c) A launch operator may employ an alternative	Range safety personnel at federal launch sites should be

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analytical approach if the launch operator demonstrates, clearly and convincingly through the licensing process, that the proposed alternative provides an equivalent level of safety. The following requirements apply to any such alternative:	analytical approach if the launch operator demonstrates, clearly and convincingly through the licensing process, that the proposed alternative provides an equivalent level of safety. **For launches at federal ranges, the range safety organization at the launch site shall approve any alternative analysis based on the current requirements of that organization, and the analysis will be acceptable to the FAA.** The following requirements apply to any such alternative:	allowed to continue to determine the validity of any analytical methods proposed by launch operators. If the range safety personnel approve an analysis methodology, there is no need for additional FAA approval.

Appendix C was not reviewed by the Industry

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APPENDIX D TO PART 417 – FLIGHT TERMINATION SYSTEM COMPONENTS AND CIRCUITRY	General comments: It is recommended that this appendix be converted into an advisory with detailed suggested implementation information included for reference only. 1. The FAA, Air Force Range Safety Offices, and Industry should perform a detailed evaluation of the information in this appendix. The goals should be to: a. Validate the requirements and eliminate any that cannot be technically justified. b. Proof check the wording of the remaining requirements 2. Some detailed comments are provided below. These are representative of the type of issues that must be addressed, but are not inclusive.	Precedence for this can be found in current Atlas V EWR 127-1 tailoring; The contents of appendix 4B1 shall be used as guidelines for developing the component test plans (as applicable) and procedures. Alternate test procedures acceptable to Range Safety may be used. All procedures shall be submitted to Range Safety for review and approval.
§D417.1.b Appendix – Flight Termination System Components and Circuitry General The design of each flight termination system component must provide for the component to be tested in accordance with appendix E of this part.	The design of each flight termination system component must provide for the component to be tested in accordance with FAA approved test plans / procedures. Appendix E illustrates the level of testing expected for various classes of FTS components	The regulation should not be specifying how the component should be tested, but rather suggesting the starting point at which the tests should be derived from. The tests should be approved by the FAA prior to performance.
§D417.3.b Design Environment Thermal environment. The design of a component must provide for the component to function without degradation in performance when exposed to preflight and flight thermal cycle environments. Each thermal cycle, from ambient temperature to one extreme of the required thermal range and then to the other extreme and then back to ambient temperature, must be continuous. The required design thermal range and number of cycles for a component must be in accordance with the following:	§D417.3.b Design Environment Thermal environment. The design of a component must provide for the component to function without degradation in performance when exposed to preflight and flight thermal cycle environments. ~~Each thermal cycle, from ambient temperature to one extreme of the required thermal range and then to the other extreme and then back to ambient temperature, must be continuous.~~ The required design thermal range and number of cycles for a component must be in accordance with the following:	The thermal cycles are not continuous, having dwell times at each extreme. This sentence is not required.

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§D417.3.b.1 Design Environment Passive components. Unless otherwise permitted, the design of a passive component must provide for the component to function without degradation in performance when subjected to eight thermal cycles from one extreme of the maximum predicted thermal range to the other extreme and 24 thermal cycles at temperature extremes of 10°C lower to 10°C higher than the maximum predicted thermal range, or from –34°C to +71°C, whichever is more severe, with a one hour dwell time at each temperature extreme. The thermal rate of change must be no less than the greater of the maximum predicted thermal rate of change or 1°C per minute.	§D417.3.b.1 Design Environment Passive and Electronic components. Unless otherwise permitted, the design of a passive component must provide for the component to function without degradation in performance when subjected to eight thermal cycles from one extreme of the maximum predicted thermal range to the other extreme **with a one hour dwell time at each temperature extreme. Design margin should be demonstrated by subjecting the qualification units to 24 thermal cycles to temperatures exceeding the maximum predicted thermal range by 10°C at the low and high extremes,** or from –34°C to +71°C, whichever is more severe, with a one hour dwell time at each temperature extreme. The thermal rate of change must be no less than the greater of the maximum predicted thermal rate of change or 1°C per minute.	This sentence is unclear. Reword to state intent Also, delete D417.3.b.2, there is no need to require 18 thermal cycles as a special case for electronic components.
D417.3(f)	Specify "with spectrum per table E417.11-2"	Boeing Comment It is not possible to design a box to survive a 1300G shock from 100 Hz to 10,000 Hz Pyrotechnic shock. 1300G shock level without specifying frequency is meaningless requirement
D417.5(g2) Paragraph limits protection to the use of fuses, circuit breakers, or limiting resistors.	Reword paragraph to add the word "items such as" before "fuses, circuit breakers, or limiting resistors"	Boeing Comment Delta IV uses active current limiters which provides required functionality without using a fuse, circuit breaker, or limiting resistor
D417.5(i) D417.13(i2)	Remove conflict between paragraphs	Boeing Comment Watchdog Timers are mandatory per H417.21, and prohibited per D417.5.and 417.13 Delta (as well as Shuttle, Atlas, Titan, Athena, Taurus,

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		etc) uses watchdog timers in the CRDs.
D417.7(a)	Change requirement to allow monitors to be independent of the firing circuit, and to allow some isolation between the circuit being monitored and the telemetry output.	Boeing Comment This will reduce reliability of FTS system. For example a system designed per this paragraph to monitor the destruct output may not function if the monitor is shorted. It is better to provide isolation between the item being monitored and monitor circuit.. Requirement is to take the measurement directly from the parameter being monitored.
D417.15(d4)	Change wording to say something like "The design of a command receiver decoder must provide for the decoding of a tone, such as pilot tone or check tone, that is representative of link and command closure, and provide a telemetry output indicating whether the tone is being decoded"	Boeing Comment Requires redesign of command receiver/decoder and telemetry system Most command receiver/decoders do not output a tone. Instead, they provide a discrete output if the tone is present
D417.15(d5) Subparagraph disallows IRIG tone decoders		Boeing Comment No impact to Delta, but many other vehicles currently flying from the range use IRIG tones
D417.17(b)	Delete subparagraph, or rewrite to show intended meaning	Boeing Comment Not sure of impact until paragraph is understood For example, does it require all wires (including telemetry outputs, firing circuit outputs, etc) use redundant wires?
D417.17(e)		Boeing Comment Not possible to meet requirement Not sure how to design wiring that will not deteriorate due to workmanship.

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D417.17(i)	Add "except for isolated circuits and telemetry monitors."	Boeing Comment Not feasible to implement An example of a circuit that violates this requirement is telemetry monitors. The redundant Command Receiver Decoders use a single telemetry system, and therefore share telemetry connectors.
D417.19 (a) Capacity The flight allowance must allow for two arm and two destruct command loads at the end of flight	Revise requirement to state the batteries shall be capable of providing the require destruct load at the end of flight.	Boeing Comment Present battery is not capable of two arm and destruct command loads and maintain system voltage above minimum requirements at minimum temperature. Will require: a. Heat battery to higher temperature; b. revise destruct current to a value more representative of system requirements; or c. redesign cell.
D417.19(b) (3) Activation for Qual tests Requires that the Qualification batteries be activated using the same procedures that will be used for flight batteries.	Replace "activation procedures" with "activation requirements"	Boeing Comment Present batteries were activated to the same activation requirements, but not using the exact activation procedure. In fact, two different procedures are used to activate flight batteries and, therefore, two complete qualification tests would be required to insure that qualification was performed with batteries prepared with each procedure. To comply with this requirement, the battery processing equipment would need to be located near the qualification location and this is usually not the case. In addition, the requirement indicates that if the activation procedure or any of the equipment use to activate the batteries was changed, a complete new qualification test would be required.
§D417.19b4 The design of a battery must permit open circuit voltage and load testing of each cell when assembled in the battery case during and after activation.	Accept the existing battery design and allow the load testing of each cell with the cover removed. §D417.19b4 The design of a battery must permit open circuit voltage and load testing of each cell when assembled in the battery case during and after activation **but prior to being installed on the vehicle.**	LM Comment Generally, once the battery leaves the activation lab and is installed on the vehicle, access is not longer available at the cell level without breaking battery configuration. Boeing Comment Present battery design allows OCV measurements

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		through a test connector on the side of the case, but load test of each cell can not be performed after the battery is assembled because the wire used to monitor the OCV is too small to allow load testing through the test connector. Load testing can be performed for each cell, but would require the removal of the battery cover.
D417.19 (b)(5) Battery and cell design are to protect against undetectable damage as a result of reverse polarity, shorting, overcharging, thermal runaway and overpressure	Change requirement to state "system shall protect the battery against . . . "	Boeing Comment Very difficult requirement to implement because considerable electronics would need to be added to the cell and battery design to detect and display the condition of the cell at all times. Present design of the battery requires that battery parameters such as OCV and voltage under test be monitored and verified to insure that the battery has not been damaged.
§D417.19d Monitoring capability. The design of a battery must provide for monitoring the status of battery voltage and current being drawn. Monitoring accuracy must be consistent with the minimum and maximum voltage and current limits to be used for launch countdown. The design of a battery that requires heating or cooling to sustain performance must provide for monitoring the battery's temperature.	Accept the present FTS battery design and allow monitoring the system current within the system and not at the battery. §D417.19d Monitoring capability. The design of a battery must provide for monitoring the status of battery voltage ~~and current being drawn~~. . Monitoring accuracy must be consistent with the minimum and maximum voltage limits to be used for launch countdown. The design of a battery that requires heating or cooling to sustain performance must provide for monitoring the battery's temperature.	LM Comment Current measurements are usually made at the system level rather than at the battery level. Shunts internal to the battery are considered a potential and avoidable failure mechanism. Boeing Comment Present battery allows for monitoring of the voltage, but no provisions are provided to monitor the battery current being drawn. Battery current is monitored elsewhere within the Flight Termination System (FTS) other than the battery.
D417.19 (h)(4) Specifies battery and cell qualification, acceptance and storage life extension tests be performed in accordance3 with Appendix E.	Accept the current FTS battery qualification and acceptance testing and delete the storage life extension tests.	Boeing Comment See Appendix E write-up for detail comments.
D417.19 (h)(5) Specifies that one cell of the same lot date code be attached to the outside of each battery built. The cell is to be used for cell acceptance verification test at the time of battery activation.	Replace "one additional cell" with "at least one additional cell"	Boeing Comment Present method is to attach two battery cells (called Flight Performance Verification (FPV) cells) of the same lot date code to the outside of each battery built. A

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		sample of only one cell is not adequate to acceptance testing. In addition, two cells provide more meaningful data on cell performance over the life of the cells.
D417.19 (I) Section is entitled " Rechargeable Batteries, such as nickel cadmium batteries".	Consider this section to pertain to nickel cadmium batteries only. State that this section does not apply to silver zinc batteries.	Boeing Comment Silver zinc batteries are also classified as "rechargeable batteries", but are not able to comply to the requirement in subparagraph (2) which specify that the battery be capable of 5 times as many cycles as expected throughout the battery's life.
D417.21 Electro mechanical safe and arm devices with an internal electro-explosive device. (g) A safe and arm device's internal electrical firing circuitry, such as wiring, connectors, and switch deck contacts, must be capable of withstanding, without degradation in performance, an electrical current pulse with an energy level of no less than 150% of the internal electro-explosive device's all-fire energy level for10 times the all-fire pulse duration. A safe and arm device must be capable of delivering this firing pulse to the internal electro-explosive device without any dropouts	Modify to assess down to 1ms dropouts.	Boeing Comment We only monitor to 1 ms dropout resolution
D417.21 Electro mechanical safe and arm devices with an internal electro-explosive device. (l) A safe and arm device must not degrade in performance when subjected to five times the total expected number of safe and arm cycles required for acceptance tests, preflight tests, and flight operations, including an allowance for potential re-tests due to schedule changes.	Delete requirement.	Boeing Comment 5 times requirement is excessive for cycle life. If it doesn't work, it is not a safety concern, just a schedule concern Same comment for ordnance interrupter.
D417.25 Ordnance interrupter safe and arm device without an electro-explosive device. h2) When locked in the safe position, an ordnance interrupter must prevent initiation of an ordnance train and the ordnance interrupter's performance must not degrade when locked in the safe position and	When locked in the safe position, an ordnance interrupter must prevent initiation of an ordnance train **when locked in the safe position and subjected to a continuous operational arming voltage for a period of up to 60 minutes** and the ordnance interrupter's performance must not degrade when locked in the safe position and subjected to a continuous operational	LM Comment Must define a time. Utilize 4B6.4 of EWR, 5 and 60 minute test

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subjected to a continuous operational arming voltage.	position and subjected to a continuous operational arming voltage **for a period of up to 5 minutes.**	
D417.27 Ordnance initiators. i) An ordnance initiator must be hermetically sealed to the equivalent of 5×10-6 scc/sec of helium.	An ordnance initiator must be hermetically sealed to the equivalent of 5×10^{-6} scc/sec of helium **at one atmosphere pressure differential.**	LM Comment Completeness – throughout document
D417.27 Ordnance initiators. j) The insulation resistance between mutually insulated points must ensure that an ordnance initiator's performance will not degrade at the maximum applied voltage during testing and flight. The insulation material must not deteriorate, whether due to workmanship, heat, dirt, oxidation, or other causes. An ordnance initiator must be capable of withstanding a workmanship voltage of no less than 500 volts.	j) The insulation resistance between mutually insulated points must ensure that an ordnance initiator's performance will not degrade at the maximum applied voltage during testing and flight. The insulation material must not deteriorate, whether due to workmanship, heat, dirt, oxidation, or other causes. An ordnance initiator must be capable of withstanding a workmanship voltage of no less than 500 volts. **The insulation resistance shall be greater than 2 megohms.**	LM Comment Non descript. Utilize 4B6.10 of EWR, or MIL-STD-1576, insulation resistance
D417.31 Percussion actuated device. (a) A percussion actuated device's lanyard pull system must include protective covers to prevent inadvertent pulling of the lanyard.	Revise requirement to require protection from inadvertent pull.	Boeing Comment Our LPI uses a safing pin, not a protective cover. Would require redesign
D417.31 Percussion actuated device. (c) A percussion actuated device must have a specified guaranteed no-fire pull force of no less than twice the largest inadvertent pull force that the device could experience during installation, preflight checkout, or flight.	c) A percussion actuated device must have a specified guaranteed no-fire pull force of no less than twice the largest inadvertent pull force that the device could experience during installation, preflight checkout **with the safing pin installed**, or flight **without the safing pin installed**.	LM Comment Split into 2 requirements – with and without the safing pin installed. Boeing Comment Permit requirement to be met with the safing pin installed.

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D417.31 Percussion actuated device. j) The design of a percussion actuated device must provide for the device to function without degradation in performance after being exposed to any inadvertent transportation, handling, or installation environment that could go undetected.	j) The design of a percussion actuated device must provide for the device to function without degradation in performance after being exposed to any ~~inadvertent~~ transportation, handling, or installation environment ~~that could go undetected.~~	LM Comment Covered by E417.9k. 'Inadvertent ' is too open a requirement. Applies throughout document
D417.31 Percussion actuated device. l) The design of a percussion actuated device must provide for the device's structural and firing components to withstand 500 percent of the largest pull or jerk force that it could experience during breakup of the launch vehicle.	l) The design of a percussion actuated device must provide for the device's structural and firing components to withstand ~~500~~ **300** percent of the largest pull force that it could experience during ~~breakup of the launch vehicle~~ **an ISDS function**.	LM Comment Force experienced during break up of the vehicle needs to be removed and covered by a all encompassing statement for all of these types of applications. Assuming 1300g minimum shock requirement and 5x covers it. Boeing Comment Change 5x to 3x. We only meet 3x for the lanyard in the vehicle
D417.31 Percussion actuated device. n) A percussion actuated device must include a safing interlock that prevents the percussion actuated device assembly from pulling more than 50% of the guaranteed no-fire pull distance. The design of the safing interlock must provide for the interlock to be positively locked into place and must provide for a means of verifying proper function of the interlock. The design of the safing interlock must eliminate the possibility of inadvertent disconnection or removal of the interlock should a pre-load condition exist on the lanyard. The safing interlock must prevent initiation of the percussion actuated device when subjected to the greatest possible inadvertent pull force that could be experienced during preflight processing.	n) (1.) A percussion actuated device must include a safing interlock that prevents the percussion actuated device assembly from pulling more than 50% of the guaranteed no-fire pull distance. The design of the safing interlock must provide for the interlock to be positively locked into place and must provide for a means of verifying proper function of the interlock. (2) **The design of the** safing interlock must eliminate the possibility of inadvertent disconnection or removal of the interlock should a pre-load condition exist on the lanyard **unless a visual or other means is available to verify no load is on the lanyard.** Boeing recommendation: Permit operational steps in lieu of safing pin. We currently lockwire the safing pin in place.	LM Comment Reword to clarify. LM Comment Broken out item 3 is covered in tailored D417.31d Boeing Comment Our lanyard pull initiator does not comply. Our safing pin does not have an interlock. Would require complete redesign and more complex item. Revise requirement to require safety inhibits against arming with pull force applied (either by design or procedural).

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
		procedural).
D417.33 Explosive transfer system. (a) Ordnance used in an explosive transfer system must utilize secondary explosives except under the provisions of § D417.1(a).	Accept use of primary explosives in TLX®. Specifically permit lead azide in TLX. Exempt TLX LE tip pyrotechnics.	Boeing Comment TLX uses primary explosives, do not comply with this paragraph. TLX HE tips use lead azide. LE tips use pyrotechnic mixes. How these are treated is unclear. If clear and convincing evidence is not accepted, entire FTS system would have to be revised from TLX to FCDC
D417.35 Destruct charge. (d) The design of a destruct charge must provide for the charge to sever or penetrate 150% of the thickness of the material that must be severed or penetrated in order for the destruct charge to accomplish its intended flight termination function. A destruct charge, when initiated to terminate the flight of a launch vehicle, must not detonate any launch vehicle or payload propellant.	d) The design of a destruct charge must provide for the charge to sever or penetrate 150% of the maximum thickness of the material that must be severed or penetrated in order for the destruct charge to accomplish its intended flight termination function. **Optional to test a nominal target with a 67% downloaded charge.** A destruct charge, when initiated to terminate the flight of a launch vehicle, must not detonate any launch vehicle or payload propellant.	Boeing Comment GEM destruct charges are tested with 67% load against nominal targets due to difficulty in obtaining 150% thickness graphite composite material Procurement of required targets, and retest, would be expensive. Future tests would also be more expensive due to custom build of target material Permit 150% target thickness or 67% charge load testing. LM Comment Clarify target condition and add option for 67% downloaded charge for target designs that cannot be simply thickened. Split into 2 requirements.
D417.35 Destruct charge. (e) All destruct charge fittings must withstand 200% of the installation, qualification, and breakup loads without degradation.	(e) All destruct charge fittings must withstand 200% of the installation~~, qualification, and breakup~~ loads without degradation.	LM Comment Why is 200% of qualification loads required? Qualification loads provide margin for break up issue.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
APPENDIX E TO PART 417 – FLIGHT TERMINATION SYSTEM COMPONENT TESTING AND ANALYSIS	Specifies in great detail the Flight Termination System Component Testing and Analysis.	Boeing Comment While much of this is what is currently done, there are many instances where over the years testing has been modified, and thus we do not fully comply. The fact that these requirements are specified in public law makes them impossible to modify. Specify that testing requirements will be established by FAA and include specifics in a FAA Document that can be "worked" to support individual situations.
E417.1 General. (e) A component sample whose test data reflects that it is out-of-family when compared to other samples of the component shall be considered a test failure even if the component satisfies other test criteria. An unexpected change in the performance of a component sample occurring from the start to the end of testing shall be considered a test failure. For such failures, a launch operator shall perform a failure analysis to determine the root cause of the failure and ensure that there are no generic design, workmanship, or process problems with other flight components of similar configuration.	(e) **The following applies for destructive lot acceptance testing.** A component sample whose test data reflects that it is out-of-family when compared to other samples of the component may be considered a test failure even if the component satisfies other test criteria, **if the out of family condition represents a component or system failure mode.** For such failures, a launch operator shall perform a failure analysis to determine the root cause of the failure and ensure that there are no generic design, workmanship, or process problems with other flight components of similar configuration.	LM Comment An 'out of family' condition is component and system dependent. For destructive lot acceptance tests only, not individual tests.
E417.9 Qualification non-operating environments. c) High temperature storage of ordnance. For tests being performed to extend the service life of an ordnance component production lot, sample components from the production lot shall be tested to demonstrate that the performance of each component does not degrade after being subjected to +71^{o}C and 40 to 60 percent relative humidity for no less than 30 days.	c) High temperature storage of ordnance. For tests being performed to extend the service life of an ordnance component production lot, sample components from the production lot shall be tested to demonstrate that the performance of each component does not degrade after being subjected to +71^{o}C and 40 to 60 percent relative humidity for no less than 30 days. **This tests extends the service life for 3 years. An option is to conduct a 39 day test for a 5 year life extension.**	LM Comment Clarification

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
Table E417.33-2 Destruct Charge Qualification Tests Propellant Detonation - Each destruct charge shall be tested to demonstrate that it will not detonate the propellant of its intended target.	Propellant Detonation - Each destruct charge shall be tested to demonstrate that it will not detonate the propellant of its intended target. **Similarity or analysis may be used in place of testing.**	LM Comment Requires conducting 2 tests. Need to caveat that this test can be eliminated by similarity, analysis or by propellant selection.
E417.39 Ordnance interfaces and manifold qualification. b2) Test 2994 flight units in a flight configuration to demonstrate that ordnance initiation occurs across each flight configured interface with a reliability of 0.999 at a 95% confidence level.	b2) ~~Test 2994 flight units in a flight configuration~~ **A statistical method shall be used** to demonstrate that ordnance initiation occurs across each flight configured interface with a reliability of 0.999 at a 95% confidence level.	LM Comment 2994 firings is impractical and not per current practice. Use statistical methods.
E417.39 Ordnance interfaces and manifold qualification. B3) (i) Test five units at four times the combined system gap. (ii) Test five units at four times the combined system axial misalignment. (iii) Test five units at four times the combined system angular misalignment. (iv) Test five units at half the combined system gap.	**(i) Five donor to receptor tests shall be assembled and fired with 4 times the nominal (combined ordnance donor and receptor port) air gap, (or 0.15 inch whichever is greater).** **(ii) Ten firings shall be conducted at the nominal temperature to demonstrate detonation transfer with an axial offset 1.5 times the maximum alignment tolerance (combined ordnance donor and receptor port) at nominal air gap. Angular offset shall be correlated to an axial misalignment and included in the maximum alignment tolerance.** **(iii) Five donor to receptors tests shall be assembled and fired with 50% the minimum air gap.**	LM Comment Recommend rewrite as shown
E417.39 Ordnance interfaces and manifold qualification. C2) Test 2994 flight units in a flight configuration to demonstrate that ordnance initiation occurs across each flight configured interface with a reliability of	C2) ~~Test 2994 flight units in a flight configuration~~ **A statistical method shall be used** to demonstrate that ordnance initiation occurs across each flight configured interface with a reliability of 0.999 at a 95% confidence level.	LM Comment 2994 firings is impractical and not per current practice. Use statistical methods.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
0.999 at a 95% confidence level.		
E417.3	Document does not specifically state that test tables are the specific requirement, and test paragraphs are applicable only as dictated by test tables	Boeing Comment Will cause confusion and misunderstandings Clarify order of precedence between tables and paragraphs: tables are the authority for detailed test requirements.
E417.5 (a)	Some defects should not be considered failures. MRB process is the correct way to handle this. This is an unnecessary paragraph since the test tables define test and inspection requirements.	Boeing Comment Possible arbitrary rejection of good hardware, depending on degree to which this paragraph is interpreted and enforced. Delete paragraph, keep all test and inspection requirements in test tables.
E417.5 (f)	This paragraph should not require multiple views be taken. Sometimes one view is adequate.	Boeing Comment Unnecessary radiography. Require radiography "as required to assess hardware"
E417.5 h 2	Current leak requirement is 5 x 10(-6) sccs helium. Paragraph disagrees with para D417.31 k. Some parts cannot pass 5 x 10(-6), but have been shown to be acceptable with greater leak rate. Some parts cannot be leak tested after assembly	Boeing Comment Possible additional scrap in lot acceptance tests with no benefit. Would delete TLX® LE design, with significant system redesign cost. Possible redesign of some ordnance components. Standardize leak criteria at 5 x 10(-6) sccs helium. Better solution is to accept designs that meet supplier established leak requirments based on successful qualification and Accel Age testing. Permit leak testing on sampling basis as required by the

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		design.
E417.9	Potential significant new analysis requirements. Previously engineering judgement has been used to waive non-operational requirements.	Boeing Comment Significant analysis costs Permit rational for omitting non-operational tests, which may include formal analysis.
E417.9(B2)	Dwell time for storage temperature test at 3 times the maximum predicted time is not feasible when storage time is months or years	Boeing Comment Not feasible to perform test Change to demonstrate the unit can survive the storage environment.
E417.9(e)	"maximum predicted handling height" is vague. A better requirement would be per MIL-STD-810, procedure VI - bench handling	Boeing Comment No-impact, we would claim our test per MIL-STD-810 covers the maximum predicted handling height Revise requirement to call out lifting edge 4 inches, or 45 degrees (or until edge balances), whichever comes first.
E417.9 j 1	Permit pull testing of TLX® at 75 lbs rather than 100 lbs.	Boeing Comment Would require either change to alternate design or scrapping large lots of lines that fail test TLX® lines cannot comply with 100 pound pull test
All ordnance test tables	Significant tailoring is currently in place for EWR 127-1 test tables. These FAA tables have none of that tailoring. Imposing these tables as is would be expensive, and tailoring process to this proposed law may not work.	Boeing Comment Significant additional test cost across all items Specifically identify test tables as guidelines to be formally implemented via the approved supplier test procedures.
E417.11	Some items can be best vibration and shock tested in hardmount setups with conservatively enveloped requirements, even though the flight installation is on	Boeing Comment Added test cost due to unique and more complex setups

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	isolators.	Require test methods that envelope all flight environments, and leave specific setups out of requirements.
E417.11 g	Humidity testing is currently not performed	Boeing Comment Would increase test cost with no benefit since parts are hermetically sealed Require humidity testing only for non-hermetically sealed components.
E417.11 i	Thermal vacuum testing is currently not performed	Boeing Comment Would increase test cost with no benefit since parts are hermetically sealed Require thermal vacuum testing only for non-hermetically sealed components.
Tables, Appendix E		Boeing Comment Tables in EWR 127-1 are currently heavily tailored as they apply to individual components.
E417.11 (h)(3)(I)	Requires a plus 10 deg C on the high temperature and 5.5 deg C on the low temperature.	Boeing Comment Existing temperature are plus/minus 10 deg F because battery temperature can be established from temperature measurements. Continue the practice of using +/- 10 deg F for prelaunch verification.
E417.11 (h)(3)(ii)	Specifies eight Thermal cycles.	Boeing Comment Eight cycles are not practical for Silver-Zinc batteries which are used on the first charge/discharge cycle. All testing, which may take a long time to include eight cycles, would have performed on a single discharge cycle. Accept the current FTS battery qualification

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Table E417.21-1, footnote (1): "These battery acceptance tests shall be performed at the launch site just prior to installation."	Either remove footnote (1) or limit its affectivity to tasks performed in the battery lab during pre-launch battery processing. These tasks include: Safety Tests Status-of-health Monitoring Capability Heater Circuit Verification Activation Electrical Performance Cell Acceptance Verification	LM Comment Many of these tests are performed by the supplier, at their facility, and not at the launch site. Others are performed by a quality representative, as part of receiving inspection.
§E417.21c Safety tests. Each battery and cell shall be tested to ensure it will not create a loss of structural integrity or create a hazardous condition when subjected to normal and abnormal operating conditions in accordance with the following:	§E417.21c Safety tests. Each battery and cell shall be tested to ensure it will not create a loss of structural integrity or create a hazardous condition when subjected to ~~normal and abnormal~~ **predicted** operating conditions plus margin, in accordance with the following:	LM Comment Testing is generally done to "predicted operating conditions plus margin" and not to "abnormal operating conditions"
§E417.21e1 Pre-activation. Insulation resistance shall be measured between mutually insulated pin-to-pin and pin-to-case points using a minimum 500-volt workmanship voltage. Continuity resistance shall be measured between mutually insulated pin-to-pin and pin-to-case points. The insulation resistance and continuity resistance measurements must be in accordance with the manufacturer's design specifications.	§E417.21e1 Pre-activation. **Prior to connecting the battery harness to the cells,** insulation resistance shall be measured between mutually insulated pin-to-pin and pin-to-case points using a minimum 500-volt workmanship voltage. Continuity of battery harness shall be measured after completion of all wiring but prior to activation. ~~resistance shall be measured between mutually insulated pin-to-pin and pin-to-case points.~~ The insulation resistance and continuity measurements must be in accordance with the manufacturer's design specifications	LM Comment 500 V Insulation resistance measurements are generally taken prior to the battery internal wiring being connected to the cells. The Insulation resistance test is for the pin-to-pin and pin-to-case resistance. Continuity is normally measured end-to-end on the batteries internal wiring.

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	specifications.	
§E417.21e2 Post activation. Leakage current shall be measured from each pin to case to verify no current leakage paths exist as a result of electrolyte leakage. This measurement must have a resolution that detects any leakage current of 0.1 milliamps or greater.		LM Comment This is typically made as a voltage measurement.
§E417.21i5 The battery or cell must supply the required current while maintaining the required voltage regulation in accordance with the manufacturer's design specification. Monitoring during the current pulse test must have a resolution of 0.1 milliseconds.	§E417.21i5 The battery or cell must supply the required current while maintaining the required voltage regulation in accordance with the manufacturer's design specification. Monitoring during the current pulse test must have a resolution of 10~~0.1~~ milliseconds.	LM Comment The sample rate for the current pulse is too high. A resolution of 10ms would be sufficient to capture 10 samples during the 100msec pulse.
§E417.21o1i A battery shall be discharged at flight loads until the capacity has reached the manufacturer's specified capacity value. The total amount of capacity consumed during the discharge test and qualification discharge shall be calculated and verified that it meets the minimum performance specification. A high current pulse of 150% of the expected current pulse shall then be applied to the flight loads. The pulse duration for this test shall be twice the expected operating flight pulse time or a minimum workmanship level of 100 milliseconds whichever is greater.	§E417.21o1i A battery shall be discharged at flight loads until the capacity has reached the manufacturer's specified capacity value **less the calculated capacity of the final pulse load below**. The total amount of capacity consumed during the discharge test, qualification discharge, and final pulse test, shall be calculated and verified that it meets the minimum performance specification. A high current pulse of 150% of the expected current pulse shall then be applied to the flight loads. The pulse duration for this test shall be twice the expected operating flight pulse time or a minimum workmanship level of 100 milliseconds whichever is greater.	LM Comment Generally, a battery needs to meet all its performance requirements within its specified capacity limits. Not after the total specified capacity has been removed.
§E417.21w1 The inspection shall include full battery inspection and verification that there was no movement of any component within the battery.	§E417.21w1 The inspection shall include full battery inspection and verification that there was no ~~movement of~~ **damage to** any component within the battery.	LM Comment The purpose of a post test disassembly is to look for damage, not movement.
§E417.21w5 Cells shall be individually tested with a chemical indicator to identify any cells that may have leaked. Any cell that shows signs of chemical leakage will be considered a test failure.	Delete §E417.21w5	LM Comment A Leakage Voltage test (ref §E417.21e2), run just prior to disassembly, would be a better way to test for leakage. It is quantitative, rather than qualitative, and has

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		identifiable pass/fail criteria. Electrolyte misting from the cell vent valves is a normal "side effect" of Silver Zinc battery operation. Electrolyte leakage, unless it impedes the operation of the battery (i.e. causes excessive leakage currents), is not justification for failure. Ref §D417.19h3 – which states electrolye leakage may be part of normal operation,
§E417.21x Battery mounting and case integrity. Battery cases and mounting hardware shall be tested to demonstrate the capability to withstand normal and abnormal flight environments. Inspection or test criteria shall be implemented to ensure welds are free of workmanship defects. Welds must be inspected by X-ray in accordance with § E417.5(f).	§E417.21x Battery mounting and case integrity. Battery cases and mounting hardware shall be tested to demonstrate the capability to withstand ~~normal and abnormal~~ **predicted flight environments plus margin**. Inspection or test criteria shall be implemented to ensure welds are free of workmanship defects. Welds must be inspected by X-ray in accordance with § E417.5(f).	LM Comment Testing is generally done to "predicted flight environments plus margin" and not to "abnormal flight environments"
§E417.21(l) Leakage.	§E417.21(l) **Nickel Cadmium** Leakage.	LM Comment The requirements of this section seem to be tailored toward Nickel Cadmium batteries, not Silver Zinc.
E417.21 (t) and Table E417.21-3	This paragraph specifies calendar life test and Silver Zinc Storage extension tests, respectively, but are inconsistent on the quantity of cells to be tested. Each require yearly test to performed to verify that cell aging has not adversely affected battery performance.	Boeing Comment These tests are not required. Existing lot acceptance, battery acceptance, battery activation and cell acceptance verification (E417.21 (j)) tests are more than sufficient to establish the acceptance of the battery over time. In addition, Silver-Zinc batteries has a storage life which has been established by testing for many years and accepted by the industry. There are no additional tests that need to be performed to verify the use of cells beyond the battery storage life. Accept the current FTS battery method of verifying

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		acceptable performance over time.
Table E417.21-2 Quantity of test articles & Leakage test [E417.21(l)] Table provides Qualification test requirements for Silver-Zinc batteries and cells.	Accept the current FTS battery cell qualification. Remove the requirement for qualification testing of 12 cells in addition to the 3 batteries. This will also affect footnote (4). Remove Leakage, Reference E417.21(l) from the list of tests.	Boeing Comment It isn't necessary to perform Non Operating and Operating Environmental tests on individual cells. Such tests are not representative of the environments to which the cell will to be exposed and needless failures can occur. The cells are designed to be packaged inside a battery case in order to survive the environmental conditions. LM Comment An FTS battery is being qualified for use. The cells are components of the battery assembly and will see the full range of qualification environments. Testing 12 additional cells in non-flight configuration (i.e. not in a battery case) is not "testing as you fly". Leakage test appears to be for Nickel Cadmium batteries and should not be a requirement for Silver Zinc
Table E417.21-3, Leakage test [E417.21(l)]	Remove Leakage, Reference E417.21(l) from the list of tests.	LM Comment Leakage test appears to be for Nickel Cadmium batteries and should not be a requirement for Silver Zinc
Table E417.17-1	Antenna system does not comply with identification, abbreviated antenna pattern, acoustic testing, and tensile load requirements	Boeing Comment Requires additional ATP tests Allow grandfathering
Table E417.17-2	3 systems were not tested Several of the listed tests were done by analysis, such as transportation vibration , fungus resistance, salt fog, fine sand, humidity, sinusoidal vibration acoustic, etc	Boeing Comment Perform additional qualification tests on cables, couplers, and antennas to add additional environments and bring number of test units to three

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		Allow grandfathering
Table E417.19-2	The CRD is not sealed so leakage test does not apply	Boeing Comment Redesign of CRD to allow leak tests Add note to specify leakage test for sealed components only
Table E417.19-2	2 CRDs were tested instead of three. Several of the listed tests were done by analysis, such as storage temperature, transportation vibration, fungus resistance, salt fog, fine sand, humidity, acceleration, sinusoidal vibration, acoustic, and explosive atmosphere	Boeing Comment Perform additional qualification tests Allow grandfathering
Table E417.33-1	TLX has shown less ability to withstand pull testing after environments due to shifting of the braid tension.	Boeing Comment May result in scrapping large lots of TLX for one isolated failure. Tensile testing should be performed prior to environments to simulate actual environmental exposure sequence.
E417.33d	This test has never been performed	Boeing Comment Large test expense with zero benefit, or results would drive unknown redesign of charges or propellant. Delete requirement for tests. Due to blast hazard zone being clear, this requirement is unnecessary.

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APPENDIX F TO PART 417 – FLIGHT TERMINATION SYSTEM ELECTRONIC PIECE PARTS	**(The following LM suggested rewrite does not represent an Industry recommendation)** **F417.1 General** This appendix contains the requirements that apply to electronic piece parts used in a flight termination system. The launch operator shall establish a Electronic Parts Control Program for all electronic piece parts used in the production of flight termination system components. **F417.2 Piece parts program plan** A launch operator shall document a Electronic Parts Control Program in a Electronic Parts Control Plan (EPCP). The plan shall address integration of electronic piece part requirements and quality control efforts as it relates to Electronic Piece Parts (EEE) , including methods for coordination between Engineering, Procurement and Quality functions. The plan shall be submitted during the licensing process in accordance with 415.119 and updated as required in accordance with part 417. The plan shall be compressive and describe how the launch operator is organized, how they plan to meet the performance criteria for the flight termination system and how the launch operator ensures flow down of performance criteria to all applicable subcontractors, supplier and vendors. The EPCP as a minimum shall address the following subjects: 1) Interface between the launch operator , its subcontractor, and the FAA as it relates to EEE parts. 2) How EEE part are to be procured to achieve compliance with hardware technical performance	

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	requirements a) Development and control of supplier for EEE parts (as applicable) b) Manufacturing, Screening and Receiving Inspection Baseline (as applicable) c) Receiving Inspection Requirements 1. Plans and procedures for conducting Destructive Physical Analysis (DPA) 2. Plans and procedures for conducting Particle Impact Nose Detection PIND testing on cavity parts. 3. Inventory Control of flight accepted EEE parts . 3) Government Industry Data Exchange Program (GIDEP) Alerts process and tracking. 4) Plans for conducting Failure Analysis (FA) , where required. review and corrective action process . 5) Parts Application and Derating criteria **F417.3 Guidelines for selection, testing and qualification of EEE parts** **F417.4 Mil-Specification Parts** a) Performance, quality and reliability levels as defined	

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	by the Department of Defense product qualification quality program as they apply to the follow part classifications: (1) Diodes and transistors.-- JANTX, JANTXV, or JANS (2) Microcircuits -- Class B or Class S (3) Hybrids- Class H or Class K (4) Passive parts-- Established reliability level R or S level (5) Established reliability level R for relays. (6) Crystal oscillators or filters-- Class B Cavity Device shall be subjected to Particle Impact Nose Detection (PIND) testing per approved part plan. Destructive Physical Analysis (DPA) shall be conducted per approved part plan **F417.5 Custom or non-military piece parts.** All custom or non-military parts used in a flight termination system shall be guided by the screening test, lot acceptance testing, and qualification testing, to demonstrate equivalence to the military-quality parts of this appendix.	

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64111 through 64113 **APPENDIX G TO PART 417 – NATURAL AND TRIGGERED LIGHTNING FLIGHT COMMIT CRITERIA**	Rewrite to exactly match Launch Commit Criteria established by Lightning Advisory Panel.	The Launch Commit Criteria established by the Lightning Advisory Panel that are used at existing federal ranges should be included in Appendix G exactly as written in Aerospace Corporation Report #TR99(1413)-1, *Natural and Triggered Lightning Launch Commit Criteria (LCC)*, 15 January 1999. The Aerospace report should be referenced in Appendix G. Shifting the responsibility of weather monitoring from the existing federal ranges to the launch operator unnecessarily burdens the launch operator. The launch operator cannot perform the weather monitoring service or maintain and upgrade weather instrumentation.

FAA NPRM PARAGRAPH	Suggested Change or Comment	Rationale
APPENDIX H TO PART 417 – SAFETY CRITICAL COMPUTING SYSTEMS AND SOFTWARE		LM Comments In general, the software requirements of appendix H appear to provide good guidelines for software development. However, these requirements are very specific and some of these requirements appear to be architecture dependent, while others are unclear or seem very hard to verify. We are concerned that implementation of these requirements as public law would severely restrict future evolution of systems or software. We recommend that paragraph 417.123 be rewritten and that appendix H be used as an Advisory Circular (or other guidelines) for the development of standards that meet 417.123. Note: The depth of these requirements far exceeds the FAA standard for aircraft. A review of FAR 25 found no specific software requirements. In a quick review of software requirements, LM found that the FAA appears to use Advisory Circulars to lead the certifier toward RTCA/DO 178B. While we have not reviewed RTCA/DO 178B, we believe that it provides guidelines for coding standards, testing, reviews, etc. dependent upon the criticality of the software. The FAA then reviews the standards and testing to verify that it meets RTCA/DO 178B. Our recommended rewrite of 417.123 and using appendix H as an Advisory Circular is more in line with this type of system. Additionally, if the FAA created advisory circular specific to software for launch vehicle safety as a guideline for launch vehicle software in the future (which may make software review an easier task for the FAA), only the Advisory Circular would need to be changed, not the FAA requirement.
H417.1 & H417.3	Requirement to identify "all flight and ground systems" that "may directly or indirectly cause a public safety hazard" and " used to or having the capability to monitor hazardous systems"	Boeing Comment This is a very broad and sweeping statement which basically encompasses every thing. This would require

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	monitor hazardous systems"	extensive analysis to determine all combinations. This requirement should only be applicable to major changes to S/W and the focus should be kept on the actual S/W required and not anything that "may indirectly or have capability to".
H417.5	The current delta systems do not meet this requirement	Boeing Comment All of the CPU designs used by Delta share the memory for code and data and do not have separate memories. RIFCA and CDPS/DLPS. This would mean a total redevelopment on a different hardware of all RIFCA flight and Ground software. This is several man years of effort by the Delta team. That the requirement to insure proper care on the separation of instruction and data to be demonstrated in the validation testing.
H417.5 (b) A central processing unit's throughput must not exceed 80 percent of its total capacity.	Clarify	LM Comment Requirement can be interpreted many ways (instantaneous throughput – averaged over an hour, etc). – Needed tailoring for existing ground and flight software.
H417.7 (c) In the event of a total power loss, a computing system must degrade in a controlled manner to a secondary mode of operations or shutdown without creating any potentially unsafe state.	Clarify	Boeing Comment The RIFCA design does handle one of it two power sources down but not both. If the definition of total does mean 100% of the Vehicle or ground system (including the UPS) this is a major S/W redesign of several man-years. The definition of total is in question. We believe our design meets the intent of what is needed, a single fault tolerance system. LM Comment Upon total power loss the computer will not operate. Controlled degradation at that point is not possible. LM attempts to have back-up systems or processes to assure

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		safety can be maintained.
H417.11 (a)(5) Notify the operator if any ARM and SAFE logic error pattern, other than the ARM and SAFE codes, is present.		LM Comment Tailoring would be required for existing programs. Current Range Safety approved Safe/Arm hardware use switches to provide location not a logic pattern.
H417.11 (a) Requires the system to be capable of: 3) The rejection of erroneous inputs. (6)(i) Anomalies must be prioritized (6)(ii) Anomalies of the same type must be grouped together (6)(iii) The most recent anomaly must be at the top of the list. (6)(iv) The details of each anomaly leads to a summary write-up that delineates actions.		Boeing Comment We have engineers, not technicians, working together with the software perform this job. This would require rewriting four sections at an approximate cost of $10k each for the CDPS/DLPS ground software. We have addressed the intent of each of these but in a different manner. 3) This requirement exceeds the capability of the present software to reject ALL erroneous inputs. This is why we have engineers and the software work together to monitor the data. We feel that is satisfies the requirement. (6)(i) Anomalies must be prioritized – Delta II/III has green, yellow, and red limits but this does not prioritize them it only provides the magnitude of concern. Delta IV only has yellow and red. The determination of the priority is given to the engineer. We feel this is the best approach. (6)(ii) Ours are not grouped together by type but by chronological order. We feel that is a more meaning full arrangement of the information assisting in the tracing of the cause and effect of the system parameters. (6)(iii) The most recent anomaly must be at the top of the list. We place the most recent at the bottom of the list but the focus of the window is at the bottom also. We feel that is satisfies the requirement. (6)(iv) The details of each anomaly leads to a summary write-up that delineates actions. We have this information in the LPD's and also require trained

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		engineers. We feel that is satisfies the requirement.
H417.11 (b)(4) Notify the operator if any ARM or SAFE logic pattern other than the ARM or SAFE code is present.		LM Comment Current flight software required tailoring. It cannot directly notify the operator. It has to relay information through the ground systems
H417.13	Current Delta systems do not meet the requirement that specified the interlock must not be autonomously controlled.	Boeing Comment This would require rewriting several section of the CDPS/DLPS ground software. The interlock is handle by two separate automation tools which must handle the interlocks to do the proper job. The one in particular is the TSS. Without this we may not be able to launch Delta III's. The automation is required to handle the rapidly changing evaluations on a very strict time line. No interlocks are overridden any condition not meeting a success criteria aborts the operation. This software is validated prior to launch and its focus is very controlled. Delete the requirement that the interlock must not be autonomously controlled.
H717.13 (c) A system with a software safety critical function must include one or more interlocks as needed to mitigate all hazards when performing maintenance or testing of the system.		LM Comment Flight software was determined to meet the intent of this requirement, it may not meet strict interpretations.
H417.17 (k) The system must provide error messages that distinguish safety critical states or errors from non-safety critical states or errors.		LM Comment Current ground system does not distinguish between safety and mission critical errors. We meet the intent by providing error message wording and coloring to convey criticality.
H417.19	The requirement states that there will be no use of code patches. Delta currently uses code patches known as resets for RIFCA.	Boeing Comment The RIFCA software uses resets to provide small code changes and late MC updates.

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		changes and late MC updates. CDPS uses patches for small modular updates. Remove requirement. To do this would force us to recompile and validation the software within the launch schedule, will only increase risk of a safety critical error to be made. A cost of 10,000 man hours and ~12 months. As compared to a patch of 600 man hours and 3 weeks. This may also precludes the present capability to do interplanetary missions and use of the load relief wind resets.
H417.21 "critical values must not be modifiable by the operator"	Remove requirement. The load relief wind update on day of launch to the mission constants would prevent us from functioning any other way.	Boeing Comment Our present operation allows us to modify any RIFCA memory as required without exclusion of any part. This precludes the present capability to do interplanetary missions and use of the load relief wind resets. This will lower the launch probabilities and increase the cost of launches ~$250K per attempt.
H417.21 (b) The design of a watchdog timer or similar device must prohibit software from entering an inner loop and resetting the timer or similar device as part of that loop sequence.		LM Comment The current flight software required tailoring of this requirement.
H417.23 All software must be modular	Should only apply to new or modified code.	Boeing Comment While is this a good coding practice we have software that was written before this was being regularly done. This represents ~2080 man hours / per S/W as an average. The exact number of non-qualifying S/W would first need to be determined but is estimate to be ~20 for Delta II/III.
H417.23 (c) Software safety critical function program modules must have no greater than one entry and one exit point.		LM Comment Tailoring of this requirement was needed for current ground systems.

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H417.27 All software must not contain unused executable code	Should only apply to new code.	Boeing Comment While is this a good coding practice we have software that was written before this was being regularly done that works just fine today. We have programs that have functionality needed at one location but not another. We also have out grown functionality that use to be needed. Not all missions use all the flight program features. Does this constitute unused code? What constitutes unused needs to be clarified as the implications could be made more broad and even include the Flight programs. Removal of unused code represents modifying and revalidating all affected S/W.
H417.27 (b) Non-executive operational software safety critical function object code must not incorporate a HALT instruction.		LM Comment Seems to be an architecture dependent requirement.
H417.27 (c) After a task has been HALTED, the executive must restart central processing unit task processing no later than the start of the next computing frame.		LM Comment Seems to be an architecture dependent requirement.
H417.27 (e) The design of a system must prevent unauthorized or inadvertent access to or modification of software safety critical function source code or assembly software or object code.		LM Comment The current flight software required tailoring of this requirement.
H417.27 (g) Software safety critical function operational program loads must not contain unused executable codes.		LM Comment This requirement required tailoring for existing ground systems. Some flight software may not use all of the executable code on a mission. (such as SRM software on a non-SRM vehicle). It is considered safer to have one version of the code rather than trying to have to track the use of several different versions.

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H417.27 (h) A software safety critical function operational program load must not contain any unreferenced variables.		LM Comment This requirement required tailoring for existing ground systems. The current flight software also required tailoring of this requirement
H417.29 (b) A software safety critical function must not employ a logic "1" and "0" to denote any potentially hazardous state including any SAFE and ARM.		LM Comment The current flight software required tailoring of this requirement. Note: current safe arm status output is dependent on the hardware. Current Range Safety approved S/A devices often have discrete outputs for denoting S/A device location.
H417.29 (c) Any ARM and SAFE states must be represented by at least a unique 4-bit pattern.		LM Comment The current flight software required tailoring of this requirement. Note: hardware dependent. Approved Range Safety Devices may not provide this output.
H417.29 (d) A SAFE-state must be a pattern that cannot represent the ARM-state pattern as a result of a 1 or 2-bit error.		LM Comment The current flight software required tailoring of this requirement.
H417.33 The multiple use of flags and scratch files. The compiled code must check the address boundary of any data written into arrays.	Should only be applied to new codes	Boeing Comment While is this a good coding practice we have software written before this was being regularly done that works just fine today. This requires an analysis of all the existing software to determine the impacted software. Then to go modify and revalidate the software. We had to turn off the compiler checking because of the overhead impact to the codes through put. But all the indirect addressing was validated and checked by other means. It is estimate to be ~20 pieces of S/W for Delta II/III. The true intent of what the rule requires has been met -

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		just not by the method proposed.
H417.33 (c) Flags and variable names must be unique and have a single purpose.		LM Comment This requirement was tailored for the current ground systems. Note: interpretation of what this means could be different. Example if we have two separate modules that each have the same variable name in them have we violated the unique name requirement?
H417.33 (f) Software must contain only those features and capabilities required by the system. Software safety critical function programs must not contain undocumented or unnecessary features.		LM Comment The term "unnecessary features" is ambiguous. If our software is designed to handle all vehicle configurations, it may have some features are not necessary for that launch. We think it is safer and easier to assure the software configuration if one set of code is used for all cases. Other interpretations may be that there should be different loads for each launch that have only the "necessary" functions for that launch.
H417.33 (g) Indirect addressing methods must not be used unless the address is verified as being within acceptable limits prior to execution of software safety critical function operations. The compiled code must check the address boundary of any data written to arrays in software safety critical function operations.		LM Comment We may not meet a strict interpretation of this requirement. By nature c type strings do not do array boundary checking. Our warning messages may not meet this requirement. Our software development and testing verifies that data remains within array boundaries.
H417.33 (j) Software safety critical function code must not incorporate one-to-one assignment statements.		LM Comment This requirement is not clear. What is exactly meant by this?
H417.35 The initial memory patterns and not used memory values or values of unused memory after memory operations.	Should only be applied to new codes	Boeing Comment In the case of RIFCA we can change some practices they will take more time for vehicle operations. For CDPS/DLPS the users do not have that type of control over UNIX. Software and/or database changes would be needed. Present a fair amount of time and money to resolve.

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		This represents a process change and more field site time in loading the flight computer. The GSE S/W being UNIX based present a totally different problem in that the OS doesn't allow you to configure unused memory. This represents a recurring cost of labor and non recurring of redefining the processes for the flight software. For the GSE S/W it may mean move to a totally different computer and operating system. This would be very expensive. About a two to three man-years of effort
H417.35 (a) All ground or preflight process static memory not used for or by the operational program must be initiated to a pattern that causes the system to revert to a safe state if executed.		LM Comment The current ground system does not meet the letter of this requirement. Use of the OS controlled virtual limit registers to define the bounds of program execution was determined to meet intent of the requirement. The flight software memory meets the intent of this requirement. It has a BEX instruction that attempts to run the next event in the scheduler and hopefully regain control of the system.
H417.35 (d) Random numbers, HALT, STOP, WAIT, or NO-OPERATION instructions must not fill processing memory.		LM Comment Current ground system was determine to meet intent of this requirement and may not meet all interpretations of it.
H417.35 (e) Data or code from previous overlays or loads must not be allowed to remain.		LM Comment Current ground system was determine to meet intent of this requirement and may not meet all interpretations of it.
H417.35 (g) Safety kernels must be resident in nonvolatile read only memory or in protected memory that cannot be overridden by the computing system.		LM Comment Current ground system was determine to meet intent of this requirement and may not meet all interpretations of it. Flight software powers up in ROM and verifies proper initialization of the system. This may meet this

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		requirement, but it is not called a safety kernel.
H417.39 (a) A launch operator shall ensure that internal independent validation and verification or a similar formal process is used to ensure safety design requirements have been correctly and completely implemented for software safety critical function code.		LM Comment Current ground system was determine to meet intent of this requirement and may not meet all interpretations of it.
H417.41 (5) Minimum and maximum input data rates in worst case configurations.		LM Comment Current ground system was determine to meet intent of this requirement and may not meet all interpretations of it.

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64116 through 64123 **APPENDIX I TO PART 417 – METHODOLOGIES FOR TOXIC RELEASE HAZARD ANALYSIS** **I417.1 General** This appendix provides methodologies for performing toxic release hazard analysis for the flight of a launch vehicle as required by § 417.229 and for launch processing at a launch site in the United States as required by § 417.407(f).	This appendix provides methodologies for performing toxic release hazard analysis for the flight of a launch vehicle as required by § 417.229 and for launch processing at a **non-federa**l launch site in the United States as required by § 417.407(f). **This appendix is not applicable for launches at federal ranges, since the range safety organization at the launch site will perform this analysis using the methods that have been established at the federal launch site.**	The range safety personnel at the launch site routinely perform a toxic release hazards analysis. It is not technically or financially reasonable for launch operators to perform flight safety analyses currently performed by the range safety organizations at the federal ranges. The existing federal ranges have, both jointly and independently, developed and improved the tools and methodologies used at their respective launch sites to perform toxic release analyses that protect the public and still afford as much launch availability to the launch operator as possible. The existing federal range toxic analysis personnel have responded to the suggestions and criticisms of toxic release experts and continue to improve the tools and methodologies used at their respective ranges. The acceptable toxic release analysis tools, methodologies, and flight commit criteria may vary among the ranges, but each range has been successful in maintaining public safety and launch availability. Therefore, there is no need for the FAA to regulate the toxic release analysis tools, methodologies, and criteria in place at the existing federal ranges. In addition to the wording change, the FAA should consider publishing the appendix as an advisory circular and deleting the appendix from the NPRM. The advisory circular could then be referenced in the NPRM as a suggested methodology.