[4910–13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Waiver of Debris Containment Requirements for Launch

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of waiver.

SUMMARY: This notice concerns two petitions for waiver submitted to the FAA by Space Exploration Technologies Corp. (SpaceX): (1) a petition to waive the requirement that a waiver request be submitted at least 60 days before the effective date of the waiver unless good cause for later submission is shown in the petition; and (2) a petition to waive the requirement that analysis must establish designated impact limit lines to bound the area where debris with a ballistic coefficient of three or more pounds per square foot is allowed to impact if the flight safety system (FSS) functions properly.

DATES: This notice is effective [Insert date of publication in Federal Register] and is applicable beginning December 18, 2015.

FOR FURTHER INFORMATION CONTACT: For technical questions concerning this waiver, contact Charles P. Brinkman, Licensing Program Lead, Commercial Space Transportation - Licensing and Evaluation Division, 800 Independence Avenue, S.W., Washington, DC 20591; telephone: (202) 267-7715; e-mail: Phil.Brinkman@faa.gov. For legal questions concerning this waiver, contact Laura Montgomery, Manager, Space Law Branch, AGC-210, Office of the Chief Counsel, Regulations Division, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-3150; e-mail: Laura.Montgomery@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

On December 3, 2015, SpaceX submitted a petition to the Federal Aviation Administration's (FAA's) Office of Commercial Space Transportation (AST) requesting relief from a regulatory requirement for a launch license for flight of a Falcon 9 launch vehicle carrying ORBCOMM-2 satellites. Specifically, SpaceX requested relief from § 417.213(a), which requires an analysis to establish flight safety limits that define when an FSS must terminate a launch vehicle's flight to prevent the hazardous effects of the resulting debris impacts from reaching any populated or other protected area, and the associated requirement of § 417.213(d), which requires an analysis to establish designated impact limit lines to bound the area where debris with a ballistic coefficient of three or more is allowed to impact if the FSS functions properly. On December 17, 2015, the FAA advised SpaceX that this relief must be requested as a waiver of § 417.213(a) and (d), and SpaceX modified its request to be a waiver petition in accordance with 14 CFR part 404. Because the scheduled launch was planned to occur in less than sixty days, SpaceX also requested a waiver to section 404.3(b)(5), which requires that a petition for waiver be submitted at least sixty days before the proposed effective date of the waiver, which in this case would be the date of the planned launch.

The FAA licenses the launch of a launch vehicle and reentry of a reentry vehicle under authority granted to the Secretary of Transportation in the Commercial Space Launch Act of 1984, as amended and re-codified by 51 U.S.C. Subtitle V, chapter 509 (Chapter 509), and delegated to the FAA Administrator and the Associate Administrator for Commercial Space Transportation, who exercises licensing authority under Chapter 509.

SpaceX is a private commercial space flight company. The petition addresses an upcoming flight that SpaceX plans to undertake to deliver ORBCOMM-2 satellites. SpaceX plans for the Falcon 9 launch vehicle to launch from Cape Canaveral Air Force Station (CCAFS) and fly back the first stage to CCAFS for landing. The flight termination system together with autonomous engine shutdown cannot prevent debris from reaching protected areas for all failure scenarios during the Falcon 9 fly back portion of the launch. Specifically, impact limit lines cannot be developed to ensure all debris with a ballistic coefficient of 3 pounds per square foot (psf) or greater remains on CCAFS.

Waiver Criteria:

Chapter 509 allows the FAA to waive a license requirement if the waiver (1) will not jeopardize public health and safety, safety of property; (2) will not jeopardize national security and foreign policy interests of the United States; and (3) will be in the public interest. 51 U.S.C. 50905(b)(3) (2011); 14 CFR 404.5(b) (2011).

Section 404.3(b)(5) Waiver Petition

Section 404.3(b)(5) requires that a petition for waiver be submitted at least sixty days before the proposed effective date of the waiver, which in this case would be the date of the planned launch, initially scheduled for December 19, 2015. This section also provides that a petition may be submitted late for good cause. Here, SpaceX initially submitted its request on December 17, 2015, shortly after being apprised by the FAA that a waiver would be required. Accordingly, the FAA is able to find good cause.

Section §417.213(a) and (d) Waiver Petition

The exact text of 14 CFR 417.213(a) and (d), the regulations at issue, states:

(a) *General.* A flight safety analysis must identify the location of populated or other protected areas, and establish flight safety limits that define when a flight safety system must terminate a launch vehicle's flight to prevent the hazardous effects of the resulting debris impacts from reaching any populated or other protected area and ensure that the launch satisfies the public risk criteria of § 417.107(b).

(d) *Designated debris impact limits.* The analysis must establish designated impact limit lines to bound the area where debris with a ballistic coefficient of three or more is allowed to impact if the flight safety system functions properly.

Launch of the Falcon 9 Vehicle

The FAA waives the requirement of § 417.213 (a) that analysis must establish flight safety limits that define when a flight safety system must terminate a launch vehicle's flight to prevent the hazardous effects of the resulting debris impacts from reaching any populated or other protected area and the associated requirement of § 417.213 (d) that the analysis must establish designated impact limit lines to bound the area where debris with a ballistic coefficient of three or more is allowed to impact if the flight safety system functions properly because the Falcon 9 launch will not jeopardize public health and safety or safety of property, a national security or foreign policy interest of the United States, and is in the public interest.

i. Public Health and Safety and Safety of Property

The Falcon 9 ORBCOMM-2 launch is the first launch of an orbital expendable launch vehicle with a planned fly back of one of its stages to its launch site. SpaceX has attempted two landings of its Falcon 9 first stage on a barge on the ocean off CCAFS. The stages reached their

intended landing spot, but did not survive the landings. In neither case was public health or safety or safety of third party property jeopardized. The damage to SpaceX's barge was minimal. The USAF conducted an assessment of the risk to property on CCAFS and has determined that the risks are acceptable.

The FAA requirements in 14 CFR part 417 have their genesis in USAF Range safety requirements. The FAA and USAF committed to a partnership during the development of today's launch safety regulations with a goal of developing common launch safety requirements and coordinating on requests for relief from the common requirements.[1] The USAF launch safety requirements were documented in EWR 127-1, which stated the governing principle that "to provide for the public safety, the Ranges, using a Range Safety Program, shall ensure that the launch and flight of launch vehicles and payloads *present no greater risk to the general public than that imposed by the over-flight of conventional aircraft*."[2] In addition, an American National Standard endorsed the same governing principle: "during the launch and flight phase of commercial space vehicle operations, the safety risk for the general public should be no more hazardous than that caused by other hazardous human activities (e.g., general aviation over flight)."[3]

Specifically, the 3 psf ballistic coefficient requirement of § 417.213(d) was intended to (1) capture the current practice of the USAF, (2) provide a clear and consistent basis to establish impact limit lines to determine if an accident as defined by § 401.5 occurred, and (3) help prevent a high consequence to the public given FSS activation.[4] Although § 417.107(c) requires

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[1] "The Air Force and the FAA remain committed to the partnership outlined in the MOA and … developing common launch safety requirements and for coordinating the common requirements." Licensing and Safety Requrieemtns for Launch, Supplemental Notice of Proposed Rulemaking, 67 FR 49456, 49471 (July 30, 2002).
[2] Eastern and Western Range 127-1, Range Safety Requirements, 1998, see page 1-viii.
3 ANSI/AIAA S-061-1998, "Commercial Launch Safety," see Section 4.5
[4] 14 CFR 417.107(a)(1)(ii)

a launch operator's flight safety analysis to account for any inert debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-lbs., impact kinetic energy was deemed an impractical metric for establishing impact limit lines because kinetic energy at impact can vary significantly depending on wind conditions, and impact limit lines that vary with wind conditions are impractical. Thus, ballistic coefficient was deemed a better metric than impact kinetic energy to establish the debris that needed to be accounted for in establishing flight safety limits. In adopting the 3 psf ballistics coefficient standard, the FAA recognized that ballistic coefficient is not well correlated with the probability of a casualty producing impact.[5] There are significant probabilities that impacts with debris with a ballistic coefficient less than 3 psf might produce a casualty and that debris impacts with a ballistic coefficient greater than 3 psf might not produce a casualty. The population potentially exposed to an impact (e.g., whether in the open or sheltered in buildings, or elsewhere), as well as the shape and impact orientation of debris, in addition to its energy and other characteristics, all influence whether or not an impact is likely to produce a casualty. Hence, the FAA required an expected casualty analysis in addition to the establishment of impact limit lines. In this regard, the 3 psf threshold for establishing impact limit lines was intended to provide an initial assessment of the risk of casualty for debris of a specific character, but this threshold correlates with public safety only in part.

In assessing the potential public safety impacts associated with debris outside of the impact limit lines for the SpaceX launch, the FAA returned to the original intent of the launch safety requirements: to ensure that launch presents no greater risk to the general public than that imposed by the over-flight of conventional aircraft. In doing so, it applied state-of-the-art techniques to examine the conditional E_c (CEC) of a failure that could generate debris outside of

[5] 67 **FR** at 49464.

the impact limit lines. The use of CEC to establish impact limit lines was endorsed by the Range Commanders Council in a consensus standard in 2010.[6] Conditional E_c is defined as the expected casualties given the occurrence of a vehicle failure during flight. The FAA analysis of 30 years of empirical evidence provided by the NTSB shows that a CEC of 0.01 represents the public safety consequence associated with general aviation accidents. Further, analysis conducted by the FAA and 45SW/SELR demonstrates that the consequence of events that could produce debris outside of the impact limit lines for a small portion of the ORBCOMM-2 fly back operations (where the concern exists) is within this threshold, even with input data that assume the worst case weather conditions. Thus, the FAA has determined that this waiver will not jeopardize public health and safety or the safety of property.

ii. National Security and Foreign Policy Implications

The USAF conducted an assessment of the risk to property on CCAFS, including assets used for national security space missions, and has determined that those risks are acceptable. The FAA has identified no national security or foreign policy implications associated with granting this waiver.

iii. Public Interest

The waiver is consistent with the public interest goals of Chapter 509 and the National Space Transportation Policy. Three of the public policy goals of Chapter 509 are: (1) to promote economic growth and entrepreneurial activity through use of the space environment; (2) to encourage the United States private sector to provide launch and reentry vehicles and associated services; and (3) to facilitate the strengthening and expansion of the United States space

[6] "A conditional risk management process should be implemented to assure that mission rules and flight termination criteria do not induce unacceptable levels of risk when they are implemented." Range Commanders Council Risk Committee of the Range Safety Group, *Common Risk Criteria for National Test Ranges*, RCC 321-10, White Sands Missile Range, New Mexico, p. 2-7 (2010).

transportation infrastructure to support the full range of United States space-related activities. See 51 U.S.C. 50901(b)(1), (2), (4). Commercial Space Transportation Licensing Regulations, Notice of Proposed Rulemaking, 62 FR 13230 (Mar. 19, 1997). A successful demonstration of a stage returning to a launch site has the potential for reducing launch costs. As it is a major procurer of launch services, reduced launch costs will be of direct benefit to the U.S. Government. It will also help to make the U.S. launch industry more competitive internationally. The National Space Transportation Policy clearly identifies how strengthening US competitiveness in the international launch market and improving the cost effectiveness of US space transportation services are in the public interest: "Maintaining an assured capability to meet United States Government needs, while also taking the necessary steps to strengthen U.S. competitiveness in the international commercial launch market, is important to ensuring that U.S. space transportation capabilities will be reliable, robust, safe, and affordable in the future. Among other steps, improving the cost effectiveness of U.S. space transportation services could help achieve this goal by allowing the United States Government to invest a greater share of its resources in other needs such as facilities modernization, technology advancement, scientific discovery, and national security. Further, a healthier, more competitive U.S. space transportation industry would facilitate new markets, encourage new industries, create high technology jobs,

lead to greater economic growth and security, and would further the Nation's leadership role in space." SpaceX's proposed demonstration is in the public interest.

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