



[4910–13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Waiver of Acceptable Risk Restriction for Launch and Reentry

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): a petition to waive the restriction that the risk to the public from the launch of an expendable launch vehicle not exceed an expected average number of 0.00003 casualties ($E_c \leq 30 \times 10^{-6}$) from debris; and a petition to waive the restriction that the combined risk to the public from the launch and reentry of a reentry vehicle not exceed an expected average number of 0.00003 casualties ($E_c \leq 30 \times 10^{-6}$). The FAA grants both petitions.

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, Senior Attorney for Commercial Space Transportation, AGC-200, 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 August 12, 2011, SpaceX submitted a petition, which it updated on February 9, 2012, to the Federal Aviation Administration's (FAA's) Office of Commercial Space Transportation (AST) requesting two waivers with respect to launch and reentry licenses for flight 003 of a Falcon 9 launch vehicle (Falcon 9 003) carrying a Dragon reentry vehicle. First, SpaceX requested a waiver of 14 CFR 417.107(b)(1), which prohibits the launch of an expendable launch vehicle if the total expected average number of casualties (E_c) for the launch exceeds 0.00003 for risk from debris. Second, SpaceX requested a waiver of 14 CFR 431.35(b)(1)(i),¹ which prohibits a mission involving a reentry vehicle when the E_c for both the launch and reentry together (referred to as a "mission" for purposes of part 431) exceeds 0.00003 for debris.

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. It has entered into a Space Act Agreement with the National Aeronautics and Space Administration (NASA) as part of NASA's Commercial Orbital Transportation Services (COTS) program. The COTS program is designed to stimulate efforts by the private sector to demonstrate safe, reliable, and cost-effective space transportation to the International Space Station. Currently, no domestic U.S. companies or entities provide transportation or supplies to the International Space Station.

The petition addresses an upcoming demonstration flight that SpaceX plans to undertake as part of the COTS program. This flight is a long-duration cargo mission to the International

¹ Even though Dragon is a reentry vehicle and not a reusable launch vehicle, 14 CFR 435.35 incorporates and applies section 431.35 to all reentry vehicles.

Space Station to demonstrate flight and berthing capabilities. SpaceX's Falcon 9 launch vehicle will launch from Cape Canaveral Air Force Station, and deploy SpaceX's reentry vehicle, Dragon, once on orbit. Once Dragon is on orbit, it will be subjected to a ground-implemented health check. The health check is designed to check time-dependent variables to ensure the health and functionality of the propulsion, power, and other safety critical subsystems. Once Dragon passes the health check and completes orbital phasing by firing its onboard thrusters, it will berth with the International Space Station. After a period of time determined by NASA, Dragon will depart from the International Space Station. When SpaceX issues a ground command or Dragon passes its onboard health check, Dragon will conduct a guided reentry to land in the Pacific Ocean.

The FAA advised SpaceX that the preliminary calculation of E_c for both the launch and the entire mission exceeded the 0.00003 limit imposed by section 417.107(b)(1) and section 431.35(b)(1)(i). SpaceX, therefore, seeks a waiver of these risk requirements.

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).

Sections 417.107(b)(1) and 431.35(b)(1)(i) Waiver Petition

Section 417.107(b)(1) prohibits the launch of a launch vehicle if the total E_c for the launch exceeds 0.00003. Section 431.35(b)(1)(i) prohibits a launch and reentry mission if the total E_c for that mission exceeds 0.00003. For reasons described below, the FAA waives the restrictions in section 417.107(b)(1) and section 431.35(b)(1)(i) to allow SpaceX to conduct a

mission whose total E_c is currently calculated to be between approximately 0.000098 and 0.000121. The lowest number in the range accounts for a nighttime launch and the upper number accounts for a daytime launch. The FAA recognizes that any estimate of the E_c for the F9-003 launch includes substantial uncertainties, and that the risk number computed on the day of launch may be different from the current range listed above. In order to account for the potential variation in the E_c for the F9-003 computed on the day of launch, the FAA will allow SpaceX to conduct a mission where launch risk does not exceed 0.00013.

A. Launch of the Falcon 9 Vehicle

The FAA waives the debris risk requirement of section 417.107(b)(1) because the Falcon 9 003 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 9 003 launch is the first launch for which the FAA has ever waived the E_c requirement of 0.00003 for launch. The 45th Space Wing Range Safety calculated the collective risk to the public from the Falcon 9 003 launch to be between approximately 0.000098 and 0.000121. The low end of this calculation is less than the 0.0001 expected casualty criterion used by NASA, the United States Air Force, and other U.S. National Test Ranges. See U.S. Air Force Instruction 91-217, Space Safety and Mishap Prevention Program (2010); NASA Procedural Requirements 8715.5 Rev A, Range Flight Safety Program (2010); Range Commanders Council (RCC) Standard 321-10, Common Risk Criteria Standards for National Test Ranges (2010). The increase in the E_c for this third launch of the Falcon 9 is largely attributable to two factors. First, the launch will follow a specific trajectory to reach the International Space Station. In order to place Dragon in the correct orbit, and accounting for

Falcon 9's launch location of Cape Canaveral, Falcon 9 must take a flight path that overflies more populated areas than the first two flights, and thus results in a higher E_c . Second, the FAA's regulations identify a large credible range of relatively high values for the estimated probability of failure to the launch vehicle based on the small number of launches the Falcon 9 has completed. See Table A417-3 Launch Vehicle Failure Probability Reference Estimates and Confidence Bounds of [Vehicles] with Two or More Flights, 14 CFR Part 417, App. A. This probability of failure is one of the most critical variables in the E_c calculations.

The flight path for the Falcon 9 is severely constrained by the mission objectives and the propellant available in the Falcon 9 and Dragon. Desired mission objectives include navigation to, and berthing with the International Space Station. Preliminary objectives include a demonstration of the Dragon's motion control, which is accomplished through controlled firing of onboard thrusters. This demonstration is comprehensive in nature to ensure safe approach and berthing with the International Space Station, utilizing considerable fuel. In order to meet all Dragon objectives, including de-orbit burns and a reasonable fuel reserve, the launch vehicle trajectory must place the Dragon in an initial location such that it has adequate fuel for all mission objectives.

This mission intends to demonstrate orbital control capability for the Dragon capsule. Should this objective be successfully demonstrated, future Dragon missions to the International Space Station will not require further demonstrations of on-orbit navigational control. Additionally, the Dragon fuel requirements will be lower, and therefore the required launch vehicle trajectory will result in a lower E_c .

The current E_c requirement for government launches from U.S. National Test Ranges is 0.0001, which, because it comprises debris, toxics, and overpressure, means that the federal

launch ranges can permit the risk attributable to debris to exceed the FAA's risk threshold. See Air Force Instruction 91-217, Space Safety and Mishap Prevention Program (2010). The U.S. Air Force approved a government launch of a Titan, where the risk ranged from 145 to 317 in a million. Dept. of the Air Force Memorandum, Overflight Risk Exceedance Waiver for Titan IV B-30 Mission, (Apr. 4, 2005). That risk was mainly attributable to downrange overflight, as is the case for the Falcon 9 launch. Additionally, of historical interest, during Space Shuttle launches debris risk routinely exceeded U.S. Air Force and FAA established risk criteria, mainly due to a large number of visitors on Kennedy Space Center property. The FAA notes that the F9-003 launch is a NASA-sponsored mission, flying a similar trajectory as previous Space Shuttle missions going to the International Space Station. The FAA also notes that the E_c for the F9-003 launch, as currently calculated, may exceed the E_c requirement for government launches from U.S. Government ranges, but only by a small amount relative to the modeling and input data uncertainties, particularly the probability of failure. Based on this uncertainty, as well as the fact that Falcon 9's E_c is smaller than that of a Space Shuttle and is close to the requirement for government launches, granting a waiver in this case would not jeopardize public health and safety or safety of property.

ii. National Security and Foreign Policy Implications

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. 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 transportation infrastructure to support the full range of United States space-related activities. See 51 U.S.C. 50901(b)(1), (2), (4). Additionally, in the Notice of Proposed Rulemaking and the Final Rule for Commercial Space Transportation Licensing Requirements, the FAA contemplated launches carrying government payloads for a critical national need exceeding the E_c requirements. Commercial Space Transportation Licensing Regulations, Notice of Proposed Rulemaking, 62 FR 13230 (Mar. 19, 1997). The Final Rule noted that, as recognized in the NPRM, commercial launches may carry government payloads, and a waiver of the risk requirement might be warranted. Commercial Space Transportation Licensing Regulations, Final Rule, 64 FR 19605 (Apr. 21, 1999).

With the elimination of the Space Shuttle Program, the U.S. is seeking other means of reaching the International Space Station. NASA is using the COTS Program to develop the capability to resupply the International Space Station. There currently exists a need for additional means to supply the International Space Station. To date, the Russian Soyuz-U rocket², European ATV and the Japanese HTV foreign vehicles have demonstrated the capability to provide supplies to the International Space Station. The COTS Program exists to provide a reliable, domestic capability for supplying the International Space Station, the importance of which is highlighted by the recent Russian failure. SpaceX's demonstrated capability to connect with the International Space Station would further the public interest in the U.S. ability to transit to, and support the ISS. The FAA notes that currently there is no domestic capability to supply

² On August 24, 2011, a Soyuz rocket engine carrying a Progress resupply ship to the International Space Station failed. This failure delayed a mission to provide supplies to the people working at the International Space Station, including U.S. astronauts. The Russians resolved this issue and successfully launched the Soyuz-U on October 30, 2011. On November 2, 2011, an M-13M cargo ship successfully berthed with the International Space Station.

the International Space Station, and has taken this fact into account when determining the public interest.

The COTS Program was established to develop a robust domestic commercial space transportation capability. This capability would provide the United States with the ability to resupply the International Space Station. As such, granting SpaceX's waiver request is consistent with Chapter 509's policy goals because it: (1) promotes SpaceX's entrepreneurial activity in the space environment; (2) encourages SpaceX, a private U.S. company, to develop and launch new launch and reentry vehicles; and (3) facilitates the expansion of the United States space transportation infrastructure by sustaining NASA's COTS program.

B. Reentry of the Dragon Capsule

SpaceX's request for a waiver of the requirements in section 431.35(b)(1)(i) raises the same issues as its previous request for waiver of mission risk for the Falcon 9 002 launch and reentry of Dragon. For the reasons stated in a previous Waiver of Acceptable Mission Risk Restriction for Reentry and a Reentry Vehicle, 75 FR 75619 (Dec. 6, 2010) the FAA is waiving the requirements of section 431.35(b)(1)(i) for the Falcon 9 003 launch and reentry of Dragon.

Issued in Washington, DC on April 17, 2012.

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