DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 21, 43, 61, 91, 101, 107, 119, 133, and 183

[Docket No.: FAA–2015–0150; Amdt. Nos. 21–99, 43–48, 61–137, 91–343, 101–9, 107–1, 119–18, 133–15, and 183–16]

RIN 2120–AJ60

Operation and Certification of Small Unmanned Aircraft Systems

AGENCY: Federal Aviation Administration (FAA) and Office of the Secretary of Transportation (OST), Department of Transportation (DOT).

ACTION: Final rule.

SUMMARY: The FAA is amending its regulations to allow the operation of small unmanned aircraft systems in the National Airspace System. These changes address the operation of unmanned aircraft systems and certification of their remote pilots. This rule will also prohibit model aircraft from endangering the safety of the National Airspace System.

DATES: This final rule is effective August 29, 2016.

ADDRESSES: For information on where to obtain copies of rulemaking documents and other information related to this final rule, see ''How To Obtain Additional Information'' in the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: For small UAS technical questions concerning this final rule, contact Lance Nuckolls, Flight Technologies and Procedures Division, AFS–400, 470 L'Enfant Plaza SW., Suite 4102, Washington, DC 20024; telephone 1–844–FLY–MYUAS; email *UAShelp@faa.gov*.

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SUPPLEMENTARY INFORMATION:

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List of Abbreviations and Acronyms Frequently Used in This Document

AC—Advisory Circular
AGL—Above Ground Level
ACR—Airman Certification Representative
ADS–B—Automatic Dependent Surveillance-Broadcast
ARC—Aviation Rulemaking Committee
ATC—Air Traffic Control
CAFTA-DR—Dominican Republic-Central America-United States Free Trade Agreement
CAR—Civil Air Regulation
CFI—Certificated Flight Instructor
CFR—Code of Federal Regulations
COA—Certificate of Waiver or Authorization
DPE—Designated Pilot Examiner
FR—Federal Register
FSDO—Flight Standards District Office
ICAO—International Civil Aviation Organization
NAFTA—North American Free Trade Agreement
NAS—National Airspace System
NOTAM—Notice to Airmen
NPRM—Notice of Proposed Rulemaking
NTSB—National Transportation Safety Board
PIC—Pilot in Command
Pub. L.—Public Law
PMA—Parts Manufacturer Approval
TCAS—Traffic Collision Avoidance System
TFR—Temporary Flight Restriction
TSA—Transportation Security Administration
TSO—Technical Standard Order
UAS—Unmanned Aircraft System
U.S.C.—United States Code

I. Executive Summary

A. Purpose of the Regulatory Action

This rule finalizes the notice of proposed rulemaking entitled *Operation and Certification of Small Unmanned Aircraft Systems* [1] (the NPRM). The NPRM proposed operating and certification requirements to allow small unmanned aircraft systems (small UAS) to operate for non-hobby and non-recreational purposes.[2] A small UAS consists of a small unmanned aircraft (which, as defined by statute, is an unmanned aircraft weighing less than 55 pounds [3]) and equipment necessary for the safe and efficient operation of that aircraft. The FAA has accommodated non-recreational small UAS use through various mechanisms, such as special airworthiness certificates, exemptions, and certificates of waiver or authorization (COAs). This rule is the next phase of integrating small UAS into the NAS.

The following are examples of possible small UAS operations that can be conducted under the framework in this rule:

- Crop monitoring/inspection;
- Research and development;
- Educational/academic uses;
- Power-line/pipeline inspection in hilly or mountainous terrain;
- Antenna inspections;
- Aiding certain rescue operations;
- Bridge inspections;
- Aerial photography; and
- Wildlife nesting area evaluations.

Because of the potential societally beneficial applications of small UAS, the FAA has been seeking to incorporate the operation of these systems into the national airspace system (NAS) since 2008. In 2012, Congress passed the FAA Modernization and Reform Act of 2012 (Pub. L. 112–95). Section 333 of Public Law 112–95 directed the Secretary to determine whether UAS operations posing the least amount of public risk and no threat to national security could safely be operated in the NAS and, if so, to establish requirements for the safe operation of these systems in the NAS, prior to completion of the UAS

[1] 80 FR 9544, Feb. 23, 2015.

[2] As used here, ''non-hobby and non-recreational purposes'' refers to small UAS that are not operated in accordance with section 336 of Public Law 112–95. A discussion of section 336 can be found below in section III.C.4 of this preamble.

[3] Public Law 112–95, sec. 331(6).

comprehensive plan and rulemakings required by section 332 of Public Law 112–95.

On February 23, 2015, as part of its ongoing efforts to integrate UAS operations in the NAS and in accordance with section 333 of Public Law 112–95, the FAA issued the NPRM proposing to amend its regulations to adopt specific rules for the operation of small UAS in the NAS. Over 4,600 public comments were submitted in response to the NPRM. The FAA has considered the comments, and now issues this final rule to integrate small UAS into the NAS.

Based on its consideration of the comments submitted in response to the NPRM, and its experience with the certification, exemption, and COA process, the FAA has developed the framework in this rule to enable certain small UAS operations to commence upon adoption of this rule and accommodate technologies as they evolve and mature. This framework allows small UAS operations for many different non-recreational purposes, such as the ones discussed previously, without requiring airworthiness certification, exemption, or a COA.

B. Summary of the Major Provisions of the Regulatory Action

This rule will add a new part 107 to Title 14 Code of Federal Regulations (14 CFR) to allow for routine civil operation of small UAS in the NAS and to provide safety rules for those operations. Consistent with the statutory definition, this rule will define small UAS as UAS that use unmanned aircraft weighing less than 55 pounds. To mitigate risk, the rule will limit small UAS to daylight and civil twilight operations with appropriate collision lighting, confined areas of operation, and visual-line-of-sight operations. This rule will also address airspace restrictions, remote pilot certification, visual observer requirements, and operational limits in order to maintain the safety of the NAS and ensure that small UAS do not pose a threat to national security. Because UAS constitute a quickly changing technology, a key provision of this rule is a waiver mechanism to allow individual operations to deviate from many of the operational restrictions of this rule if the Administrator finds that the proposed operation can safely be conducted under the terms of a certificate of waiver.

Below is a summary of the major provisions of the rule.

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107

Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle. • Daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. • Must yield right of way to other aircraft. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy ''see-and-avoid'' requirement but can be used as long as requirement is satisfied in other ways. • Maximum groundspeed of 100 mph (87 knots). • Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission. • No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving aircraft. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No careless or reckless operations. • No carriage of hazardous materials. • Requires preflight inspection by the remote pilot in command. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375. • External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. • Transportation of property for compensation or hire allowed provided that— ○ The aircraft, including its attached systems, payload and cargo weigh less than 55 pounds total; ○ The flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and ○ The flight occurs wholly within the bounds of a State and does not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession. • Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.
Remote Pilot in Command Certification and Responsibilities.	

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107—Continued

	• Establishes a remote pilot in command position. • A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). • To qualify for a remote pilot certificate, a person must: ○ Demonstrate aeronautical knowledge by either: ▪ Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or ▪ Hold a part 61 pilot certificate other than student pilot, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA. ○ Be vetted by the Transportation Security Administration. ○ Be at least 16 years old. • Part 61 pilot certificate holders may obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon successful completion of TSA security vetting. The FAA anticipates that it will be able to issue a temporary remote pilot certificate within 10 business days after receiving a completed remote pilot certificate application. • Until international standards are developed, foreign-certificated UAS pilots will be required to obtain an FAA-issued remote pilot certificate with a small UAS rating. A remote pilot in command must: • Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the rule. • Report to the FAA within 10 days of any operation that results in at least serious injury, loss of consciousness, or property damage of at least $500. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation. • Ensure that the small unmanned aircraft complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency.
Aircraft Requirements	• FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation.
Model Aircraft	• Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112–95. • The rule codifies the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

C. Costs and Benefits

Technological advances in small UAS have led to a potential commercial market for their uses by providing a safe operating environment for them and for other aircraft in the NAS. In addition to enabling this industry to develop, the FAA anticipates that this final rule will provide an opportunity to substitute small UAS operations for some risky manned flights, such as inspection of houses, towers, bridges, or parks, thereby averting potential fatalities and injuries.

The FAA has analyzed the benefits and the costs associated with this final rule. The estimated out-of-pocket cost for an individual to become FAA certificated as a remote pilot with a small UAS rating is $150, which is less than the cost of any other airman certification that allows non-recreational operations in the NAS.[4] The final rule will enable a new industry to unfold while imposing relatively low individual costs. The private sector expected benefits exceed private sector expected costs because each entity voluntarily chooses to incur the compliance cost of this rule in anticipation that their benefits exceed the costs. The sum of these entities' actions results in societal benefits which exceed societal costs when government costs are also taken into account. The FAA has quantified these benefits by estimating consumer surplus resulting from future commercial operations. Benefits to society equal the consumer surplus minus certain additional costs discussed.

The regulatory analysis for this final rule presents two scenarios in order to present a range for costs—a high case and a low case. The scenarios are based on two fleet forecasts that were prepared independently at separate times. As a result, the high case and low case projections for small UAS sales, fleet, and pilots differ significantly.

Depending on which small UAS forecast is used, the FAA expects this rule will result in a net social benefit ranging from about $733 million in the low case to about $9.0 billion in the high case over five years.[5]

II. Background

This final rule addresses the operation and airman certification of civil small UAS. The following sections discuss: (1) The public risk associated with small UAS operations; (2) the current legal framework governing small UAS operations; and (3) the FAA's ongoing efforts to incorporate small UAS operations into the NAS.

A. Authority for This Rulemaking

This rulemaking is promulgated under the authority described in the FAA Modernization and Reform Act of 2012 (Pub. L. 112–95). Section 333 of Public Law 112–95 directs the Secretary of Transportation [6] to determine whether ''certain unmanned aircraft systems may operate safely in the

[4] To become certificated as remote pilot with a small UAS rating, an individual is only required to pass a knowledge test. The certification does not require an individual to attend ground school or to pass a practical skills exam, both of which are required to receive an airman's certificate for sport pilot and above.

[5] See the full regulatory evaluation for a detailed description on the two small UAS forecasts the FAA used to estimate benefits and costs.

[6] The primary authority for this rulemaking is based on section 333 of Public Law 112–95 (Feb. 14, 2012). In addition, this rulemaking also relies on FAA statutory authorities. Thus, for the purposes of this rulemaking, the terms ''FAA,'' ''the agency,'' ''DOT,'' ''the Department,'' and ''the Secretary'' are used synonymously throughout this document.

national airspace system.'' If the Secretary determines, pursuant to section 333, that certain unmanned aircraft systems may operate safely in the national airspace system, then the Secretary must ''establish requirements for the safe operation of such aircraft systems in the national airspace system.'' [7]

This rulemaking is also promulgated pursuant to 49 U.S.C. 40103(b)(1) and (2), which charge the FAA with issuing regulations: (1) To ensure the safety of aircraft and the efficient use of airspace; and (2) to govern the flight of aircraft for purposes of navigating, protecting and identifying aircraft, and protecting individuals and property on the ground. In addition, 49 U.S.C. 44701(a)(5) charges the FAA with prescribing regulations that the FAA finds necessary for safety in air commerce and national security. This rulemaking also establishes a new class of airman certificate tailored to remote pilots, consistent with the statutory obligation set forth in 49 U.S.C. 44703.

The model-aircraft component of this rulemaking incorporates the statutory mandate in section 336(b) that preserves the FAA's authority, under 49 U.S.C. 40103(b) and 44701(a)(5), to pursue enforcement ''against persons operating model aircraft who endanger the safety of the national airspace system.''

B. Analysis of Public Risk Posed by Small UAS Operations

Small UAS operations pose risk considerations that are different from the risk considerations typically associated with manned-aircraft operations. On one hand, certain operations of a small unmanned aircraft, discussed more fully in section III.E of this preamble, have the potential to pose significantly less risk to persons and property than comparable operations of a manned aircraft due to differences in the weight of the aircraft. The typical total takeoff weight of a general aviation aircraft is between 1,300 and 6,000 pounds as compared to a total takeoff weight of a small unmanned aircraft of less than 55 pounds. Consequently, because of the reduced weight, the small unmanned aircraft would pose significantly less risk to persons and property on the ground in the event of a mishap or pilot error. As such, a small UAS operation whose parameters are well defined to mitigate risk to other aircraft would also pose a smaller overall public risk or threat to national security than the operation of a manned aircraft.

On the other hand, even though small UAS operations have the potential to pose a lower level of public risk in certain types of operations, the unmanned nature of the small UAS operations raises two unique safety concerns that are not present in manned-aircraft operations. The first safety concern is whether the person operating the small unmanned aircraft, who is physically separated from that aircraft during flight, would have the ability to see manned aircraft in the air in time to prevent a mid-air collision with that manned aircraft. As discussed in more detail below, the FAA's regulations currently require each person operating an aircraft to maintain vigilance ''so as to see and avoid other aircraft.'' [8] This is one of the fundamental principles for collision avoidance in the NAS.

For manned-aircraft operations, ''see and avoid'' is the responsibility of pilots on board an aircraft. Because the remote pilot in an unmanned aircraft operation is not physically on the unmanned aircraft, that remote pilot does not have the same visual perspective and ability to see other aircraft as a manned-aircraft pilot. Thus, the challenge for small unmanned aircraft operations is to ensure that the person operating the small unmanned aircraft is able to see and avoid other aircraft.

The second safety concern with small UAS operations is the possibility that, during flight, the person piloting the small unmanned aircraft may lose control of the aircraft due to a failure of the control link between the aircraft and the remote pilot's control station. This is known as a loss of positive control and may result from a system failure or because the aircraft has been flown beyond the signal range or in an area where control link communication between the aircraft and the control station is interrupted. A small unmanned aircraft whose flight is unable to be directly controlled could pose a significant risk to persons, property, or other aircraft.

C. Current Statutory and Regulatory Structure Governing Small UAS

Due to the lack of an onboard pilot, small UAS operations cannot be conducted in accordance with many of the FAA's current operating regulations, codified in 14 CFR part 91, that apply to general aviation. The primary example of this conflict is § 91.113(b), which requires each person operating an aircraft to maintain vigilance ''so as to see and avoid other aircraft.'' The FAA created this requirement in a 1968 rulemaking,[9] which combined two previous aviation regulatory provisions (Civil Air Regulations (CAR) §§ 60.13(c) and 60.30) into the ''see and avoid'' requirement now found in § 91.113(b). These CAR provisions were intended to address aircraft collision-awareness problems by requiring a pilot on board the aircraft to look out of the aircraft during flight to observe whether other aircraft are on a collision path with his or her aircraft. Those provisions did not contemplate the use of technology to substitute for the human vision of a pilot on board the aircraft nor did they contemplate the manipulation of the aircraft from outside of the aircraft. To the contrary, CAR § 60.13(c) stated that one of the problems it intended to address was ''preoccupation by the pilot with cockpit duties,'' which indicates that the regulation contemplated the presence of a pilot on board the aircraft.

Based on this intent, § 91.113(b) requires an aircraft pilot to have the perspective of being inside the aircraft as that aircraft is moving in order to see and avoid other aircraft. Since the remote pilot of a small UAS does not have this perspective, operation of a small UAS cannot meet the see and avoid requirement of § 91.113(b).

In addition to regulatory considerations, there are statutory considerations that apply to small UAS operations. For example, even though a small UAS is different from a manned aircraft, the operation of a small UAS still involves the operation of an aircraft under the FAA's statute, which defines an ''aircraft'' as ''any contrivance invented, used, or designed to navigate or fly in the air.'' 49 U.S.C. 40102(a)(6). Congress reaffirmed that an unmanned aircraft is an aircraft in the FAA Modernization and Reform Act of 2012, by defining unmanned aircraft as ''an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft.'' Sec. 331(8), Public Law 112–95. In *Administrator* v. *Pirker,* the National Transportation Safety Board (NTSB) unanimously affirmed this understanding, finding that an unmanned aircraft is an aircraft for purposes of the FAA's statutes and regulations.[10]

Because a small UAS involves the operation of an ''aircraft,'' this triggers the FAA's registration and certification statutory requirements. Specifically, subject to certain exceptions, a person

[7] Public Law 112–95, sec. 333(c).

[8] 14 CFR 91.113(b).

[9] *Pilot Vigilance,* 33 FR 10505 (July 24, 1968).

[10] *Administrator* v. *Pirker,* NTSB Order No. EA–5730 (Nov. 17, 2014). A copy of the *Pirker* opinion may be found at: *http://www.ntsb.gov/legal/alj/Documents/5730.pdf.*

may not operate a civil aircraft that is not registered. 49 U.S.C. 44101(a). In addition, a person may not operate a civil aircraft in air commerce without an airworthiness certificate. 49 U.S.C. 44711(a)(1). Finally, a person may not serve in any capacity as an airman on a civil aircraft being operated in air commerce without an airman certificate. 49 U.S.C. 44711(a)(2)(A).[11]

The term ''air commerce,'' as used in the FAA's statutes, is defined broadly to include ''the operation of aircraft within the limits of a Federal airway, or the operation of aircraft that directly affects, or may endanger safety in foreign or interstate air commerce.'' 49 U.S.C. 40102(a)(3). Because of this broad definition, the NTSB has held that ''any use of an aircraft, for purpose of flight, constitutes air commerce.'' [12] Courts that have considered this issue have reached similar conclusions that ''air commerce,'' as defined in the FAA's statute, encompasses a broad range of commercial and non-commercial aircraft operations.[13]

Accordingly, because ''air commerce'' encompasses such a broad range of aircraft operations, a civil small unmanned aircraft cannot currently be operated, for purposes of flight, if it does not comply with the above statutes. However, the FAA's current processes for issuing airworthiness and airman certificates were designed to be used for manned aircraft and do not take into account the considerations associated with civil small UAS.

Because the pertinent existing regulations do not differentiate between manned and unmanned aircraft, a small UAS is currently subject to the same airworthiness certification process as a manned aircraft. These existing regulations do not contemplate small UAS operations that could, as a result of their operational parameters, safely be conducted without any airworthiness certification. This framework imposes an undue burden on such operations.

Additionally, under current pilot certification regulations, depending on the type of operation, the remote pilot in command of the small UAS currently must obtain a sport, recreation, private, commercial, or airline transport pilot certificate. While a private pilot and commercial pilot may both operate an aircraft for the furtherance of a business, a private pilot may only do so if the flight is incidental to the pilot's business or employment and not for compensation or hire. Only a commercial or airline transport pilot certificate may be used to operate an aircraft for compensation or hire.[14]

Typically, to obtain a sport, private, recreational, commercial, or airline transport pilot certificate, the small UAS pilot currently has to: (1) Receive training in specific aeronautical knowledge areas; (2) receive training from an authorized instructor on specific areas of aircraft operation; and (3) pass an aeronautical knowledge test and a practical (skills) test. A certificate applicant also has to obtain minimum hours of flight time prior to applying for the certificate: (1) 20 hours for a sport pilot certificate; (2) 30 hours for a recreational pilot certificate; (3) 40 hours for a private pilot certificate; (4) 250 hours for a commercial pilot certificate; and (5) 1,500 hours for an airline transport pilot certificate. Finally, the certificate applicant has to establish his or her physical capability by: (1) Holding a valid and effective driver's license (for a sport pilot certificate); (2) obtaining a third-class airman medical certificate (for a recreational or private pilot certificate); (3) obtaining a second-class airman medical certificate (for a commercial pilot certificate or to exercise second-in-command privileges of an airline transport pilot certificate); or (4) obtaining a first-class airman medical certificate (to exercise pilot-in-command privileges of an airline transport pilot certificate).

While these airman certification requirements are necessary for manned aircraft operations, they impose an unnecessary burden for many small UAS pilots because a person obtains a pilot certificate under part 61 by learning how to operate a manned aircraft. Much of that aeronautical experience/flight training is not applicable to small UAS operations because a small UAS is operated differently than a manned aircraft. In addition, the aeronautical/flight experience currently necessary to obtain a pilot certificate under part 61 does not equip the certificate holder with all of the tools necessary to safely pilot a small UAS. Specifically, applicants for a pilot certificate under part 61 currently are not trained in how to deal with those aspects of ''see-and-avoid'' and loss-of-positive-control safety issues that are unique to small unmanned aircraft. Thus, requiring persons wishing to operate a small UAS to obtain a pilot certificate under part 61 imposes the cost of airman certification on those persons, but does not result in a significant safety benefit because the process of obtaining the certificate does not equip those persons with all of the tools necessary to mitigate the public risk posed by small UAS operations.

D. Integrating Small UAS Operations into the NAS through Rulemaking

To address the issues discussed above, the Department has been engaged in a rulemaking to integrate small UAS into the NAS.[15]

In 2012, Congress passed the FAA Modernization and Reform Act of 2012 (Pub. L. 112–95). In section 332(b) of Public Law 112–95, Congress directed the Secretary to issue a final rule on small unmanned aircraft systems that will allow for civil operations of such systems in the NAS.[16] In section 333 of Public Law 112–95, Congress also directed the Secretary to determine whether ''certain unmanned aircraft systems may operate safely in the national airspace system.'' To make a determination under section 333, the Secretary of Transportation must assess ''which types of unmanned aircraft systems, if any, as a result of their size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight do not create a hazard to users of the national airspace system or the public or pose a threat to national security.'' Public Law 112–95, Sec. 333(b)(1). The Secretary must also determine whether a certificate of waiver or authorization, or airworthiness certification is necessary to mitigate the public risk posed by the unmanned aircraft systems that are under consideration. Public Law 112–95, Sec. 333(b)(2). If the Secretary

[11] The statutes also impose other requirements that are beyond the scope of this rulemaking. For example, 49 U.S.C. 44711(a)(4) prohibits a person from operating as an air carrier without an air-carrier operating certificate.

[12] *Administrator* v. *Barrows,* 7 N.T.S.B. 5, 8–9 (1990).

[13] *See, e.g., United States* v. *Healy,* 376 U.S. 75, 84 (1964) (holding that the statutory definition of ''air commerce'' in the Federal Aviation Act is not limited to commercial airplanes); *Hill* v. *NTSB,* 886 F.2d 1275, 1280 (10th Cir. 1989) (''[t]he statutory definition of 'air commerce' is therefore clearly not restricted to interstate flights occurring in controlled or navigable airspace''); *United States* v. *Drumm,* 55 F. Supp. 151, 155 (D. Nev. 1944) (upholding amendments of Civil Air Regulations, which among other things prohibited any person from piloting a civil aircraft unless the person held a valid pilot certificate and the aircraft possessed an airworthiness certificate, on the grounds that the regulatory action was within the scope of powers conferred by Congress).

[14] *See* 14 CFR 61.113, 61.133 and 61.167(a).

[15] The FAA chartered the small UAS Aviation Rulemaking Committee (ARC), which provided it with recommendations on how small UAS could be safely integrated into the NAS. A copy of the ARC Report and Recommendations can be found in the docket for this rulemaking.

[16] As discussed in more detail further in the preamble, the FAA Modernization and Reform Act of 2012 also contained a provision prohibiting the FAA from issuing rules and regulations for model aircraft meeting certain criteria specified in section 336 of the Act.

determines that certain unmanned aircraft systems may operate safely in the NAS, then the Secretary must ''establish requirements for the safe operation of such aircraft systems in the national airspace system.'' Public Law 112–95, Sec. 333(c). The flexibility provided for in section 333 did not extend to airman certification and security vetting, aircraft marking, or registration requirements.

As discussed previously, the FAA's statute normally requires an aircraft being flown outdoors to possess an airworthiness certificate.[17] However, subsection 333(b)(2) allows for the determination that airworthiness certification is not necessary for certain small UAS. The key determinations that must be made in order for UAS to operate under the authority of section 333 are: (1) The operation must not create a hazard to users of the national airspace system or the public; and (2) the operation must not pose a threat to national security.[18] In making these determinations, the Secretary of Transportation must consider the following factors: size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight.

In 2013, the Department issued a comprehensive plan and subsequently the FAA issued a roadmap of its efforts to achieve safe integration of UAS operations into the NAS.[19] As a result of its ongoing integration efforts, the FAA seeks to change its regulations to take the first step in the process of integrating small UAS operations into the NAS. The NPRM proposed to utilize the airworthiness-certification flexibility provided by Congress in section 333 of Public Law 112–95, and allow some small UAS operations to commence in the NAS.[20] As noted earlier in this executive summary, the FAA published the NPRM on February 23, 2015, and received over 4,600 comments. The NPRM proposed to issue small UAS airman certificates to applicants who passed a knowledge test, and proposed to allow line-of-sight operations of small unmanned aircraft below 500 feet AGL at speeds of less than 100 miles per hour. Airworthiness certification would not be required under the proposed rule. The FAA has considered the public comments filed in response to the NPRM, and now issues this final rule.

E. Related UAS Integration Initiatives

While this rulemaking was pending, the FAA recognized that there already exists a population of small UAS operators and remote pilots who are ready and able to operate safely. To address the needs of these operators and remote pilots while these regulations were being finalized, the Department issued thousands of exemptions under its section 333 authority to permit civil visual-line-of-sight small UAS operations in the NAS.[21] The operations permitted under those exemptions are similar to those that will be enabled by part 107.

In addition, to further facilitate the integration of UAS into the NAS, the FAA has chosen six UAS research and test site operators across the country. In selecting the six test site operators, the FAA considered geography, climate, location of ground infrastructure, research needs, airspace use, safety, aviation experience, and risk. In totality, these six test site applications achieve cross-country geographic and climatic diversity and help the FAA meet its UAS research needs. As of December 2015, all of the UAS test sites are operational and are gathering operational data to foster further integration, as well as evaluating new technologies. The FAA has also selected, after a rigorous competition, a Mississippi State University team as the FAA's Center of Excellence for Unmanned Aircraft Systems. The Center of Excellence will focus on research, education, and training in areas critical to safe and successful integration of UAS into the NAS.[22]

In May 2015, the FAA announced the UAS Focus Area Pathfinders initiative,[23] a partnership with industry to explore the next steps in unmanned aircraft operations beyond the type of operations the agency proposed in the small UAS NPRM. Three companies reached out to the FAA to work on research to continue expanding use of UAS in the nation's airspace in three focus areas: Visual line-of-sight operations in urban areas; extended visual-line-of-sight operations in rural areas; and beyond visual line-of-sight in rural/isolated areas. In October 2015 a fourth Pathfinder initiative was added, testing technology to identify small UAS operating around airports.

In September 2015, the FAA issued Advisory Circular 91–57A,[24] *Model Aircraft Operating Standards,* replacing and superseding the guidance provided in the now-cancelled Advisory Circular 91–57, issued in 1981. The updated document provides guidance to persons operating unmanned aircraft for hobby or recreation purposes meeting the statutory definition of ''model aircraft'' contained in Section 336 of the FAA Modernization and Reform Act (Public Law 112–95), and describes means by which model aircraft may be operated safely in the NAS.

In February 2016, the FAA convened an aviation rulemaking committee (ARC) to provide recommendations for a performance-based standard that would allow certain UAS to be operated over people. Previously characterized as micro UAS in the NPRM for this final rule, this category of operations will now be considered in a separate rulemaking. The ARC submitted its recommendations to the FAA on April 2, 2016, and the FAA is currently evaluating the recommendations. A copy of the ARC's report is available in docket for this rulemaking, and more information regarding the status of this new rulemaking may be found in the Department's significant rulemakings report, available at *www.transportation.gov/regulations*.

III. Discussion of the Final Rule

As discussed in the previous section, in order to determine whether certain UAS may operate safely in the NAS pursuant to section 333, the Secretary must find that the operation of the UAS will not: (1) Create a hazard to users of the NAS or the public; or (2) pose a threat to national security. The Secretary must also determine whether small UAS operations subject to this rule pose a safety risk sufficient to require airworthiness certification. The following preamble sections discuss the specific components of this rule, and section III.J explains how these components work together and allow the Secretary to make the statutory findings required by section 333.

A. Incremental Approach and Waiver

In the NPRM, the FAA noted that this rulemaking is one step of a broader process to fully integrate UAS into the NAS. ''Once the entire integration process is complete, the FAA envisions the NAS populated with UAS that operate well beyond the operational

[17] 49 U.S.C. 44711(a)(1).

[18] Public Law 112–95, sec. 333(b)(1).

[19] *http://www.faa.gov/uas/media/uas_roadmap_2013.pdf.*

[20] As discussed in section III.C.4 below, 14 CFR part 107 will not apply to model aircraft that satisfy all of the statutory criteria specified in section 336 of Public Law 112–95. The FAA has recently published an interpretive rule for public comment explaining the statutory criteria of § 336. See Interpretation of the Special Rule for Model Aircraft, 79 FR 36172, 36175 (June 25, 2014).

[21] *http://www.faa.gov/uas/legislative_programs/section_333/.*

[22] *http://www.faa.gov/uas/legislative_programs/coe/.*

[23] *http://www.faa.gov/uas/legislative_programs/pathfinders/.*

[24] *https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf.*

limits proposed in [the NPRM].'' [25] However, because higher-risk UAS operations pose additional safety issues that require more time to resolve, the FAA proposed to limit this rulemaking to small UAS operations posing the least amount of risk so that the agency could move to quickly issue a final rule integrating those operations into the NAS. ''In the meantime, the FAA will continue working on integrating UAS operations that pose greater amounts of risk, and will issue notices of proposed rulemaking for those operations once the pertinent issues have been addressed, consistent with the approach set forth in the UAS Comprehensive Plan for Integration and FAA roadmap for integration.[26]

The FAA also acknowledged that new technologies could come into existence after this rule is issued that could alleviate some of the risk concerns underlying the provisions of this rulemaking. As such, the FAA invited comment as to whether the final rule should include some type of waiver authority (such as a letter of deviation or a waiver) to better accommodate these new technologies. For the reasons discussed below, the FAA has decided to proceed with an incremental approach in this final rule but has added waiver authority to the regulatory text in order to accommodate new technologies and unique operational circumstances.

A number of commenters, including NTSB, Airlines for America (A4A), and the Small UAV Coalition, supported the FAA's proposed incremental approach to issue a final rule immediately integrating low-risk UAS operations into the NAS while continuing to work on integrating UAS posing a higher risk in separate regulatory actions. Qualcomm Incorporated, Google, Inc., the Oregon Department of Aviation, and the North Dakota Department of Agriculture urged the FAA to move quickly to issue a final rule integrating small UAS operations into the NAS. Google emphasized that ''[a]s the [small UAS] industry evolves, any lengthy delay in the issuance of a final [small UAS] rule would substantially reduce the benefits of the final rule. It will be difficult, if not impossible, for the FAA to adequately consider the many likely technological developments during a protracted rulemaking.'' The National Association of Flight Instructors added that because UAS are a relatively new technology whose risks are still being studied, the FAA should use ''a phased in set of regulations that ease into basic use of [small UAS] in the NAS with close attention to the degree of responsible use and compliance with regulations before considering relaxation of rules to allow increasing capability of the aircraft.''

The Coalition of Airline Pilots Associations (CAPA) commented that ''creating a set of regulations and standards that have a lower level of safety in the name of expedience is problematic.'' CAPA asserted that this rulemaking ''is an opportunity to develop a regulatory schema, using the hard lessons learned over the past one hundred years that has the long-range vision to be capable and integrated to handle the full spectrum of anticipated operations.'' CAPA also claimed that there may ultimately be remotely piloted vehicles that are the size of commercial transport category aircraft, and that any system put in place to govern UAS must account for this eventuality and provide the appropriate level of regulation. The Flight School Association of North America recommended a 12 to 18-month extension to the rulemaking timeline, ''so that more review can be accomplished.''

Other commenters, including Amazon.com, Inc. (Amazon), the American Farm Bureau Federation, and several state farm bureaus,[27] raised concerns about the proposed incremental approach. These and other commenters, such as the U.S. Small Business Administration (SBA) Office of Advocacy and the George Washington University Regulatory Studies Center, argued that more flexibility is necessary in the final rule to keep pace with new and emerging technologies. In addition, the commenters asserted that by delaying the integration of certain operations, such as beyond-visual-line-of-sight operations, until a future rulemaking, the FAA would also delay the benefits associated with those operations until the pertinent future rulemaking is complete. The George Washington University Regulatory Studies Center suggested that the FAA set regular deadlines for issuing future final rules to further integrate UAS into the NAS.

To address these concerns, a number of commenters including the SBA Office of Advocacy, the National Business Aviation Association (NBAA), and Google, urged the FAA to include deviation authority in the final rule. Google suggested that the FAA should grant a deviation from the provisions of part 107 if an applicant can establish that his or her small UAS operation would provide a level of safety equivalent to the one provided by the operating parameters of part 107. Several commenters including the National Ski Areas Association, EEI,[28] and the American Farm Bureau Federation (AFBF) asserted that there exist industries (such as agriculture, electrical utilities, and ski resorts) whose unique operating environments may allow them to mitigate some of the safety concerns underlying the operational parameters of the NPRM proposal. The Small UAV Coalition emphasized that the key to including deviation authority in the final rule would be for the FAA to establish a process by which it may authorize certain operations to exceed the other provisions of part 107 based on case-specific characteristics such as the operational circumstances of the mission, technological capabilities of the small UAS, and the training and experience of the operator.

After considering the comments, the FAA has decided to proceed incrementally and issue a final rule that immediately integrates the lowest-risk small UAS operations into the NAS. As Qualcomm, Google, the Oregon Department of Aviation, and other commenters pointed out, delaying the integration of the lowest-risk small UAS operations until issues associated with higher-risk operations have been addressed would needlessly delay the realization of societal benefits associated with integrating UAS operations for which the pertinent safety issues have been addressed. In addition, the immediate integration of the lowest-risk small UAS operations into the NAS would provide the FAA with additional operational experience and data that could be used to assist with the integration of higher-risk operations.

However, the FAA also agrees with the SBA Office of Advocacy and other commenters who pointed out that: (1) The rulemaking process for higher-risk

[25] 80 FR at 9552.

[26] 80 FR at 9552. Section 332(a) of Public Law 112–95 requires the Secretary of Transportation to develop a comprehensive plan to safely accelerate the integration of civil UAS into the NAS. This plan must be developed in consultation with representatives of the aviation industry, Federal agencies that employ UAS technology in the NAS, and the UAS industry. Section 332(a) also requires the Secretary of Transportation to develop a 5-year roadmap for the introduction of civil UAS into the NAS. Both the comprehensive plan and the roadmap were published in November 2013.

[27] Some of these commenters include the Michigan Farm Bureau, the Indiana Farm Bureau, the Louisiana Farm Bureau Federation, and the South Dakota Farm Bureau Federation.

[28] EEI, NRECA, and APPA submitted a joint comment to the docket. For ease of reference, this preamble will refer to the joint submission simply by the name of the first organization on the letterhead, which is EEI.

UAS operations may lag behind new and emerging technologies; and (2) certain individual operating environments may provide unique mitigations for some of the safety concerns underlying this rule. To resolve these issues, this rule will, in § 107.200, include the option to apply for a certificate of waiver. This certificate of waiver will allow a small UAS operation to deviate from certain provisions of part 107 if the Administrator finds that the proposed operation can safely be conducted under the terms of that certificate of waiver. This is similar to the standard that the FAA utilizes to consider waivers to the requirements of 14 CFR part 91.[29] A discussion as to whether a provision of part 107 is waivable can be found in the preamble section discussing that provision.

To obtain a certificate of waiver, an applicant will have to submit a request containing a complete description of the proposed operation and a justification, including supporting data and documentation as necessary, that establishes that the proposed operation can safely be conducted under the terms of the requested certificate of waiver. The FAA expects that the amount of data and analysis required as part of the application will be proportional to the specific relief that is requested. Similarly, the FAA anticipates that the time required for it to make a determination regarding waiver requests will vary based on the complexity of the request. For example, a request for a major deviation from part 107 for an operation that takes place in a congested metropolitan area with heavy air traffic will likely require significantly more data and analysis than a request for a minor deviation for an operation that takes place in a sparsely populated area with minimal air traffic. If a certificate of waiver is granted, that certificate may include additional conditions and limitations designed to ensure that the small UAS operation can be conducted safely.

The certificate-of-waiver process will allow the FAA to assess case-specific information concerning a small UAS operation that takes place in a unique operating environment and consider allowing additional operating flexibility that recognizes safety mitigations provided by the specific operating environment. The FAA anticipates that this process will also serve as a bridging mechanism for new and emerging technologies; allowing the FAA to permit testing and use of those technologies, as appropriate, before the pertinent future rulemaking is complete.

Like information collected from § 333 exemptions, the FAA plans to collect useful data derived from waiver application and issuance such as what part 107 provisions have the greatest number of waiver requests, what technology is being utilized to enhance safety, and what safe operating practices are most effective. To evaluate the effectiveness of operating practices, the FAA plans to compare the mitigations imposed by waiver grants against accident and incident reports and observations made as part of the FAA's oversight. For example, an FAA inspector conducting an inspection of a small UAS that is operating under a waiver will be able to observe potential safety issues that may arise during the operation. This information will used to assess risk and be shared with various organizations in the FAA to inform policy decisions and rulemaking efforts.

Some commenters requested authorization to deviate for specific activities. For example, the National Rural Electric Cooperative Association (NRECA) requested deviation authority for utility maintenance and operations of UAS in electric cooperative power line right-of-way corridors. The American Petroleum Institute (API) requested deviation authority in circumstances in which environmental protection and health and human safety issues are implicated. Princeton University recommended that the rule include an option for universities to certify that the aircraft is to be used for educational purposes and poses no unreasonable danger to the public. Vail Resorts requested that the FAA provide a vehicle for deviation authority through agency practices that will enable ski areas to obtain authorization or exemption from certain final rules.

The FAA notes that the safety of a small UAS operation is a result of that operation's operating parameters and not the purpose for which the operation is conducted. For example, if a small UAS operation is conducted at a remote ski resort, the safety-pertinent factor is not that the operation is conducted for ski-area purposes, but that the operation is conducted in a remote area. However, at this time, the FAA does not have sufficient data to determine what (if any) operational mitigations are included when a small UAS operation is conducted in a given industry and how widespread those mitigations are within the industry. To take the earlier example of ski areas, the FAA does not have sufficient data to determine whether all ski areas are remotely located and the density of manned-aircraft traffic near each ski area. Accordingly, the FAA will evaluate operations seeking to go beyond the baseline part 107 requirements on a case-by-case basis as part of its evaluation of the waiver applications.

Modovolate Aviation and Colorado Ski Country USA encouraged the FAA to make available class exemptions under section 333 of Public Law 112–95 if specific classes of small UAS cannot reasonably be accommodated within the final rule. Similarly, DJI recommended that, where technology or operating practice is widely available or known, the FAA could issue guidance allowing its inspectors to routinely grant deviation authority to all operators meeting certain standards rather than evaluating individual requests for deviation. Another commenter encouraged the FAA to consider issuing equipment-specific authorizations or waivers based on specific technologies rather than granting authorizations or waivers to specific operators flying specific aircraft. An individual urged the FAA to set up a program to let manufacturers self-certify that their aircraft models qualify for exemption from applicable rules.

The FAA notes that the Administrative Procedure Act imposes certain requirements on agency rulemaking. When conducting a rulemaking, an agency must, among other things, issue a notice of proposed rulemaking, allow time for public comment, consider public comments, and issue a final rule after consideration of public comments.[30] As part of its process to integrate UAS into the NAS, the FAA may, in the future, consider categories of UAS and UAS operations, but absent changes to the statute, the method by which the agency will integrate those categories into the NAS will have to comply with the Administrative Procedure Act. With regard to manufacturer self-certification, the FAA notes that part 107 will not contain airworthiness certification requirements and thus, there will be no part 107 requirement to which a manufacturer could self-certify.[31]

NetMoby encouraged the FAA to circumscribe very specific rules establishing standards for UAS deviation authority at the outset of the

[29] *See* 14 CFR 91.903(a) (allowing a certificate of waiver from part 91 requirements ''if the Administrator finds that the proposed operation can be safely conducted under the terms of that certificate of waiver'').

[30] *See* 5 U.S.C. 553(b) and (c).

[31] Part 107 does require the remote pilot to conduct a preflight check to ensure that the small UAS is in a condition for safe operation, but the manufacturer would be unable to self-certify for that requirement because a small UAS may become damaged after it leaves the manufacturer's possession.

UAS regulatory environment to avoid being immediately overwhelmed with waiver requests and other requests for deviation authority. Google proposed a specific process for the deviation authority. Google explained that the FAA would be able to tailor different operational restrictions, as appropriate, if a petitioner can demonstrate that: (i) The small UAS has enhanced safety technology; (ii) the small UAS meets a higher level of airworthiness or complies with a more detailed maintenance and inspection protocol; or (iii) the small UAS operator (pilot) has a higher level of pilot and small UAS operator qualification, training, and/or certification than the proposed part 107 would require.

As discussed earlier, the standard that an applicant seeking a waiver will be required to meet is to demonstrate that his or her proposed small UAS operation can safely be conducted under the terms of a certificate of waiver. This waiver process is intended to allow for case-specific mitigations that could take many different forms or combinations. These mitigations could even be based on technology that does not exist at this time. Because prescriptive requirements imposed on the waiver process as part of this rulemaking may limit the FAA's flexibility to consider new or unique operational circumstances and safety mitigations, the FAA declines to add more prescriptive requirements to this process.

The International Air Transport Association urged the FAA to adopt a final rule that allows for regular and systemic review to ensure the appropriate level of regulation or oversight. The Agricultural Retailers Association similarly recommended timely reauthorization of the rules ''to mirror technological advances and risk mitigation.'' The Virginia Department of Aviation asserted that the rules ''should be reviewed as quickly as the safety data permits,'' which the commenter estimated to be every 24 months ''until we achieve full integration of the technology into the NAS.''

Several commenters urged the FAA to specifically address the timeline for implementation, so that the industry can prepare appropriately. One individual questioned whether the FAA intends to create a forecast for UAS ''rule evolution.'' Specifically, the commenter questioned when the FAA expects to develop rules for UAS greater than 55 pounds and what constraints the agency expects to put on operations for these larger vehicles. Another individual recommended the FAA set regular deadlines for issuing final rules to update UAS integration standards, and commit to removing some of the requirements (*e.g.,* size, visual line of sight) by a date certain, unless experience justified maintaining them.

The FAA notes that it has issued a comprehensive plan and roadmap laying out its long-term vision for UAS integration into the NAS. The FAA is currently updating these documents with an FAA strategic plan for UAS integration into the NAS.[32]

With regard to review of the rules once they are in place, the FAA notes that Executive Order 13610 requires the FAA to review its regulations to examine whether they remain justified and whether they should be modified or streamlined in light of changed circumstances, including the advent of new technologies. The FAA regularly conducts a retrospective review of its regulations, and the regulations of this rule will be no exception.

B. Discussion of the Applicable Statutory Framework

The Mercatus Center at George Mason University and the Competitive Enterprise Institute questioned the Department's reliance on Public Law 112–95, section 333 as the authority for the proposed rule. Both commenters stated that Public Law 112–95, § 332 includes Congress' mandate to the FAA to promulgate rules for small UAS integration into the NAS. The Competitive Enterprise Institute urged the Department to clearly articulate why it is invoking section 333 authority, as opposed to § 332(b) authority, as the basis for this rulemaking.

Section 332(b)(1) requires the Secretary to publish a final rule allowing for the civil operation of small UAS in the NAS ''to the extent the systems do not meet the requirements for expedited authorization under section 333.'' Conversely, section 333(a) requires the Secretary to determine whether certain UAS may operate safely in the NAS ''before completion of the plan and rulemaking required by section 332. . . .'' As part of the consideration under section 333, section 333(b)(2) directs the Secretary to determine whether ''. . . airworthiness certification under section 44704 of title 49, United States Code is required for the operation of unmanned aircraft systems.'' If the Secretary determines that certain UAS may operate safely in the NAS, then section 333(c) requires the Secretary to ''establish requirements for the safe operation'' of those UAS in the NAS.

Because the statutory text of section 332(b)(1) applies only to those UAS that do not meet the requirements of section 333, sections 332 and 333 cannot both apply to the same UAS. The Department is pursuing this rulemaking under section 333 because section 333(b)(2) allows it to find that airworthiness certification is not necessary for small UAS that will be subject to this rule. As discussed in section III.J.3 of this preamble, the Department has indeed found that mandatory airworthiness certification is unnecessary to ensure the safety or security of these types of small UAS operations. However, unlike section 333(b)(2), section 332 does not contain a provision that would allow the Department to find that airworthiness certification should not be required for a small UAS. Because airworthiness certification is normally a statutory requirement imposed by 49 U.S.C. 44704 and 44711(a)(1), the FAA would have to include an airworthiness certification requirement in this rule if it were to conduct this rulemaking under section 332 rather than section 333. This would impose an additional requirement on small UAS whose operational parameters do not pose a hazard to users of the NAS or a threat to national security.

Matternet, Inc. argued that Public Law 112–95 compels the FAA to develop a regulatory framework for unmanned aircraft systems, but does not bind or limit the Agency to existing statutes concerning aviation, or to decades-long aviation regulatory doctrines that, Matternet asserted, do not apply to these new technologies. Furthermore, Matternet argued that because Public Law 112–95, section 333 expressly contemplates that ''certain unmanned aircraft systems [would] operate safely in the NAS before completion of the plan and rulemaking required by section 332,'' Congress gave the FAA a ''blank slate'' to create small UAS regulations ''without any suggestion that existing statutes or regulations would act as impediments to the rulemaking process.'' Matternet also stated that it ''is concerned that the FAA's proposal is impeded by an apparent notion that statutes, regulations or doctrines that were created decades ago to address manned aircraft operations are mandated to apply to unmanned aircraft, without any safety or economic rationale.''

Matternet's argument that existing statutes and regulatory doctrines are limited to manned aircraft operations is foreclosed by precedent. In

[32] *http://www.faa.gov/uas/publications/.*

Administrator v. *Pirker*,[33] the NTSB considered the issue of whether an unmanned aircraft is an ''aircraft'' within the meaning of FAA statutes and regulations and whether it is subject to the existing FAA regulations of part 91, which ''prescribes rules governing the operation of aircraft.'' [34] The NTSB found that the statutory and regulatory definitions of aircraft are ''clear on their face'' and ''draw no distinction between whether a device is manned or unmanned.'' [35] Thus, the NTSB concluded that the existing regulatory provision of § 91.13 (which prohibits careless or reckless operation of an aircraft) apply to the unmanned aircraft operation that was at issue in *Pirker*.[36]

The FAA is also unpersuaded by Matternet's other argument that Public Law 112–95 overturned all existing aviation statutes and regulations, leaving the FAA with a ''blank slate'' for this rulemaking. The Supreme Court has held that ''[w]hile a later enacted statute . . . can sometimes operate to amend or even repeal an earlier statutory provision . . . repeals by implication are not favored and will not be presumed unless the intention of the legislature to repeal [is] clear and manifest.'' [37] The Court added that ''[w]e will not infer a statutory repeal ''unless the later statute expressly contradict[s] the original act or unless such a construction is absolutely necessary in order that the words of the later statute shall have any meaning at all.'' [38] Implied repeals of a longstanding statutory provision are particularly disfavored.[39]

The aviation statutes at issue here were enacted in 1958 as part of the Federal Aviation Act of 1958 (which created the Federal Aviation Agency).[40] Because these statutory provisions have been in place for 58 years, they are longstanding statutory provisions whose implied repeal would be particularly disfavored. Many of the pertinent regulatory provisions at issue in this rulemaking are similarly longstanding. For example, the ''see and avoid'' requirement of § 91.113(b) was created in 1968.[41] Thus, for the reasons discussed below, the FAA finds that, with the exception of 49 U.S.C. 44704 and 44711(a)(1), Public Law 112–95 did not repeal these existing statutes and regulations.

Section 333 of Public Law 112–95 directs the Secretary of Transportation to determine whether certain UAS may operate safely in the NAS and if so, to establish requirements for the safe operation of such UAS in the NAS.[42] With the exception of section 333(b)(2), which allows the Secretary to determine whether the airworthiness-certification requirements of 49 U.S.C. 44704 and 44711(a)(1) should be imposed on certain UAS, section 333 does not expressly contradict any existing statute or regulation. Furthermore, interpreting section 333 as repealing all prior aviation statutes and regulations is unnecessary in order to give meaning to section 333, which simply directs the Secretary to determine whether existing aircraft regulations prohibit or otherwise burden certain UAS operations that could operate safely in the NAS. If the Secretary determines that this is the case, then section 333(c) directs the Secretary to make the appropriate changes to the pertinent regulations. Because, with the exception of section 333(b)(2), section 333 can be given meaning without repealing other existing aviation statutes or regulations, we decline Matternet's suggestion that section 333 impliedly repeals those statutes or regulations.

We also note that section 333(b)(2) provides further evidence that Congress intended section 333 to work in conjunction with the existing aviation statutes. This subsection provides the Secretary with discretion to determine whether airworthiness certification is necessary for UAS subject to this rule. The FAA normally does not possess this discretion because 49 U.S.C. 44711(a)(1) requires airworthiness certification for any civil aircraft that is operated in air commerce. Subsection 333(b)(2) also expressly cross-references 49 U.S.C. 44704, which specifies the process by which the FAA may issue an airworthiness certificate. If Congress had intended section 333 to repeal all other aviation statutes and regulations, there would be no need to cross-reference § 44704 or explicitly give the Secretary the power to determine whether airworthiness certification should be required because a repeal of § 44711(a)(1) and § 44704 would automatically remove the statutory constraints on FAA's airworthiness certification discretion. Thus, interpreting section 333 as repealing all other aviation statutes would also render meaningless the Congressional directive in section 333(b)(2) for the Secretary to determine whether the airworthiness certification requirements of §§ 44711(a)(1) and 44704 should be applied to UAS subject to this rule.

The North Dakota Department of Agriculture noted that the FAA has authority over the NAS and requested clarification on how UAS operations will operate in an interstate manner. In response, the FAA notes that, as the North Dakota Department of Agriculture pointed out, the FAA's authority extends over the entire national airspace system.[43] Thus, with the exception of operations discussed in section III.C of this preamble, the provisions of part 107 will apply to small UAS operations operating in any State or manner in the United States.

C. Applicability

To integrate small UAS operations into the NAS, this rule will create a new part in title 14 of the CFR: Part 107. The regulations of part 107, which are tailored to address the risks associated with small UAS operations, will apply to small UAS operations in place of certain existing FAA regulations that impede civil small UAS operations. Specifically, for small UAS operations, the requirements of part 107 will generally replace the airworthiness provisions of part 21, the airman certification provisions of part 61, the operating limitations of part 91, and the external load provisions of part 133.

However, part 107 will not apply to all small UAS operations. For the reasons discussed below, part 107 will not apply to: (1) Air carrier operations; (2) international operations; (3) public aircraft operations; (4) certain model aircraft; and (5) moored balloons, kites, amateur rockets, and unmanned free balloons. Additionally, part 107 will allow current holders of an exemption issued under section 333 of Public Law 112–95 to continue operating under the terms of their exemption rather than under part 107.

1. Transporting Property for Compensation (Air Carrier Operations)

The NPRM proposed to allow transportation of property provided it is not done for compensation. The reasoning for the limitation on accepting payment or compensation for such

[33] A copy of the *Pirker* decision can be found at: *http://www.ntsb.gov/legal/alj/OnODocuments/Aviation/5730.pdf.*

[34] 14 CFR 91.1(a).

[35] *Pirker* at 4–5.

[36] *Pirker* at 8–12.

[37] *Nat'l Ass'n of Home Builders* v. *Defenders of Wildlife,* 551 U.S. 644, 662 (2007) (internal citations and punctuation marks omitted).

[38] *Id.*

[39] *Andrus* v. *Glover Constr. Co.,* 446 U.S. 608, 618 (1980) (noting ''the axiom that repeals by implication of longstanding statutory provisions are not favored'').

[40] Federal Aviation Act of 1958, Public Law 85–726, 72 Stat. 731 (1958).

[41] *Pilot Vigilance,* 33 FR 10505, July 24, 1968.

[42] Public Law 112–95, sec. 333(a) and (c).

[43] *See, e.g.,* Public Law 112–95, section 333(a) (directing the Secretary of Transportation to determine whether certain UAS may operate safely in the ''*national* airspace system'') (emphasis added).

transport is that, in general, when someone is transporting persons or property by air for compensation, that person may be considered an ''air carrier'' by statute and would then be required to obtain OST economic authority and additional FAA safety authority.[44] Because the traveling and shipping public have certain expectations of safety and consumer protection when payment is exchanged for carriage, air carriers are subject to both economic and safety regulations to mitigate the risks to persons or non-operator-owned property on the aircraft, including statutory requirements for liability insurance coverage.

The Department sought comment on whether the rule should go further—that is, whether UAS should be permitted to transport property for payment within the other proposed constraints of the rule, *e.g.,* the ban on flights over uninvolved persons, the requirements for line of sight, and the intent to limit operations to a confined area. The Department also sought comment on whether a special class or classes of air carrier certification should be developed for UAS operations.

Commenters including NAAA, International Brotherhood of Teamsters, and ALPA supported the proposed prohibition on carrying property for compensation. These commenters generally asserted that allowing air carrier operations at this time would be premature. NAAA stated that a more stringent regulatory regime, including certification of the safety of a small UAS for air carrier operations, should be developed before air carrier operations are permitted. The International Brotherhood of Teamsters stated that weakening the regulations before ''package delivery technologies'' are proven safe and reliable could endanger not only the public but also the warehouse and operational staff involved in the loading and maintenance of small UAS. ALPA stated that until there is a demonstrated safety record for UAS air carrier operations, the Department should not authorize such operations.

Other commenters, including FAST Robotics, NBAA, and Small UAV Coalition argued that the FAA should permit such operations. Life Drone argued that the final rule should allow small UAS to deliver ''medical AED units'' to emergency and remote locations where there is little or no risk of interference with the NAS. MAPPS requested a ''geospatial exemption'' to allow companies to obtain air carrier services for various geospatial sensors owned by those other than the small UAS operator.

The Small UAV Coalition, Matternet, and the Information Technology and Innovation Foundation opposed the prohibition on the basis that allowing a company to use a small UAS to transport property in furtherance of the company's own business, but not for compensation, is an arbitrary distinction. Matternet and the Small UAV Coalition argued that there is no safety or economic rationale to justify allowing property transport for business purposes but not for compensation. The Information Technology and Innovation Foundation asserted that the safety of goods transported by UAS does not depend on whether the UAS operator receives payment. This commenter further stated that ''[the] goal should be to optimize both safety and commercial value when it comes to the integration of UAS into the NAS,'' but the prohibition on air carrier operations places ''unnecessary restrictions on commercial activity.''

Matternet noted that UAS analysis shows that over 80% of goods intended for delivery by UAS will be in the range of two kilograms or less, and that the total weight of the small UAS, including payload, will therefore be 6 kilograms or less. Thus, Matternet argued, the safety risks associated with manned air carrier operations—where the aircraft weighs considerably more and has significant fuel capacity, and where the operation could impact people both on the aircraft and on the ground—do not exist for unmanned air carrier operations. Google and the Consumer Electronics Association also pointed out that most UAS cargo delivery will consist of relatively low-weight items that create minimal safety concerns.

Google argued that UAS cargo operations are very similar to operations that require external payloads, such as sensors or cameras, and then noted that FAA has already authorized several small UAS operators to carry such external payloads. Amazon and American Farm Bureau Federation similarly noted that there are circumstances in which FAA already permits certain commercial operations (*e.g.,* aerial work operations, crop dusting, banner towing, ferry or training flights, and some transport of persons or property for compensation) without requiring an air carrier certificate, and a similar carve-out should be established for low-risk transport using small UAS.

Pointing to the low risks associated with the transport of property by small UAS under the operating limitations of the proposed rule, Amazon, Matternet, American Farm Bureau Federation, and Michigan Farm Bureau stated that an air carrier certification is not necessary for small UAS air carrier operations. If, however, the Department determines that some type of air carrier certification is required by statute, those four commenters, the Small UAV Coalition, and Continental Mapping suggested that the Department develop an alternative certification process that is tailored to small UAS operations.

NBAA and UPS stated that FAA can ensure safe operations by defining performance-based standards to enable transport of property for compensation. For example, UPS suggested weight limitations for small UAS involved in transporting property. AUVSI said risks could be mitigated by compliance with industry standards for design and build that would normally occur through the aircraft certification process. Aviation Management noted that small UAS should be permitted to transport property if they have received approval to do so—*i.e.,* through compliance with an advisory circular or with an industry standard for design and build, such as one developed by ASTM. The Consumer Electronics Association and Small UAV Coalition pointed out that companies that want to transport property by UAS for compensation have powerful business incentives to ensure safe, efficient, and complete operations.

Other commenters, including NetMoby, FAST Robotics, and Planehook Aviation Services, LLC (Planehook Aviation), said that a special class of air carrier certification should be required for UAS to transport property for payment. Planehook Aviation stated that, at a minimum, FAA should create a ''common carriage certification'' that mirrors the care and safety requirements for manned aviation under 14 CFR part 119.

The Department has reviewed the comments and legal authorities that govern the transport of property for compensation and has determined that it is appropriate to allow some limited operations involving the transport of property for compensation to be done

[44] *See* 49 U.S.C. 41101 (noting that an air carrier may provide air transportation only if the air carrier holds a certificate issued under this chapter [chapter 411—Economic Regulation of Air Carrier Certificates] authorizing the air transportation), 49 U.S.C. 44705 (requiring the FAA Administrator to ''issue an air carrier operating certificate to a person desiring to operate as an air carrier when the Administrator finds, after investigation, that the person properly and adequately is equipped and able to operate safely under this part and the regulations and standards prescribed under this part''), and 49 U.S.C. 44711(a)(4) (prohibiting a person from operating as an air carrier without an air carrier operating certificate). Air transportation is defined in 49 U.S.C. 40102(a)(5) as ''foreign air transportation, interstate air transportation, or the transportation of mail by aircraft.''

under the other provisions of part 107, as analyzed below.

As noted earlier, in general when someone is transporting persons or property by air for compensation, that person may be considered an ''air carrier'' by statute and would then be required to obtain economic authority from the Office of the Secretary and additional FAA safety authority. Historically, the FAA has also required, through regulation, that certain commercial operators who may be transporting people or property for compensation wholly within a State, and thus not triggering the statutory requirements for air carriers, be certificated and comply with heightened safety requirements, based on the Administrator's authority in § 44701(a)(5) to prescribe regulations that are necessary for safety in air commerce. The rationale for this is that even aircraft operating wholly within a State could be operated in such a manner that directly affects, or may endanger safety in foreign or interstate air commerce.

In contrast, the FAA has also recognized that some commercial operations should not be subject to these heightened operator certification requirements and should be allowed to operate under the general operating rules of 14 CFR part 91. Some examples of this include student instruction, sightseeing flights conducted in hot air balloons, and non-stop flights conducted within a 25-statute mile radius of the airport of takeoff for the purpose of conducting parachute operations, as well as certain helicopter flights conducted within a 25-mile radius of the airport of takeoff.[45] These exceptions are narrow and well-defined, and must be conducted in accordance with operating limitations set forth in § 119.1(e) and 14 CFR part 91.

In light of our experience with certification of other commercial operations, and with particular attention to the safe integration of new technologies, applications that are emerging, and limited nature of the transportation that could occur given the operating limits of the final rule, the Department has determined that a similar exception from air carrier operations for unmanned aircraft involving limited transport of property for compensation is appropriate. As adopted, the final rule provides immediate flexibility for remote pilots to engage in the limited carriage of property by small UAS, provided that the operations are conducted within a confined area and in compliance with the operating restrictions of 14 CFR part 107. It does not, however, allow individuals or corporations, acting as ''air carriers,'' to engage in ''air transportation'' as those terms are defined in 49 U.S.C. 40102.[46] As technology develops in the future, the Department will evaluate the integration of more expansive UAS air carrier operations into the NAS and will propose further economic and safety regulations if warranted.

In order to not be considered ''air transportation,'' first, the transport must occur wholly within the bounds of a state. It may not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession, as this is defined by statute as interstate air transportation and would otherwise trigger the Department's statutory requirements for air carrier operations. Thus, remote pilots may not offer or conduct ''air transportation,'' in which goods move across State or national borders. By statute and regulation, individuals seeking to carry more than a *de minimis* volume of property moving as part of a continuous journey over state, territorial, or international boundaries are considered by the Department of Transportation to be ''air carriers'' engaging in ''air transportation.'' [47] The assessment of whether an operator is engaging in ''air transportation'' is specific to the facts and circumstances of each case. Generally, the Department looks to how the transportation is being marketed and offered to customers, whether the transporting entity has existing aviation economic authority, and the extent to which the people or goods are being transported as part of an inter- or multi-State network.

Second, as with other operations in part 107, small UAS operations involving the transport of property must be conducted within visual line of sight of the remote pilot. While the visual-line-of-sight limitation can be waived for some operations under the rule, the restriction is a critical component of the Department's finding that these part 107 operations do not warrant further safety or economic authority at this time. The visual-line-of-sight restriction limits the area of operation to a circle with only about a 1-mile radius around the remote pilot in command, depending on the visibility conditions at the time of the operation. This limited area of operation mitigates the safety concerns that underlie the additional requirements that the FAA normally imposes on commercial operators under part 119. Operating within visual line of sight of the remote pilot is also critical to the Department's finding that these operations are so limited such that at this time, they could not be considered air transportation, or part of a broader network of interstate commerce warranting economic authority to ensure adequate protection of consumers' interests at this time. Accordingly, any waivers that the FAA may grant to the visual-line-of-sight provisions of part 107 will not allow the operation to transport property for compensation or hire beyond visual line of sight.

For these reasons, this rule will also not allow the operation of a small UAS from a moving vehicle if the small unmanned aircraft is being used to transport property for compensation or hire. Allowing operation from a moving vehicle could allow the remote pilot in command to significantly expand the area of operation, raising the same safety and economic concerns as operations conducted beyond visual line of sight.

Third, the provisions of part 107 limit the maximum total weight of the small unmanned aircraft (including any property being transported) to under 55 pounds. This limits the size and weight of any property transported by the unmanned aircraft. Additionally, other provisions of the final rule require the remote pilot to know the unmanned aircraft's location; to determine the unmanned aircraft's attitude, altitude and direction; to yield the right of way to other aircraft; and to maintain the ability to see-and-avoid other aircraft. In the aggregate, the provisions of the final rule are designed to create an integrated framework and strike a balance that, on the one hand, allows limited transportation of property for compensation, but, on the other hand, ensures safety in the NAS and the opportunity to evaluate more expansive carriage of property that would require both OST economic authority and additional FAA safety authority.

Fourth, the FAA notes that the carriage of hazardous materials poses a higher level of risk than the carriage of other types of property. For example, in the context of external load operations conducted under 14 CFR part 133, the FAA has found, that ''the transport of hazardous materials, especially forbidden [by PHMSA] hazardous materials, in external load operations creates a hazard to persons or property

[45] See 14 CFR 119.1(e)(1–10).

[46] *See* 49 U.S.C. 40102(a)(2) (defining ''air carrier'') and (a)(5) (defining ''air transportation'').

[47] *See* 49 U.S.C. 41101; 14 CFR 298.2.

in the surface.'' [48] Because the carriage of hazardous materials poses a higher level of risk, part 107 will not allow the carriage of hazardous materials.

Based on these operational limits, the Department at this time does not view the limited transport of property for compensation that could occur via a small UAS that is operated within visual line of sight of the remote pilot to constitute ''interstate air transportation.'' The final rule, therefore, creates a new exception under 14 CFR part 119 for these operations authorized by part 107. This approach will encompass the vast majority of transportation by small UAS that could be conducted under part 107, including many of the specific scenarios suggested by commenters, without requiring the Department to design and develop a new infrastructure for issuance and administration of a new air carrier economic and safety licensing regime.

We note that while the operations permitted by this rule do not rise to the level of air transportation, they are still considered to be commercial operations. Thus as discussed in the next section, if a person does not satisfy U.S. citizenship requirements, he or she must seek authority under 14 CFR part 375 before conducting these operations.

2. International Operations and Foreign-Owned Aircraft

The International Civil Aviation Organization (ICAO) has recognized that UAS are aircraft, and as such, existing standards and recommended practices (SARPs) that apply to aircraft apply to UAS. ICAO currently is reviewing the existing SARPs to determine what modifications, if any, need to be made to accommodate UAS. In the U.S., however, UAS may operate with DOT authorization, under the authority of section 333 [49] of Public Law 112–95, in a much less restrictive manner than current ICAO SARPs require. Thus, the FAA proposed to limit the applicability of part 107 to small UAS operations that are conducted entirely within the United States. Persons who wish to conduct operations outside of the United States would be able to do so, provided they seek and obtain the proper authorization from the requisite foreign civil aviation authority.

In addition, based on the ICAO framework and the current review that ICAO is conducting, the FAA proposed to limit the rule to operations of U.S.-registered UAS. Under 49 U.S.C. 44103 and 14 CFR 47.3, an aircraft can be registered in the United States only if it is not registered under the laws of a foreign country and meets one of the following ownership criteria:

- The aircraft is owned by a citizen of the United States;
- The aircraft is owned by a permanent resident of the United States;
- The aircraft is owned by a corporation that is not a citizen of the United States, but that is organized and doing business under U.S. Federal or State law and the aircraft is based and primarily used in the United States; or
- The aircraft is owned by the United States government or a State or local governmental entity.

In proposing this requirement, the FAA noted that existing U.S. international trade obligations, including the North American Free Trade Agreement (NAFTA), cover certain kinds of operations known as specialty air services. Specialty air services are generally defined as any specialized commercial operation using an aircraft whose primary purpose is not the transportation of goods or passengers, including but not limited to aerial mapping, aerial surveying, aerial photography, forest fire management, firefighting, aerial advertising, glider towing, parachute jumping, aerial construction, helilogging, aerial sightseeing, flight training, aerial inspection and surveillance, and aerial spraying services. The FAA invited comments on whether foreign-registered small unmanned aircraft should be permitted to operate under part 107, or recognized as specialty air services under international trade obligations.

With respect to limiting UAS operations under part 107 to operations within the United States, the National Agricultural Aviation Association (NAAA), DJI, and another commenter supported the limitation, but sought clarification and additional guidance material on what steps individuals may need to complete to obtain the proper authorization from foreign civil aviation authorities and the FAA to operate outside the United States.

Article 8 of the Chicago Convention specifies that no unmanned aircraft ''shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization.'' Article 8 also calls on States to undertake ''to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.'' In accordance with this obligation, the provisions of part 107 set forth the necessary authorizations for operations conducted by U.S. citizens only within the United States. For those seeking to operate outside the United States, special authorization from the foreign civil aviation authority will be required. Thus, remote pilots wishing to conduct operations over another country's airspace should review that country's statutes, regulations, and guidance for clarification about how to operate in its airspace.

The Small UAV Coalition sought clarification regarding whether UAS operations over water and beyond 12 nautical miles from the U.S. coast could be conducted under part 107, provided the operations are within U.S. flight information regions and not over the territory of a contracting member state.

Until such time as agreements are reached with other countries, the FAA has determined that operations will be restricted to the land areas, internal waters, and territorial sea of the United States. U.S. flight information regions that are more than 12 nautical miles from the coast of the United States do not satisfy these criteria, and as such, part 107 will not apply to operations in those areas.

Planehook Aviation argued that the rule should be consistent with applicable articles of the Chicago Convention, which, as noted previously, deal with unmanned aircraft operations and the safe separation from manned civil aircraft operations.

As discussed earlier, ICAO has recognized that existing SARPs that apply to aircraft apply to UAS. ICAO currently is reviewing the existing SARPs to determine what modifications, if any, need to be made to accommodate UAS and in fact, recently amended the standard contained in paragraph 3.1.9 of Annex 2 (Rules of the Air). This standard requires that ''[a] remotely piloted aircraft shall be operated in such a manner as to minimize hazards to persons, property or other aircraft and in accordance with the conditions specified in Appendix 4.'' That appendix sets forth detailed conditions ICAO Member States must require of civil UAS operations for the ICAO Member State to comply with the Annex 2, paragraph 3.1.9 standard.

Consistent with the recent amendment to 3.1.9 of Annex 2, the provisions of part 107 are designed to minimize hazards to persons, property or other aircraft operating within the

[48] Memorandum to Christopher Bonanti from Rebecca MacPherson, Assistant Chief Counsel, AGC 200 (Aug. 17, 2009). PHMSA is the abbreviation for ''Pipeline and Hazardous Materials Safety Administration.''

[49] In addition to granting authorization through section 333 exemptions, the FAA may authorize UAS operations under sections 334 and 336 of Public Law 112–95, as well as through Experimental Airworthiness Certification of UAS and OPA (FAA Order 8130.34).

United States. Given the on-going evaluation of the SARPs by ICAO, this rule will, for the time being, limit the applicability of part 107 to small UAS operations that are conducted entirely within the United States. The FAA envisions that operations in international and foreign airspace will be dealt with in a future FAA rulemaking as ICAO continues to revise and more fully develop its framework for UAS operations to better reflect the diversity of UAS operations and types of UAS and to distinguish the appropriate levels of regulation in light of those differences.

Transport Canada stated that there is a discrepancy between the proposed rule's description of U.S. territorial waters extending to 12 nautical miles from the U.S. coast, and text in 14 CFR 91.1 that makes reference to ''waters within 3 nautical miles of the U.S. Coast.''

Under Presidential Proclamation 5928, the territorial sea of the United States, and consequently its territorial airspace, extends to 12 nautical miles from the baselines of the United States determined in accordance with international law. Thus, UAS operations that occur within 12 nautical miles from the baselines of the United States will be considered as operations occurring within the United States consistent with the applicability of part 107.

The FAA notes that this approach is consistent with part 91. While, as Transport Canada pointed out, § 91.1(a) refers to waters within 3 nautical miles of the U.S. Coast, the applicability of part 91 is not limited to the 3-nautical-mile area. Specifically, § 91.1(b) clarifies that certain part 91 regulations also apply to aircraft operations taking place between 3 and 12 nautical miles from the coast of the United States. Thus, the 12-nautical-mile metric used in this rule is consistent with the FAA's agency practice (as codified in § 91.1(b)) and reflects the directive of Presidential Proclamation 5928.

With respect to operation of foreign-registered aircraft for non-recreational and non-hobby purposes, NBAA, NetMoby, and Planehook Aviation supported the Department's decision not to include foreign-registered UAS in this rulemaking. DJI, however, recognized that the current statutory restrictions in 49 U.S.C. 44102(a)(1) impose constraints on who can register an aircraft in the United States. DJI urged the FAA to consider asking Congress either to drop the aircraft registration requirement for all small UAS altogether or to withdraw the citizenship requirement (including its limited exceptions) as part of the agency's upcoming reauthorization.

Additionally, to the extent some of these operations could be conducted by foreign citizens using foreign-registered small UAS, DJI suggested that DOT evaluate whether existing agreements allow the use of small UAS and, to the extent they cannot be reasonably construed as including these aircraft, explore a diplomatic solution that would allow their use in U.S. airspace. Similarly, Textron Systems, Predesa, LLC, and the Aerospace Industries Association (AIA) suggested that FAA evaluate existing bilateral agreements and consider new bilateral agreements as the mechanism to permit foreign-registered UAS to operate in the United States. The Small UAV Coalition endorsed this approach as well and urged the Department to authorize the operation of specialty air services by foreign-owned small UAS in the United States.

In the NPRM, the FAA proposed to exclude foreign-registered aircraft from part 107 because the proposed rule included a registration component and foreign-registered aircraft may not be registered by the FAA. The FAA has since promulgated a separate interim final rule, titled *Registration and Marking Requirements for Small Unmanned Aircraft* [50] (Registration Rule), to address the registration and marking of all small unmanned aircraft, including unmanned aircraft that will be subject to part 107. In the Registration Rule, the Department acknowledged that under 49 U.S.C. 41703, the Secretary may authorize certain foreign civil aircraft to be navigated in the United States only if: (1) The country of registry grants a similar privilege to aircraft of the United States; (2) the aircraft is piloted by an airman holding a certificate or license issued or made valid by the U.S. government or the country of registry; (3) the Secretary authorizes the navigation; and (4) the navigation is consistent with the terms the Secretary may prescribe.[51]

A foreign civil aircraft is defined in 14 CFR 375.1 as (a) an aircraft of foreign registry that is not part of the armed forces of a foreign nation, or (b) a U.S.-registered aircraft owned, controlled or operated by persons who are not citizens or permanent residents of the United States. For those that fall within this definition and wish to operate under the provisions of part 107, they must first apply with the Office of the Secretary's Foreign Air Carrier Licensing Division for permission to operate in the United States.

The Department only will authorize operations of foreign-registered UAS in the United States if it determines that such operations are recognized under international agreements or via findings of reciprocity, consistent with the statutory obligations under section 41703, and via the process as described below. The notion of reciprocity has a long-standing tradition in international relations and has been used in the realm of specialty air services for years. While there are many types of specialty air operations authorized under free trade agreements, it has been the long-standing policy of DOT to require a finding of reciprocity before allowing foreign-owned specialty air services to operate in the United States, even when the United States has no obligation under a trade agreement. The Department also will continue to review whether existing international agreements address the operation of UAS, and if not, what negotiations will need to occur to address these operations in the future.

With respect to the supply of specialty air services in the United States by foreign-owned or controlled entities, DOT may allow these operations to occur provided that the UAS are registered and the owners have provided proof of reciprocity by their homeland of the ability for U.S. investment in UAS operations. Additional conditions may be imposed as necessary to satisfy the statutory requirements of section 41703.

The FAA notes that, initially, all airmen operating under part 107 will be required to obtain a remote pilot certificate. Currently, ICAO has not adopted standards for the certification of pilots of unmanned aircraft that the FAA could rely on in determining whether it is obligated under international law to recognize a foreign-issued UAS-specific airman certificate. However, once an ICAO standard has been developed, this rule will allow the FAA to determine whether a foreign-issued UAS-specific airman certificate was issued under standards that meet or exceed the international standards, and therefore must be recognized by the FAA for purposes of operating a foreign-registered aircraft within the United States.

The FAA also notes that remote pilots of foreign-registered aircraft will need to comply with any applicable requirements imposed by their country of registration that do not conflict with part 107. For example, while part 107 will not require airworthiness

[50] 80 FR 78594, Dec. 16, 2015.

[51] *See also* 14 CFR part 375, Navigation of Foreign Civil Aircraft in the United States.

certification, the small unmanned aircraft will need to obtain airworthiness certification if required to do so by its country of registration.

3. Public Aircraft Operations

The FAA is not making any changes to the final rule regarding public aircraft operations because this rule applies to civil aircraft operations only. In the NPRM, the FAA explained that this rulemaking would not apply to ''public aircraft operations with small UAS that are not operated as civil aircraft. This is because public aircraft operations, such as those conducted by the Department of Defense, the National Aeronautics and Space Administration (NASA), Department of Homeland Security (DHS) and NOAA, are not required to comply with civil airworthiness or airman certification requirements to conduct operations. However, these operations are subject to the airspace and air-traffic rules of part 91, which include the 'see and avoid' requirement of § 91.113(b).'' [52] The proposed rule did point out, however, that it ''would provide public aircraft operations with greater flexibility by giving them the option to declare an operation to be a civil operation and comply with the provisions of proposed part 107 instead of seeking a COA from the FAA.'' [53]

DJI generally supported the FAA's approach to small UAS public aircraft operations. The Nez Perce Tribe—which also supported the proposal to give public aircraft operations the option to declare an operation to be a civil operation and comply with the provisions to proposed part 107—asserted that the proper statutory interpretation of ''public aircraft'' includes federally recognized Indian tribes. Conversely, NAAA stated that public aircraft operations should continue to be conducted under the COA process.

One individual said proposed § 107.11 should be amended to indicate that public agencies may choose to voluntarily operate under part 107. The City of Arlington, Texas requested the ability to follow the small UAS rules, not the COA process. Aerial Services, Inc. also said that public entities should be allowed to operate like commercial operators, but only for research and instructional purposes.

Under this rule, a public aircraft operation can continue to operate under a COA or can voluntarily operate as a civil aircraft in compliance with part 107. As stated in the NPRM, this rule will not apply to public aircraft operations of small UAS that are not operated as civil aircraft. These operations must continue to comply with the FAA's existing requirement to obtain a COA providing the public aircraft operation with a waiver from certain part 91 requirements such as the ''see and avoid'' requirement of § 91.113(b).

However, this rule will provide greater flexibility to public aircraft operations because it allows small UAS public aircraft operations to voluntarily opt into the part 107 framework. In other words, a remote pilot may elect to operate his or her small UAS as a civil rather than a public aircraft and comply with part 107 requirements instead of obtaining a COA. With regard to Nez Perce's assertion that aircraft operated by federally recognized Indian tribes are public aircraft, that issue is beyond the scope of this rule.

The FAA also disagrees with NAAA's comment that public aircraft operations should all be required to obtain a COA. As discussed in III.J.1 of this preamble, the FAA has found that small UAS operations conducted within the parameters of part 107 will not create a hazard to users of the NAS or pose a threat to national security. Consequently, there will be no adverse safety or security impact by the FAA providing public entities with an option to conduct their small UAS operations under part 107.

NASA stated that the proposed rule should be written to specifically authorize NASA small UAS use without a COA because ''it is incorrect to infer that NASA's high aviation certification standards do not meet the rigors of civil standards.'' NASA asserted that the proposed rule conflicts with statutory authority and does not align with the current FAA/NASA memorandum of agreement for the operation of small UAS.

The Department of Defense Policy Board on Federal Aviation (DOD) also supported operations without a COA, ''commensurate with civil provisions.'' DOD suggested several changes to language in the preamble regarding the option for government entities to conduct a civil UAS operation under part 107. DOD argued that ''public operator statutory authorities'' need to be preserved and the regulation needs to ''enable operations without a COA commensurate with civil provisions.''

To that end, DOD stated that the FAA should clarify that public agencies currently operating under memoranda of agreement or understanding will be authorized to continue operating in that manner even where provisions of part 107 are more restrictive in nature. DOD also asked that the FAA explicitly exclude aircraft operating under a COA from the applicability of part 107. Finally, DOD recommended that the FAA further amend § 107.1 to clarify that part 107 does not apply to aircraft operated by or for the National Defense Forces of the United States, but could be used as an alternative means of compliance.

These comments are largely beyond the scope of the proposed rulemaking. The proposed rule addressed only civil small UAS operations. As stated above, the NPRM would enable remote pilots of public aircraft to opt into the civil framework for small UAS operations, but does not address public aircraft operations beyond that. In response to NASA, the FAA points out that under this rule, NASA may operate small UAS without a COA as long as it complies with part 107. With regard to DOD's suggestions, there is no need to amend part 107 because § 107.1 expressly limits the applicability of part 107 to civil small UAS. After the effective date of this rule, the FAA does not anticipate issuing a public aircraft operations COA that is less flexible than the regulations promulgated in this rule, provided that all the circumstances are identical to that available to a civil operator.

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and Tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $155.0 million in lieu of $100 million. One commenter suggested that the FAA should designate a special status for public UAS operating in a civil capacity that exempts them from visual-line-of-sight and daylight-only operation limitations. However, this is unnecessary because public aircraft operations are not required to be conducted as civil aircraft subject to part 107. Thus, a public aircraft operation that does not wish to comply with part 107 can operate under the existing public-aircraft framework rather than under part 107.

Agreeing that the proposed rules should not apply to small UAS operations by DOD, NASA, NOAA, DHS or FAA, one individual stated that the proposed rule should apply to ''second and third tier public agencies not directly tied to constant aeronautical activities, testing and research.'' Two

[52] NPRM, 80 FR at 9554.

[53] NPRM, 80 FR at 9554–9555.

other individuals stated that any commercial rules for small UAS should apply to both private and public sectors.

This rule will allow any public agency, regardless of the ''tier'' of operations, to choose to operate a small UAS as a civil aircraft under part 107.

The Association for Unmanned Vehicle Systems International (AUVSI) recommended that the FAA modify the current limitation in § 107.11 concerning ''civil'' aircraft to include ''public aircraft'' as well. This is necessary, AUVSI asserted, because some current operation rules for manned aircraft (such as those found in part 91) apply to both ''public aircraft'' and ''civil aircraft.''

The FAA disagrees. This rulemaking applies to civil aircraft only. Expanding its application to public aircraft is beyond the scope of the proposed rule.

The Next Gen Air Transportation Program at North Carolina State University indicated that proposed § 107.3 needs a definition of ''civil operation.'' The commenter asked how a public agency declares a civil operation. The commenter also implied that part 107 does not make clear that there would be no adverse safety effects from allowing public aircraft operations under part 107.

Twelve members of the Wisconsin Legislature signed a joint letter stating that ''[t]he NPRM states public entities must get a Certificate of Waiver or Authorization because they are not 'exempt' from restrictions in the proposed rules. However, the proposed rules allow public entities to 'declare an operation to be a civil operation' and therefore operate commercially and be exempted from flight restrictions.'' The members also stated that the FAA has not ''promulgated, clarified or made public its rules, policies, and legal opinions on public versus commercial UAS.''

The Wisconsin Society of Land Surveyors stated that ''government agencies have been getting a head start on the market, at the expense of the private sector, by obtaining certificates to perform UAS services that are commercial in nature,'' and ''[a]s a result, government and universities are conducting operational missions, developing markets and cultivating clients.'' This commenter concluded that there ''should not be unfair competitive advantages granted to government or university UAS vis-à-vis the private sector.''

These comments reflect some misunderstanding of public aircraft operations in general and the FAA's role in such operations. The authority to conduct a public aircraft operation is determined by statute (49 U.S.C. 40102(a)(41) and 40125). The FAA has no authority to prohibit a qualified government entity from conducting public aircraft operations, manned or unmanned. Consequently, many of the FAA's regulations, such as aircraft certification and pilot requirements, do not apply to public aircraft operations. Some of the general operating rules apply to all aircraft operations, public aircraft and civil, and that is where the need for COAs affects public aircraft operations of UAS. For example, all aircraft must comply with 14 CFR 91.113, and UAS require a conditional waiver of that regulation in order to operate in the NAS; the conditions are specified in the COA.

Qualified governmental entities may choose to operate a public aircraft operation as long as they do so within the limits of the public aircraft statute. Under this rule, they may choose to operate their UAS as a civil aircraft instead, and operate under the civil regulations. Government entities have always had the option to do this with their manned aircraft; in some cases, government entities may be required to operate under civil regulations if their operations do not comply with the public aircraft statute. The new UAS regulations do not change this option or the requirements of the public aircraft statute.

''Civil aircraft'' is already a defined term in 14 CFR 1.1, which defines a civil aircraft as an aircraft that is not a public aircraft. The definition of public aircraft in part 1 is a restatement of the requirements in the public aircraft statute sections cited above. Government entities that qualify to conduct public aircraft operations but choose to operate instead under civil rules must comply with the same requirements as civil entities; no special notice is required. If an operation is commercial, it is civil by definition, but not all civil operations are commercial. Operations for a commercial purpose are prohibited by the public aircraft statute. The public aircraft statute requires that public aircraft operations have a governmental function and not have a commercial purpose. In short, a government entity may choose to conduct a public aircraft operation within the restrictions of the public aircraft statute (and certain civil regulations applicable to all aircraft operating in the NAS), or it may choose to conduct a civil operation and comply with the requirements of the applicable regulations in 14 CFR.

Under the definitions in 49 U.S.C. 40102(a)(41), a university may qualify to conduct a public aircraft operation if it meets the statutory criteria as a part of the government of the State or a political subdivision of the state. A determination of whether a public university meets these criteria is made by individual states. Operations of aircraft by these universities are subject to the same requirements as other public aircraft operations. The ability to conduct a public aircraft operation is determined by statute and cannot be changed by the FAA. The FAA has not given an ''unfair competitive advantage'' or showed favoritism to any entity by declaring their operations public aircraft operations because it has no authority to do otherwise under the statute. The FAA does review the operations submitted by UAS proponents to ensure that, as described, they meet the requirements of the public aircraft statute.

The FAA has made public its policies and opinions on all public aircraft matters, manned and unmanned. The FAA has also published Advisory Circular 00–1.1A, *Public Aircraft Operations,* dated February 12, 2014. That document is available on the FAA Web site. Matters of legal interpretation that have been presented to the FAA for its opinion are available as part of the FAA Office of the Chief Counsel's interpretation database.[54]

4. Model Aircraft

The NPRM proposed that part 107 would not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112–95. Section 336(c) defines a model aircraft as an ''unmanned aircraft that is—(1) capable of sustained flight in the atmosphere; (2) flown within visual line of sight of the person operating the aircraft; and (3) flown for hobby or recreational purposes.'' Subsection 336(a) specifically prohibits the FAA from promulgating rules regarding model aircraft that meet all of the following statutory criteria:

- The aircraft is flown strictly for hobby or recreational use;
- The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;
- The aircraft is limited to not more than 55 pounds unless otherwise certificated through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;

[54] *http://www.faa.gov/about/office_org/headquarters_offices/agc/pol_adjudication/agc200/Interpretations/.*

• The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and

• When flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport) with prior notice of the operation.

Because of the statutory prohibition on FAA rulemaking regarding model aircraft that meet the above criteria, the NPRM proposed that model aircraft meeting these criteria would not be subject to the provisions of part 107. However, although section 336(a) exempts certain model aircraft from FAA rulemaking, section 336(b) explicitly states that the exemption in section 336(a) does not limit the FAA's authority to pursue enforcement action against those model aircraft that ''endanger the safety of the national airspace system.'' The FAA proposed to codify this authority in part 101 by prohibiting a person operating a model aircraft from endangering the safety of the NAS.

The FAA received approximately 2,850 comments on the model-aircraft aspect of the NPRM. Many of these commenters, including NAMIC, Horizon Hobby, LLC (Horizon Hobby), Skyview Strategies, Inc. (Skyview Strategies), the Academy of Model Aeronautics (AMA) and many individuals, supported excluding model aircraft operations from the provisions of part 107. DJI, Aviation Management, and UAS America Fund, LLC (UAS America Fund) recommended that the FAA expand the model-aircraft exception from the requirements of part 107 and adopt more lenient regulatory standards for recreational uses of small UAS that do not comply with all of the criteria specified in section 336. UAS America Fund suggested that the final rule make a special allowance for small UAS operations that do not meet all of the criteria of section 336(a) but are conducted for educational or other salutary purposes.

Conversely, NAAA, the Transportation Trades Department AFL–CIO (TTD), A4A, the American Chemistry Council, the Information Technology and Innovation Foundation, the Southwest Airlines Pilots' Association (SWAPA) and a number of individual commenters advocated for greater regulation and oversight of all model aircraft operations. Many of these commenters felt that the risks associated with recreational and non-recreational UAS operations are the same, and thus, there should be no difference in how these operations are regulated. A number of commenters also expressed concern that recreational and hobby use of UAS could pose a significant safety hazard and that additional regulations should be imposed to mitigate this hazard. For example, NAAA asserted that ''[t]he majority of UAS incidents that occurred in recent years have been by UAS operated as model aircraft . . . including two in 2014 where [agricultural] operators were harassed by model aircraft in Idaho and Illinois.'' Green Vegans argued that failure to regulate model aircraft operations may have an adverse impact on the environment.

Section 336 of Public Law 112–95 specifically prohibits the FAA from issuing any new rules with regard to model aircraft that satisfy the statutory criteria specified in that section. Accordingly, the FAA cannot impose additional regulations on model aircraft that meet the criteria of section 336 nor can the FAA make those aircraft subject to the provisions of part 107.

However, with regard to the request that the FAA apply the terms of section 336 to other operations, the FAA agrees with NAAA, TTD, A4A and other commenters who pointed out that, from a safety point of view, there is no difference between the risk posed by recreational operations, operations used for salutary purposes, and non-recreational/non-salutary operations. There is no data indicating that a small UAS operation whose operational parameters raise the safety risks addressed by part 107 would become safer simply as a result of being conducted for recreational or salutary purposes rather than commercial purposes. As such, the FAA declines the request to apply the terms of section 336 beyond the statutory criteria specified in that section.

The Air Line Pilots Association, International (ALPA) and the Kansas State University Unmanned Aircraft Systems Program (Kansas State University UAS Program) stated that if model aircraft operations are being added to part 101, then the title of part 101 should be changed to reflect that part 101 now encompasses those operations. AMA, Horizon Hobby, Skyview Strategies, and numerous individuals noted that the statutory text of section 336 also applies to ''aircraft being developed as model aircraft,'' and these commenters asked the FAA to add the pertinent statutory text to the model-aircraft provisions of part 101.

As the commenters pointed out, the statutory language of section 336 applies not just to aircraft that are operated as model aircraft but also to ''aircraft being developed as a model aircraft.'' [55] Accordingly, the FAA has added this statutory language to the regulatory text of § 101.41. The FAA also agrees with ALPA and the Kansas State University UAS Program and has updated the title of part 101 to indicate that this part will now include model aircraft operations that are operated under section 336.

AMA and a number of individual commenters supported the proposed inclusion of the section 336 criterion concerning nationwide community-based organizations into the regulatory text of part 101. A number of other commenters raised concerns about having to comply with safety guidelines issued by a community-based organization and having to operate within the programming of such an organization. The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative stated that the FAA should demonstrate the efficacy of using community-based safety guidelines to regulate model aircraft operations prior to using such an approach. DJI and the Stadium Managers Association, Inc. stated that it is unclear what makes an organization a nationwide community-based organization within the meaning of section 336. DJI went on to ask the FAA to provide guidance as to what criteria the agency will look for in recognizing a nationwide community-based organization. The Washington Aviation Group and Green Vegans suggested that the FAA identify, or seek comments to identify, a single set of community-based safety guidelines and incorporate those guidelines by reference into proposed part 101 and make them available on the FAA's Web site.

Section 336 of Public Law 112–95 includes a specific list of criteria that must be satisfied in order for the section 336 exception to apply. One of these criteria is that ''the [model] aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization.'' [56] Because compliance with a community-based set of safety guidelines and operating within the programming of a nationwide community-based organization is one of the statutory criteria that must be satisfied in order for section 336 to apply, the FAA has retained this provision.

The FAA notes, however, that those model aircraft operations that do not wish to comply with a community-based set of safety guidelines and

[55] Public Law 112–95, sec. 336(a).

[56] Public Law 112–95, sec. 336(a)(2).

operate within the programming of a nationwide community-based organization will be able to simply conduct their operations under part 107. Part 107 was designed to impose the minimal burden necessary to ensure the safety and security of a small UAS operation. As discussed in the Regulatory Impact Assessment that accompanies this rule, the out-of-pocket cost for someone who wishes to operate under part 107 will be less than $200.

With regard to comments asking for additional clarity as to what makes an organization a nationwide community-based organization under section 336, the FAA notes that this issue is beyond the scope of this rule. The FAA is currently engaged in a separate regulatory action titled *Interpretation of the Special Rule for Model Aircraft,*[57] (Interpretive Rule) in which the FAA is interpreting the statutory provisions of section 336 and explaining how those provisions apply to model aircraft operations. The FAA published this interpretation for public comment in June 2014 and has since received over 33,000 public comments. The FAA is currently considering the issues raised by these commenters and will issue a final Interpretive Rule that reflects its consideration of the comments.

Because the FAA is considering the specific meaning of section 336 provisions in a separate regulatory action, in order to avoid duplication, the FAA limited the scope of the model-aircraft component of this rulemaking simply to codifying the FAA's enforcement authority over model-aircraft operations that endanger the safety of the NAS. As such, issues concerning the specific meaning of section 336 (such as what makes an organization a nationwide community-based organization) are beyond the scope of this rule.

With regard to Washington Aviation Group and Green Vegans' suggestions that the FAA codify a single set of community-based safety guidelines and incorporate those guidelines by reference into part 101, the FAA notes that this suggestion is also beyond the scope of this rule. However, even if the scope of this rule was broad enough to reach this issue, the language of section 336(a)(2) is not limited to a single set of community-based safety guidelines, nor is it limited to community-based safety guidelines that exist today. Accordingly, the FAA cannot incorporate a single definitive set of safety guidelines into the regulatory text of part 101.

The NextGen Air Transportation Program at NC State University stated that § 101.41 should be amended to include a requirement to operate at locations approved by a nationwide community-based organization. Another commenter suggested that the FAA clarify that the programming of nationwide community-based organizations is interpreted to include location. Colorado Ski Country USA said the FAA should add a provision that prohibits recreational UAS operations within the airspace above ''Places of Public Accommodation'' without prior approval from the Place of Public Accommodation.

As discussed previously, the scope of the model-aircraft component of this rulemaking is limited simply to codifying the FAA's enforcement authority over model-aircraft operations that endanger the safety of the NAS. Accordingly, these suggestions are beyond the scope of this rule.

A number of commenters, including ALPA, NAAA, and the International Air Transport Association, supported the FAA's proposal to codify a prohibition on model aircraft operations endangering the safety of the NAS. NAAA emphasized that the FAA should ''continue to utilize every tool possible to ensure model aircraft are operating safely in the NAS.''

The Small UAV Coalition, the Airports Council International—North America, and the American Association of Airport Executives asked the FAA to clarify what actions would endanger the safety of the NAS. AMA argued that enforcement of the ''endangering the safety of the NAS'' provision should not affect other airman certificates that may be held by a model aircraft operator. AMA and several other commenters also argued that the FAA is not permitted to oversee general safety issues involving model aircraft. These commenters suggested narrowing the ''endangering the safety of the NAS'' provision to make it analogous to 14 CFR 91.11, which prohibits interference with a crewmember.

Subsection 336(b) explicitly states that the FAA has authority to pursue enforcement action ''against persons operating model aircraft who endanger the safety of the national airspace system.'' Because the scope of the FAA's enforcement authority is explicitly specified in section 336(b), the FAA has decided to finalize the proposed prohibition on model aircraft operators endangering the safety of the NAS. To do otherwise and artificially narrow the FAA's statutory enforcement authority over section 336 operations would be contrary to Congressional intent because Congress has explicitly specified, in section 336(b), the scope of the FAA's enforcement authority over model aircraft operations.

With regard to examples of actions that may endanger the safety of the NAS, the FAA notes that this is an issue that is being addressed by the Interpretive Rule.[58] Because the issues addressed by the Interpretive Rule have been subject to extensive public input (33,000 plus comments) and because addressing those issues here would be duplicative, the FAA will defer discussion of what qualifies as endangering the safety of the NAS to the Interpretive Rule. Finally, with regard to AMA's suggestion that enforcement of the ''endangering the safety of the NAS'' provision should not affect other airman certificates that may be held by a model aircraft pilot, the FAA notes that determination of the remedy that it may seek in specific enforcement cases is beyond the scope of this rulemaking.

Many commenters, including Skyview Strategies, AMA, the Experimental Aircraft Association, and numerous individuals, reiterated arguments that were raised in the comments filed on the Interpretive Rule. These commenters restated arguments such as: (1) Considering model aircraft to be ''aircraft'' would effectively make those aircraft subject to manned-aircraft regulations; (2) the Interpretive Rule interprets the phrase ''hobby or recreational use'' too narrowly; (3) the Interpretive Rule does not properly interpret Congressional intent; (4) model aircraft operations should not be subject to any airspace restrictions; (5) requiring notification when operating within 5 miles of an airport is too burdensome; and (6) the interpretation of ''visual line of sight'' within the Interpretive Rule would prohibit the use of first-person-view devices. AMA and the Small UAV Coalition argued that the FAA must address and adjudicate the 33,000 plus comments that were made on the Interpretive Rule and resolve the issues and concerns presented before moving forward in finalizing the small UAS Rule.

Because these are all issues that have been commented on (in much greater detail) and are currently being considered as part of the Interpretive Rule, considering these issues in this rule would be duplicative. Accordingly, the FAA declines to address these issues here as they are currently the subject of a separate regulatory action.

The FAA also declines the suggestion that it issue the final Interpretive Rule prior to finalizing this rule. The FAA is currently working as quickly as possible to issue the final Interpretive Rule.

[57] 79 FR 36172, June 25, 2014.

[58] *See, e.g.,* 79 FR at 36175–76.

Because the model-aircraft component of this rulemaking simply codifies the FAA's statutory authority over section 336 operations and because delaying this rulemaking would prejudice non-model small UAS operations, the FAA declines to withhold this rule until issuance of the final Interpretive Rule.

AMA and Horizon Hobby asked the FAA to add regulatory text that would exempt model aircraft operations and aircraft being developed as model aircraft from the regulatory provisions of parts 21, 43, 45, 47, 61, and 91. These commenters also noted the revision that the NPRM proposed to make in § 91.1(e) and expressed concern that this revision may make model aircraft subject to the provisions of part 91. Skyview Strategies asked the FAA to rewrite the guidance that it recently issued to law enforcement agencies concerning model aircraft that may be operated unsafely.

As discussed previously, the proposed rule was limited simply to codifying the FAA's statutory enforcement authority over model aircraft operations. Because the FAA did not propose making any changes to its existing regulations with regard to section 336 operations, those changes are beyond the scope of this rulemaking. Similarly, the FAA did not propose to make any changes to its existing enforcement guidance as part of this rulemaking, and those changes are also beyond the scope of this rule.

With regard to the revision that the NPRM proposed in § 91.1(e), this revision does not expand the scope of part 91. Specifically, the NPRM proposed to move the regulatory text concerning existing exceptions to part 91 applicability for moored balloons, kites, unmanned rockets, and unmanned free balloons into a newly created subsection (§ 91.1(e)). The NPRM then proposed to add an extra exception (also in § 91.1(e)) to part 91 applicability for small UAS operations governed by part 107, because the purpose of this rulemaking is, in part, for the regulations of part 107 to replace the regulations of part 91 as the governing regulations for small UAS operations. Because this additional exception for part 107 operations is the only substantive change that the NPRM proposed to the applicability of part 91, finalizing this exception would not expand the scope of part 91. Accordingly, this rule will finalize § 91.1(e) as proposed in the NPRM.

Two commenters disagreed with one aspect of the proposed definition of model aircraft, namely that the aircraft must be capable of sustained flight in the atmosphere. These commenters argued that the proposed requirement was more burdensome than requirements imposed on some manned aircraft operations. However, section 336(c)(1) specifically defines a ''model aircraft'' in pertinent part as an aircraft that is ''capable of sustained flight in the atmosphere.'' Because the definition of ''model aircraft'' is specified in statute, this rule will finalize the statutory definition in the regulatory text of part 101.

The Aircraft Owners and Pilots Association (AOPA) and The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative suggested that the FAA take additional steps to issue clear and definitive guidance for recreational operators and to encourage manufacturers to include information on this FAA guidance in their packaging materials. AOPA further stated that the FAA should work with AOPA and remote control aircraft groups ''to conduct education outreach, and publish guidance to help pilots file timely reports of reckless UAS operations.''

The FAA agrees with AOPA and The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative that guidance and education would greatly assist model aircraft operators. To that end, the FAA has partnered with AMA, AUVSI, AOPA and the Small UAV Coalition on an education campaign titled ''Know Before You Fly,'' which is designed to educate prospective users about the safe and responsible operation of model aircraft.[59] As pointed out by the commenters, education and outreach efforts will enhance the safety of the model aircraft community and, just like it did with the ''Know Before You Fly'' campaign, the FAA will consider partnering with interested stakeholders in future education and outreach efforts.

The FAA is also currently taking the steps suggested by AOPA and The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative to issue clear and definitive guidance for recreational operators. Specifically, the FAA is working on drafting and issuing a final Interpretive Rule that addresses the issues raised by commenters. The agency has also issued an updated AC 91–57A, which is the main advisory circular for model aircraft operations.

5. Moored Balloons, Kites, Amateur Rockets, and Unmanned Free Balloons

Moored balloons, kites, amateur rockets, and unmanned free balloons are currently regulated by the provisions of 14 CFR part 101. Because they are already incorporated into the NAS through part 101, the NPRM proposed to exclude them from the provisions of part 107. The FAA did not receive any comments objecting to this aspect of the NPRM and, as such, this rule will, as proposed, exclude part 101 operations from the applicability of part 107.

The FAA did, however, receive several comments asking for clarification as to which types of operation are subject to part 101. The NextGen Air Transportation Program at NC State University and three individuals asked whether tethered powered unmanned aircraft meet the definition of unmanned free balloons and kites, which are subject to part 101.

FAA regulations define a balloon as ''a lighter-than-air aircraft that is not engine driven, and that sustains flight through the use of either gas buoyancy or an airborne heater.'' [60] A kite is defined as ''a framework, covered with paper, cloth, metal, or other material, intended to be flown at the end of a rope or cable, and having as its only support the force of the wind moving past its surfaces.'' [61] Based on these definitions, a small unmanned aircraft that uses powered systems for actions such as propulsion or steering is not a balloon or kite subject to part 101.[62]

A commenter asked whether unmanned moored airships and blimps are subject to part 101. In response, the FAA notes that an airship is defined as ''an engine-driven lighter-than-air aircraft that can be steered.'' [63] Conversely, as discussed previously, the definition of ''balloon'' excludes aircraft that are engine-driven. Because an airship is not a balloon or kite, a moored unmanned airship is not encompassed by part 101. With regard to blimps, an engine-driven blimp would be considered an airship, which is not subject to part 101.

6. Current Treatment of UAS and Grandfathering of Section 333 Exemption Holders

The FAA currently accommodates non-recreational small UAS use through various mechanisms, such as special airworthiness certificates, exemptions, and COAs. However, the FAA recognizes that many holders of

[59] *http://knowbeforeyoufly.org/*.

[60] 14 CFR 1.1 (definition of ''balloon'').

[61] *Id.* (definition of ''kite'').

[62] Additional information can be found in FAA Order 7210.3, Chapter 18, Section 5, Moored Balloons, Kites, Unmanned Rockets, and Unmanned Free Balloons/Objects, *http://www.faa.gov/documentLibrary/media/Order/7210.3Z.pdf*; and FAA Order 7110.65, Chapter 9, Section 6, Unmanned Free Balloons, *http://www.faa.gov/documentLibrary/media/Order/ATC.pdf*.

[63] 14 CFR 1.1 (definition of ''airship'').

exemptions issued under section 333 of Public Law 112–95 (section 333 exemptions) may wish to take advantage of part 107 when it goes into effect. On the other hand, some section 333 exemption holders may prefer to continue operating under the terms and conditions of their exemptions. Therefore, the FAA will allow any section 333 exemption holder to either continue operating under the terms and conditions of the exemption until its expiration, or conduct operations under part 107 as long as the operation falls under part 107.

Approximately 40 commenters criticized the framework currently regulating small UAS operations as slow, cumbersome, and inefficient. These commenters expressed concern that the current framework is having an adverse effect on UAS development in the United States.

The FAA anticipates that this rulemaking will alleviate many of the concerns commenters raised with the existing UAS framework. Under this rule, many operations that would previously require exemptions and COAs will now fall under the purview of part 107, which generally does not require an exemption or a COA prior to operation.

Some commenters, including the American Petroleum Institute and the Consumer Electronics Association (CEA), encouraged the FAA to acknowledge that existing permitted commercial uses of small UAS are unaffected by the rule. The American Petroleum Institute stated that such acknowledgement is necessary to avoid unintended consequences and preserve the expectation and business interests of current authorization holders.

CEA stated that the FAA should either grandfather-in existing exemptions or afford existing exemptions a 3-year transition period in recognition of the hard work and expense each exemption represents. The commenter further recommended that, if the FAA chose a 3-year transition period, and if no renewal was sought, then the exemption would terminate 3 years after the new rules became effective. However, if a petitioner sought renewal of the exemption, the commenter recommended that the exemption remain valid until final action by the FAA on the renewal application. CEA noted that, to the extent that the new rules are more permissive than existing exemptions, operators should be permitted to rescind their exemption and operate under the new rules.

The FAA clarifies that current section 333 exemptions that apply to small UAS are excluded from part 107. The FAA has already considered each of these individual operations when it considered their section 333 exemption requests and concluded that these operations do not pose a safety or national security risk.

The FAA recognizes, however, that there may be certain instances where part 107 is less restrictive than a section 333 exemption. Therefore, under this rule, a section 333 exemption holder may choose to operate in accordance with part 107 instead of operating under the section 333 exemption. This approach will provide section 333 exemption holders time to obtain a remote pilot certificate and transition to part 107. Operations that would not otherwise fall under part 107 may not take advantage of this option. For example, an operation with a section 333 exemption that does not fall under part 107, such as an operation of a UAS weighing more than 55 pounds, would not have the option of operating in accordance with part 107 rather than with its section 333 exemption.

Additionally, when section 333 exemptions come up for renewal, the FAA will consider whether renewal is necessary for those exemptions whose operations are within the operational scope of part 107, which also includes those operations that qualify for a waiver under part 107. The purpose of part 107 is to continue the FAA's process of integrating UAS into the NAS. If a section 333 exemption is within the operational scope of part 107, there may be no need for the agency to renew an exemption under section 333. Because the FAA's renewal considerations will be tied to the outstanding section 333 exemptions' expiration dates, a 3-year transition period is not necessary. This will not affect those section 333 exemptions that are outside of the operational scope of part 107 or where a part 107 waiver would not be considered.

Future exemptions may be issued to provisions of part 107 that do not allow for a waiver. These exemptions may also be issued pursuant to section 333. Small UAS remote pilots holding an exemption for a provision contained in part 107 will not be excluded from the other part 107 requirements if the exemption specifies that part 107 provisions that are not waived or exempted still apply.

A commenter asked whether there will be a grace period for individuals already operating small UAS to comply with the requirements of part 107, or whether those individuals will be required to stop operating until they can complete those requirements.

As stated above, a person currently operating under a section 333 exemption will not need to immediately comply with part 107. Additionally, a person currently operating on the basis of a part 61 pilot certificate other than student pilot would, as discussed below, be eligible to obtain a temporary remote pilot certificate upon satisfying the prerequisites specified in this rule. The temporary remote pilot certificate will authorize its holder to operate under part 107.

D. Definitions

The NPRM proposed to define several terms in part 107 including: (1) Control station; (2) corrective lenses; (3) unmanned aircraft; (4) small unmanned aircraft; and (5) small unmanned aircraft system (small UAS).[64]

1. Control Station

The NPRM proposed to define a control station as ''an interface used by the operator to control the flight path of the small unmanned aircraft.'' The NPRM explained that, unlike a manned aircraft, the interface that is used to control the flight path of a small unmanned aircraft remains outside of the aircraft. The proposed definition was intended to clarify the interface that is considered part of a small UAS under part 107.

NAAA and another commenter agreed with the proposed definition. Transport Canada asked the FAA to consider refining this definition by adding a definition of ''control link'' to distinguish between command and control functions and communication functions. One commenter asserted that the proposed definition does not encompass instances in which a small UAS's flight path is preprogrammed via waypoints, and the interface used by the remote pilot is intended simply to commence execution of the program.

The link between the ground control station and the small unmanned aircraft is commonly referred to as the ''command and control link'' or ''C2.'' When a communication link between the remote pilot and another person, such as a visual observer or an air traffic controller, is added to C2, it is referred to as ''command, control and communications'' or ''C3.'' C2 is an inherent requirement for safe operations, even if the small unmanned aircraft flight is completely autonomous (*i.e.,* preprogrammed flight operations without further input from the remote pilot) because the remote pilot must be

[64] The FAA also proposed to create two new crewmember positions: (1) Operator; and (2) visual observer. Those positions are discussed in sections III.E.1 and III.E.2.b of this preamble.

able to take direct command of the flight in order to exercise his/her responsibility for collision avoidance, yielding right of way to other aircraft, etc. C3, on the other hand, is only needed if the remote pilot is using the ground control station to communicate with another person directly involved in the operation, such as a visual observer. Because this rule does not require multi-person operations, the definition of a ground control station will not include the requirement for a communications link.

Furthermore, as technology advances, the concept and use of C2 and C3 could change significantly. Omitting a rigid regulatory definition of these terms in this rule will allow them to evolve as technology changes.

2. Corrective Lenses

In connection with the visual-line-of-sight requirements in the NPRM, the FAA proposed to define the term ''corrective lenses'' as ''spectacles or contact lenses.'' The FAA explained that, unlike other vision-enhancing devices, spectacles and contact lenses do not restrict a user's peripheral vision, and thus could be used to satisfy the visual-line-of-sight requirements proposed in the NPRM. The FAA did not receive any adverse comments on this proposed definition, and thus finalizes the proposed definition of ''corrective lenses'' in this rule without change.

3. Unmanned Aircraft

The NPRM proposed to define ''unmanned aircraft'' as ''an aircraft operated without the possibility of direct human intervention from within or on the aircraft.'' This proposed definition would codify the statutory definition of ''unmanned aircraft'' specified in Public Law 112–95, section 331(8).

MAPPS stated that the definition of ''unmanned aircraft'' needs to be clarified because the current definition leaves open the possibility that paper airplanes, model airplanes, model rockets, and toys could be considered unmanned aircraft. The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative stated that this definition and the definition of small unmanned aircraft may permit infant passengers and asked the FAA to amend the definition to categorically prohibit the carriage of passengers on an unmanned aircraft.

The definition of unmanned aircraft as ''an aircraft operated without the possibility of direct human intervention from within or on the aircraft'' is a statutory definition and, as such, this rule will finalize that definition as proposed. In response to MAPPS' comment, as discussed in section III.C.5 of this preamble, part 107 will not apply to operations governed by part 101. Those operations include model aircraft, moored balloons, kites, amateur rockets, and unmanned free balloons. With regard to carriage of infants on small unmanned aircraft, this concern is addressed by other provisions in this rule that prohibit careless or reckless operations that endanger the life of another person.

4. Small Unmanned Aircraft

The NPRM proposed to define ''small unmanned aircraft'' as ''an unmanned aircraft weighing less than 55 pounds including everything that is on board the aircraft.'' The NPRM noted that Public Law 112–95, section 331(6) defines a small unmanned aircraft as ''an unmanned aircraft weighing less than 55 pounds.'' However, the NPRM pointed out that this statutory definition does not specify whether the 55-pound weight limit refers to the total weight of the aircraft at the time of takeoff (which would encompass the weight of the aircraft and any payload on board) or simply the weight of an empty aircraft. The NPRM proposed to define small unmanned aircraft using total takeoff weight because: (1) Heavier aircraft generally pose greater amounts of public risk in the event of an accident, because they can do more damage to people and property on the ground; and (2) this approach would be similar to the approach that the FAA has taken with other aircraft, such as large aircraft, light-sport aircraft, and small aircraft.

Commenters including AOPA, ALPA, and the Helicopter Association International, supported the proposed definition. The New England Chapter of the Association of Unmanned Vehicles International and Devens IOP, commenting jointly, pointed out that there are commercial applications being developed that will need to exceed 55 pounds. Event 38 Unmanned Systems stated that rather than segregate small unmanned aircraft by total weight, the FAA should use a ''kinetic energy split'' that combines weight and speed.

Several commenters asked that the 55-pound weight limit be lowered. Event 38 Unmanned Systems recommended an initial weight restriction of 10 pounds, with adjustments based on subsequent research. Prioria Robotics, Inc. stated that the weight limitation for small unmanned aircraft should be less than 25 pounds, and that the definition should include a requirement that the aircraft be ''hand-launchable.'' Another commenter asked for the weight limit to be reduced to 33 pounds.

Green Vegans stated that FAA must provide test data on the collision impact of a 55-pound UAS, traveling at various speeds, on both humans and birds. The advocacy group argued that the public cannot make informed comments on the proposed weight limitation without such data. The advocacy group also noted that such data would be provided by a National Environmental Policy Act (NEPA) Environmental Impact Statement, which the group stated the FAA must do. Crew Systems similarly opposed the maximum weight limitation, arguing that FAA provided no justification for it. The company asserted that a 55-pound UAS is large enough to be hazardous when operated in an urban environment, even if care is taken. Although it did not expressly object to the weight limitation, the United States Ultralight Association also expressed concern about the significant damage that a 50-plus-pound unmanned aircraft could do to light, open-cockpit aircraft.

Other commenters asked the FAA to increase the 55-pound weight limit. Consumers Energy Company objected to the definition's proposed weight limitation as too light, arguing that a 55-pound weight restriction will negatively impact small UAS flight times and the usage of alternative fuel sources. Consumers Energy urged the FAA to consider fuel loads and to increase the weight restriction to 120 pounds. The commenter also suggested that, if the FAA has concerns about safety, it could create subcategories under which maximum weight restriction is imposed on the fuel load, rather than adopt a blanket weight restriction. Several commenters also suggested higher weight limits, including: 80 pounds; a range of 30–100 pounds; and 150 pounds. Another commenter called the weight restriction ''arbitrary,'' and noted that other States have defined small UAS to include unmanned aircraft weighing up to 150 kilograms.

One commenter suggested that the FAA amend the definition of small unmanned aircraft to include aircraft weighing exactly 55 pounds. Another commenter stated that the definition of ''small unmanned aircraft'' must be clarified to account for different types of UAS (*e.g.,* fixed-wing, rotor-wing, small, medium, large).

The definition of ''small unmanned aircraft'' is a statutory definition. Specifically, Public Law 112–95, section 331(6) defines a small unmanned aircraft as ''an unmanned aircraft weighing less than 55 pounds.'' Accordingly, this rule will retain the

statutory definition, which includes 55 pounds as the weight limit for a small unmanned aircraft. However, the FAA emphasizes that, as discussed in section III.A of this preamble, this rule is merely one step of UAS integration into the NAS. As such, the FAA anticipates that future rulemakings will integrate larger UAS into the NAS and thus enable additional commercial opportunities.

Several commenters discussed the ambiguity in the statutory definition with regard to how the 55-pound weight limit should be calculated. The Small UAV Coalition and Federal Airways & Airspace supported the inclusion of payload in the weight calculation. Conversely, DJI, the Associated General Contractors of America, and another commenter questioned whether the 55-pound weight limitation should include payload that is carried by the small unmanned aircraft. DJI argued that the FAA does not consider the weight of payload in its regulations governing the operation of ultralights. Kapture Digital Media stated that the 55-pound weight limit should not include the weight of the battery.

As noted in the NPRM, the FAA uses total takeoff weight for multiple different types of aircraft, including large aircraft, light-sport aircraft, and small aircraft.[65] One of the reasons that the FAA uses total takeoff weight in all of these regulations is because in the event of a crash, a heavier aircraft can do more damage to people and property on the ground than a lighter aircraft. In evaluating this type of risk for a small UAS, it is the total mass of the small unmanned aircraft that is important; the manner in which that mass is achieved is irrelevant. In other words, a 50-pound unmanned aircraft carrying 30 pounds of payload does not pose a smaller risk than an 80-pound unmanned aircraft that is not carrying any payload. As such, this rule will retain the proposed inclusion of everything onboard the aircraft in the 55-pound weight limit of a small unmanned aircraft.

The General Aviation Manufacturers Association (GAMA) pointed out that, although the FAA typically points to maximum takeoff weight when identifying an aircraft's weight and associated mass, the proposed definition of small unmanned aircraft does not include the term ''takeoff.'' As such, GAMA recommended that the FAA modify the definition to reference the point of takeoff as follows: ''Small unmanned aircraft means an unmanned aircraft weighing less than 55 pounds including everything that is on board the aircraft on takeoff.'' Another commenter stated that the choice of ''on board'' in the definition of ''small unmanned aircraft'' will create confusion, because these aircraft routinely have ''attached'' external payloads because there is little room for internal ''on board'' payloads.

The FAA agrees with these comments and has modified the proposed definition to refer to the total aircraft weight at takeoff and to include possible external attachments to the aircraft in the calculation of small unmanned aircraft weight.

5. Small Unmanned Aircraft System (Small UAS)

Finally, the NPRM proposed a definition of ''small unmanned aircraft system'' as ''a small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) that are required for the safe and efficient operation of the small unmanned aircraft in the national airspace system.'' The NPRM explained that this proposed definition would be similar to the statutory definition of UAS specified in Public Law 112–95, section 331(9), except that it does not include a ''pilot in command'' reference that appears in the statute. The FAA did not include the ''pilot in command'' reference in the proposed definition of small UAS because that position did not exist under the NPRM. Even though the FAA is creating a remote pilot in command position in this final rule, the FAA considers adding a reference to that position in the small UAS definition as unnecessary.

AirShip Technologies Group, Inc. (AirShip Technologies) supported the proposed definition. Conversely, Transport Canada asked the FAA to consider whether it would be better to use the ICAO terminology of remotely piloted aircraft system (RPAS) instead of small UAS. Foxtrot Consulting, LLC stated that the inclusion of the phrase ''associated elements (including communications links and the components that control the small unmanned aircraft)'' in the definition of small UAS creates a ''regulatory nightmare,'' because it means cellular network providers and their infrastructure are considered part of a small UAS. The commenter pointed out that small UAS can be controlled via Wi-Fi and cellular networks, which opens enormous capabilities to small UAS operations. The commenter went on, however, to question whether, as a result of the proposed definition, a cellular provider is liable if a UAS being controlled through their network causes damage to property, serious injury, or death.

The proposed definition of small UAS is derived from the statutory definition of ''unmanned aircraft system'' in Public Law 112–95, § 331(9). As such, this final rule will codify the proposed definition. Because Congress has selected the term ''unmanned aircraft system'' to describe this type of a system, the FAA may not use a different term, such as RPAS, in this rule.

With regard to cellular providers, the requirements of this rule apply only to the remote pilot, the owner of the small UAS, and people who may be involved in the operation of the small UAS. As such, a cellular provider whose involvement in the small UAS operation is limited to a remote pilot simply using the provider's infrastructure would not be in violation of part 107 if something were to go wrong. The FAA does not opine on liability issues that are beyond the scope of this rule, such as whether the provider may be liable to the remote pilot or third parties under tort or contract law.

The NextGen Air Transportation Program at NC State University and another commenter recommended specifically stating that tethered powered small UAS are considered small UAS under proposed part 107. In response to these comments, the FAA notes that the definition of small UAS in this rule includes tethered powered small UAS.

6. Other Definitions

One commenter asked the FAA to define the term ''aerial photography'' in the regulatory text. However, with the exception of operations involving the transportation of property, part 107 does not contain any requirements specific to the use to which a small UAS is put. For example, a small UAS used for aerial photography will be subject to the same operating restrictions as a small UAS used for bridge inspection, precision agriculture, or utility inspection. Because this rule does not contain any requirements specific to aerial photography, no definition of the term is necessary.

E. Operating Rules

As discussed earlier in this preamble (section III.A), instead of a single omnibus rulemaking that applies to all small UAS operations, the FAA has decided to proceed incrementally and issue a rule governing small UAS operations that pose the least amount of risk. Subpart B of part 107 will specify the operating constraints of these operations. The FAA emphasizes that it

[65] *See* 14 CFR 1.1 (referring to ''takeoff weight'' for large, light-sport, and small aircraft in the definitions for those aircraft).

intends to conduct future rulemaking(s) to incorporate into the NAS small UAS operations that pose a greater level of risk than the operations that will be permitted by this rule.

1. Remote Pilot in Command

The NPRM proposed to create a new crewmember position (called ''operator'') for small UAS operations conducted under part 107. The proposed rule would define an operator as a person who manipulates the flight controls of a small UAS. The NPRM also proposed prohibiting a person from serving as an operator if he or she does not have an unmanned aircraft operator certificate with a small UAS rating, which would be a new airman certificate created by the proposed rule. Finally, the NPRM invited comments as to whether this rule should create a pilot in command (PIC) position and whether the PIC should be given the power to deviate from FAA regulations in response to an in-flight emergency.

For the reasons discussed below, this rule will remove the proposed crewmember position of ''operator'' and will instead create a new position of ''remote pilot in command.'' The remote pilot in command will have the final authority and responsibility for the operation and safety of a small UAS operation conducted under part 107. Additionally, the remote pilot in command will be required to obtain a remote pilot certificate with a small UAS rating. However, an uncertificated person will be permitted to manipulate the flight controls of a small UAS as long as he or she is directly supervised by a remote pilot in command and the remote pilot in command has the ability to immediately take direct control of the small unmanned aircraft. Finally, in case of an in-flight emergency, the remote pilot in command will be permitted to deviate from any rule of part 107 to the extent necessary to meet that emergency. A remote pilot in command who exercises this emergency power to deviate from the rules of part 107 will be required, upon FAA request, to send a written report to the FAA explaining the deviation.

a. Terminology

The NPRM proposed to create a new crewmember position called ''operator,'' which would be defined as a person who manipulates the flight controls of a small UAS. The NPRM also proposed to create a new airman certificate for the operator, which would be called an ''unmanned aircraft operator certificate with a small UAS rating.'' The NPRM noted, however, that the term ''operator'' is already used in manned-aircraft operations, and invited comments as to whether this term would cause confusion if used in part 107.

Several commenters noted that using the term ''operator'' in part 107 could result in confusion. NTSB, ALPA, and TTD pointed out that ''operator'' is currently used to refer to a business entity and that use of that term to refer to a small UAS pilot would be inconsistent with existing usage. Transport Canada and several other commenters stated that ICAO defines the person manipulating the flight controls of a small UAS as a ''remote pilot'' and asked the FAA to use this terminology in order to harmonize with ICAO. Transport Canada also noted that: (1) Canada uses the same terminology as ICAO; and (2) calling an airman certificate issued under part 107 an ''operator certificate'' may lead to confusion with FAA regulations in part 119, which allow a business entity to obtain an operating certificate to transport people and property. ALPA and TTD suggested that the person manipulating the controls of the small UAS should be referred to as a pilot, asserting that this would be consistent with how the word pilot has traditionally been used.

As pointed out by the commenters, FAA regulations currently use the term ''commercial operator'' to refer to a person, other than an air carrier, who engages in the transportation of persons or property for compensation or hire.[66] Commercial operators are issued an ''operating certificate'' under 14 CFR part 119.[67] Because other FAA regulations already use the term ''operator'' to refer to someone other than a small UAS pilot under part 107, the FAA agrees with commenters that use of the term ''operator'' in this rule could be confusing.

In considering alternative terminology to replace the term ''operator,'' the FAA noted that ICAO[68] and the United Kingdom[69] both use the term ''remote pilot'' to refer to the person manipulating the flight controls of a small UAS. Additionally, as pointed out by Transport Canada, Canada also uses the term ''remote pilot.'' Accordingly, this rule will use the term ''remote pilot'' instead of ''operator'' in order to harmonize with international terminology. Consequently, the FAA has changed the name of the airman certificate issued under part 107 to a ''remote pilot certificate with a small UAS rating.''

In addition, as discussed below, this rule will create a new crewmember position of ''remote pilot in command.'' The remote pilot in command will be a certificated airman and will have the final authority and responsibility for the operation and safety of a small UAS operation. Because the FAA anticipates that the remote pilot in command will often also be the person manipulating the flight controls of a small UAS, there is no need to have a separately defined crewmember position for the person manipulating the flight controls. Accordingly, the proposed definition of ''operator'' has been removed from this rule.

b. Remote Pilot in Command

The current regulations of part 91 create a separate PIC crewmember position that has ultimate authority and responsibility for the safety of the operation to: (1) Ensure that a single person on board the aircraft is accountable for the operation; and (2) provide that person with the authority to address issues affecting operational safety.[70] The NPRM proposed to forego this type of position in part 107, but invited comments as to whether a separate ''operator in command'' position should be created for small UAS operations.

Commenters including Aerius Flight, NetMoby, Predesa, and NRECA, generally agreed that a separate operator in command designation is not necessary for small UAS operations. NBAA commented that since small UAS operations will largely be excluded from airspace covered by traditional definitions of ''operator'' and ''pilot,'' there is no need to create a separate operator in command position for part 107 operations.

Other commenters requested that the FAA include a separate ''operator in command'' position in the final rule similar to the PIC position used in manned-aircraft operations. The University of North Dakota's John D. Odegard School of Aerospace Sciences pointed out that due to a wide variety of system configurations available for small UAS, it is possible that one or more flight crew members or sensor stations may affect the flight path of the unmanned aircraft. Accordingly, the commenter recommended that the term operator-in-command be added and defined in the rule to reflect the final authority and responsibility for the operation and safety of the flight.

[66] 14 CFR 1.1 (definition of ''commercial operator'').

[67] *See* 14 CFR 119.5(b).

[68] ICAO Manual on Remotely Piloted Aircraft (draft) Chapter 7 Personnel Competence.

[69] Unmanned Aircraft System Operations in UK Airspace—Guidance CAP 722.

[70] *See* 14 CFR 91.3.

ArgenTech Solutions, Inc. also recommended the rule address the title of operator-in-command and specify the requirements for operator hand-off of small UAS. Similarly, the Kansas State University UAS Program recommended clarification of responsibility in regard to operations with multiple operators and noted that creation of an operator-in-command designation would be an appropriate clarification.

As discussed below, this rule will allow small UAS to be operated by more than one person for purposes such as instruction or crew augmentation. As such, the FAA agrees that there needs to be a designated crewmember who is responsible for the safe operation of a small UAS and has final authority over that operation. Thus, this rule will create a new crewmember position of remote pilot in command.

Just as with manned-aircraft PICs, the remote pilot in command: (1) Must be designated as remote pilot in command before or during the flight; and (2) will have the final authority and responsibility for the operation. In light of this change, the FAA has amended the regulatory text of part 107 to transfer the duties that the NPRM proposed to impose on the operator to the remote pilot in command and, where appropriate, to the person manipulating the flight controls of the small UAS. The remote pilot in command will also be generally responsible for ensuring that the small UAS operation complies with all applicable FAA regulations.

Turning to the comments about operator hand-off, a person manipulating the flight controls of a small UAS may be augmented by another person during operation. Specifically, the person manipulating the flight controls may safely transfer the controls to another person during flight as long as the transfer does not violate the operational provisions of part 107 and a remote pilot in command is designated. For example, the flight controls of a small UAS may not be transferred if the process of transferring the controls would cause the unmanned aircraft to enter Class B airspace without ATC permission.

The FAA emphasizes that, as discussed in section III.E.2.a of this preamble, at any point throughout the entire flight of the small unmanned aircraft, the remote pilot in command and the person manipulating the flight controls of the small UAS must both have the ability to see the small unmanned aircraft unaided by any device other than corrective lenses. Therefore, the person manipulating the flight controls must be able to see the small unmanned aircraft at the time of the handoff sufficiently well to satisfy the visual-line-of-sight requirements of this rule. The FAA also emphasizes that § 107.19(c) requires the remote pilot in command to ensure that the small unmanned aircraft will not pose an undue hazard to other aircraft, people, or property on the ground if positive control is lost. Thus, the remote pilot in command must ensure that the technology and method used for conducting the handoff does not unduly increase the risk associated with a possible loss of positive control.

c. Airman Certification Requirement

The NPRM proposed to require that each person manipulating the flight controls of a small UAS obtain a part 107 airman certificate. The FAA's statute requires a person serving as an airman to obtain an airman certificate. Because the person manipulating the flight controls of a small UAS would be an airman under the crewmember framework proposed in the NPRM, that person would statutorily be required to obtain an airman certificate. The NPRM also proposed to create a new airman certificate to be issued for small UAS operations in place of the existing part 61 pilot certificates that focus on manned-aircraft operations.

Many commenters, including Air Tractor, Inc., Ag Info Tech, LLC, and the American Fuel & Petrochemicals Manufacturers, supported the proposal to require the person manipulating the flight controls of a small UAS to obtain a part 107 airman certificate. Commenters generally supported this provision because it was viewed as an economical means to achieve the rule's safety objective. Commenters including Modovolate and the National Association of Broadcasters stated the proposed approach of adding a new category of airmen provides a good balance with the need to verify operator qualifications without unduly burdening the operators.

Several commenters disagreed with the proposed airman certification requirement. Airship Technologies argued that an airman certificate is unnecessary to operate a small UAS and asserted that the proposed regulatory framework is too complex, costly, and burdensome for both the public and the FAA. Airship Technologies suggested that the operator should instead depend upon the product manufacturer's training in the form of classes and documented materials. Another commenter asserted that processing certificate applications will create a backlog for the FAA. Yet another commenter suggested a self-certification procedure in lieu of a required airman certificate asserting that the proposed certificate would offer little benefit to the operators or the NAS.

Commenters from the educational and academic community, including Princeton University and the Council on Government Relations, suggested that a remote-pilot-in-command position should allow a faculty member acting as a remote pilot in command to oversee student operators utilizing small UAS as part of a course or research activity. Princeton University expressed concern over requiring the person manipulating the flight controls of a small UAS to hold an airman certificate, citing complications in the academic environment. Princeton provided scenarios where students would use a small UAS in projects as part of their academic courses and the challenges involved in obtaining an operator certificate prior to testing their project. To resolve these concerns, Princeton recommended that universities be able to obtain an ''Educational UAS License,'' which would give them the authority to designate an ''Operator-in-Command'' and administer the knowledge test to appropriate faculty and staff.

The FAA agrees with the majority of comments that an airman certificate to operate a small UAS should be required unless directly supervised by a remote pilot in command. This is in fact a statutory requirement, as 49 U.S.C. 44711(a)(2)(A) prohibits a person from serving in any capacity as an airman with respect to a civil aircraft used or intended to be used in air commerce ''without an airman certificate authorizing the airman to serve in the capacity for which the certificate was issued.'' The FAA's statute defines an airman to include an individual ''in command, or as pilot, mechanic, or member of the crew, who navigates aircraft when under way.'' 49 U.S.C. 40102(a)(8)(A). Because the remote pilot in command and the person manipulating the flight controls of a small UAS without supervision are both pilots and members of the crew who navigate the small unmanned aircraft when it is under way, these crewmembers are statutorily required to have an airman certificate. The FAA therefore maintains the requirement that a person manipulating the flight controls of a small UAS without supervision must obtain a remote pilot certificate with a small UAS rating and this rule will also extend this requirement to the remote pilot in command.

However, the FAA acknowledges the educational concerns that have been raised by the academic commenters and

notes that in the manned-aircraft context, an uncertificated person can manipulate the flight controls of an aircraft in flight as long as he or she is directly supervised. An individual whose manipulation of the flight controls is closely supervised by a certificated airman is not in command and is not a pilot or member of the crew because his or her presence is not necessary to fly the aircraft. Instead, the certificated airman who is providing the supervision is exercising the judgment that is normally expected of a pilot and that airman could simply fly the aircraft by him or herself instead. Thus, an individual who is directly supervised by a certificated airman is not an ''airman'' within the meaning of section 40102(a)(8)(A) and is therefore not statutorily required to obtain an airman certificate.

To further enable the educational opportunities identified by the commenters, this rule will allow the remote pilot in command (who will be a certificated airman) to supervise another person's manipulation of a small UAS's flight controls. A person who receives this type of supervision from the remote pilot in command will not be required to obtain a remote pilot certificate to manipulate the controls of a small UAS as long as the remote pilot in command possesses the ability to immediately take direct control of the small unmanned aircraft. This ability is necessary to ensure that the remote pilot in command can quickly address any mistakes that are made by an uncertificated person operating the flight controls before those mistakes create a safety hazard.

The ability for the remote pilot in command to immediately take over the flight controls could be achieved by using a number of different methods. For example, the operation could involve a ''buddy box'' type system that uses two control stations: One for the person manipulating the flight controls and one for the remote pilot in command that allows the remote pilot in command to override the other control station and immediately take direct control of the small unmanned aircraft. Another method could involve the remote pilot in command standing close enough to the person manipulating the flight controls so as to be able to physically take over the control station from the other person. A third method could employ the use of an automation system whereby the remote pilot in command could immediately engage that system to put the small unmanned aircraft in a pre-programmed ''safe'' mode (such as in a hover, in a holding pattern, or ''return home'').

The FAA also emphasizes that, as discussed in section III.E.3.b.ii of this preamble, part 107 will not allow a person to act as a remote pilot in command in the operation of more than one small unmanned aircraft at the same time. In the educational context, this means that a faculty member who is acting as a remote pilot in command could not directly supervise the simultaneous operation of more than one small unmanned aircraft. The faculty member could, however, instruct a class of students in a manner that does not involve the simultaneous operation of multiple small unmanned aircraft. For example, a class of students could operate a single small unmanned aircraft with students passing control of the aircraft to each other under the supervision of a faculty member who is a remote pilot in command. An academic institution could also require a certain number of students to obtain a remote pilot certificate prior to beginning a class involving small UAS use in order to increase the number of people who would be available to act as a remote pilot in command.

Several commenters, including the Utah Governor's Office of Economic Development and Textron Systems, expressed the view that there should be different small UAS certifications for different altitudes, locations, aircraft sizes, and applications.

The FAA recognizes there are differences between the various small UAS operations as articulated by the commenters. However, the key knowledge areas that will be tested on the initial and recurrent knowledge tests will be applicable to all small UAS operations that could be conducted under part 107 regardless of the altitude, location, size, or application of the small UAS. Requiring only a single remote pilot certificate with a small UAS rating will give the remote pilot in command the flexibility to operate various small UAS within the parameters permitted by part 107 without any additional FAA-required training or testing.

Many commenters, including ALPA, NAAA, and TTD, argued that small UAS operators should be required to have a part 61 pilot certificate to operate in the NAS. These commenters remarked that operating in the NAS is a great responsibility, and that all persons operating in the NAS should be aware of these responsibilities.

ALPA, TTD, Schertz Aerial Services, Inc., and many other commenters recommended that the FAA require a part 61 commercial pilot certificate. TTD stated that the standards put in place must ensure one level of safety for all who operate in the NAS, and if small UAS operators are operating for compensation or hire in shared airspace with manned aircraft, then they too should hold a commercial pilot certificate. Schertz Aerial Services added that small UAS pose a risk of collision or interference with manned aircraft and that UAS operators are not putting their own life at risk when flying. Schertz Aerial Services argued that the FAA should not carve out exceptions to the well-established requirement of commercial airman certificates for commercial operations.

NAAA and several other commenters suggested that, in place of a part 61 commercial pilot certificate, the FAA should require small UAS pilots to hold a part 61 private pilot certificate. NAAA stated that this position is a change from its section 333 exemption comments. After further analysis NAAA determined that requiring a commercial pilot certificate is not necessary and a private pilot certificate with a UAS knowledge and skills test rating would be sufficient to operate a UAS safely. Another commenter asserted that a UAS pilot should be required to have a part 61 student pilot certificate.

Many other commenters, including AIA, AOPA, and the National Association of Realtors, supported having a separate part 107 airman certificate. Commenters including the National Association of Wheat Growers, and the American Fuel & Petrochemicals Association stated that requiring a part 61 pilot certificate would be overly burdensome and pointed out that many of the knowledge areas and skills required for manned aircraft do not apply to the operation of unmanned aircraft.

The FAA agrees with the commenters who pointed out that the skills necessary to obtain a part 61 pilot certificate would not equip the remote pilot in command with all of the aeronautical skills necessary to safely operate a small UAS and would instead impose a significant cost burden without a corresponding safety benefit. Specifically, manned-aircraft training may not prepare a pilot to deal with UAS-specific issues such as how to maintain visual line of sight of the unmanned aircraft or how to respond when signal to the unmanned aircraft is lost.

Required training for a part 61 pilot certificate would, however, impose the burden of training on areas of knowledge that are inapplicable to small UAS operations. For example, unlike a manned-aircraft pilot, a remote pilot in

command does not need to know how to operate the flight controls of a manned aircraft. Similarly, the remote pilot in command does not need to be able to takeoff, land, or maneuver a manned aircraft. While these skills are critical to the safe operation of manned aircraft and are thus required for a part 61 pilot certificate, they are not typically necessary for the safe operation of a small UAS. Because requiring a part 61 pilot certificate would not ensure that certificate applicants learn all areas of knowledge specific to small UAS operations while at the same time requiring those applicants to learn areas of knowledge that are not necessary to safely operate a small UAS, this rule will not require a remote pilot in command to obtain a part 61 pilot certificate.

Several commenters stated that despite the language of 49 U.S.C. 44711(a)(2)(A), the FAA should not require an airman certificate for small UAS operations conducted in rural areas on private property, and at low altitudes. One commenter stated that there is no statutory or regulatory requirement that a small UAS operator must be an airman given that part 103 operators need not have an airman certificate yet they fly in the NAS. Another commenter stated that the FAA was overly broad in its definitions of aircraft and air commerce. The commenter claimed the proposal ignored the flexibility FAA exercised in creating the regulations of 14 CFR part 101 regulating amateur rockets, kites, and unmanned free balloons. The commenter added that current part 101 regulations for these devices are safety-based and they appropriately make no artificial distinction between commercial and non-commercial use.

Several other commenters disagreed with the proposed certificate requirements, claiming they should not be applicable to hobbyists.

In response to the comment arguing that the FAA was overly broad in its definitions of aircraft and air commerce, the FAA notes that both terms are defined by statute. As discussed earlier, the NTSB has held that the statutory definition of ''aircraft'' is ''clear on [its] face'' and that definition encompasses UAS.[71] The NTSB has also held that, based on the statutory definition of air commerce, ''any use of an aircraft for purpose of flight constitutes air commerce.'' [72]

Turning to the comments arguing that certain UAS operations should be exempt from airman certification, as discussed earlier, it is a statutory requirement, under 49 U.S.C. 44711(a)(2)(A), that a person may not serve as an airman with respect to a civil aircraft used or intended to be used in air commerce without an airman certificate. The statute does not distinguish between different types of operations, such as those suggested by the commenters. Accordingly, regardless of where and how a small UAS operation is conducted, this rule will require the person manipulating the flight controls of a small UAS to hold a remote pilot certificate unless he or she is directly supervised by a certificated remote pilot in command who has the ability to immediately take direct control of the small unmanned aircraft. However, as discussed in section III.C.4 of this preamble, operations of model aircraft as a hobby or for recreational use under the provisions of section 336 will not be subject to part 107. With regard to parts 101 and 103, those regulations are beyond the scope of this rule.

The Flight School Association of North America and Event 38 Unmanned Systems suggested that the airman certificate should include the operator's information and a color photo. Under this rule, the FAA will issue the same type of pilot certificate for the remote pilot in command as it does for all other airmen. The airman's specific information will be listed along with the date of issuance. At this time, the FAA does not issue airman certificates with a photo; however the FAA is addressing that issue through a separate rulemaking effort.

Event 38 Unmanned Systems suggested that the FAA create a database of registered airmen, but limit accessibility to FAA and law enforcement. NetMoby suggested allowing the public to access the database so they may confirm a person flying a small UAS in their vicinity is authorized to do so and assist in enforcement. Additionally, NetMoby suggested that the FAA use the current airman certificate database as the template for its suggested database.

The FAA currently maintains an airman certification database that permits the public to search or download through its public Web site. This information includes name, address, and certificates and ratings held by the certificate holder. The agency will issue remote pilot certificates in accordance with its existing processes for issuing airman certificates and the public will be able to search the airman certification database for those who hold a remote pilot certificate. The certificate holder may opt to request their address not be published on the public Web site.[73]

The University of North Dakota John D. Odegard School of Aerospace Sciences recommended that the FAA remove the ''small UAS rating'' from a part 107 airman certificate. The commenter stated that an additional small UAS rating is redundant because part 107 will apply only to small UAS operations.

As discussed in section III.A of this preamble, this rule is only one step of the FAA's broader effort to fully integrate all UAS operations into the NAS. Future agency actions are anticipated to integrate larger and more complex UAS operations into the NAS and integrating those operations may require the creation of additional UAS-specific airman certificate ratings. To accommodate these future actions, the FAA will retain the small UAS rating.

Textron Systems recommended establishing a small UAS certificate with appropriate category ratings (*e.g.,* rotorcraft or airplane) which would require documentation of aeronautical experience and a practical test prior to issuance. Textron stated the skills and knowledge required to operate unmanned rotorcraft and unmanned airplanes are substantially different during launch, semi-autonomous missions, and recovery, and therefore there should be a difference indicated on the certificate.

The category and class designations used for part 61 pilot certificates stem from the airworthiness certification designations given on the type certificate data sheet (TCDS) when an aircraft type becomes certificated. The TCDS identifies the airworthiness standards that a specific aircraft has met as those standards differ for different types of aircraft. However, as discussed in section III.J.3 of this preamble, small UAS operating under part 107 will not be required to obtain an airworthiness certificate. As such, there will be no airworthiness standards or a TCDS that will be issued for every small UAS design, and a category designation would not be workable under part 107.

One commenter recommended that the FAA require that the remote pilot certificate be displayed on a name badge, lanyard, or armband during a small UAS operation in case the remote pilot in command is approached or questioned about authorization for the activity.

[71] *Administrator* v. *Pirker,* at 4–5, 8–12. A copy of the *Pirker* decision can be found at: *http://www.ntsb.gov/legal/alj/OnODocuments/Aviation/5730.pdf.*

[72] *Administrator* v. *Barrows,* 7 NTSB 5, 8–9 (1990).

[73] *http://www.faa.gov/licenses_certificates/airmen_certification/change_releasability/.*

The FAA emphasizes that § 107.7(a)(1) will require the remote pilot certificate holder to, upon request, make his or her remote pilot certificate available to the Administrator. This rule will not specify the method by which the certificate holder stores and displays his or her certificate, but whatever method is used, the certificate holder must provide the certificate to the FAA upon request.

d. Emergency Powers of a Remote Pilot in Command

In case of an in-flight emergency, the existing regulations in 14 CFR 91.3 give a PIC the power to deviate from the applicable FAA regulations to the extent necessary to respond to that emergency.[74] A PIC who exercises this power must provide a written report of the deviation to the FAA if requested to do so by the agency.[75] The NPRM proposed to not provide emergency powers to a small UAS operator because a small unmanned aircraft is highly maneuverable and much easier to land than a manned aircraft. Thus, the NPRM posited that in an emergency situation, an operator should be able to promptly land the small unmanned aircraft without needing to deviate from any part 107 regulations. The NPRM invited comments as to whether a small UAS remote pilot in command should be permitted to exercise emergency powers similar to those available to a PIC under § 91.3.

Several commenters including AUVSI, AIA, and Trimble Navigation, supported allowing small UAS operators to exercise emergency powers in certain circumstances. Prioria provided examples where a small UAS may need to violate the proposed 500-foot altitude limit and the visual-line-of-sight requirement in order to avoid a collision with a manned aircraft or remove an uncontrollable small unmanned aircraft from the NAS. Another commenter provided an example of a situation where the only viable option to prevent a mid-air collision would violate the prohibition on operations over people (as a result of any lateral movement by the UAS) or the various operational restrictions in § 107.51 (as a result of any vertical movement by the UAS). The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative noted that there are scenarios where unauthorized small UAS penetration of controlled airspace may be required to avoid an accident, and proposed that the FAA authorize small UAS operators to penetrate controlled airspace to the extent necessary to avoid (at least) personal injury or death.

One commenter said small UAS operators should be permitted to exercise emergency powers, but only to prevent serious injury, death, or a mid-air collision. Southern Company and Trimble recommended permitting UAS operators to deviate from FAA regulations in emergencies to mitigate injury, damage, or risk. Southern Company argued that by not extending emergency deviation authority to UAS operators, the FAA could be forcing a UAS operator to choose between deviating from FAA regulations and ensuring safety.

Several commenters, including Skycatch, Clayco, and AUVSI, specifically recommended revising proposed § 107.19 to be consistent with 14 CFR 91.3—*i.e.,* allow an operator to deviate from any rule of part 107 to the extent required in an emergency requiring immediate action, and require, upon the request of the Administrator, the operator to submit a written report of that deviation. Textron Systems said that 14 CFR 91.3 should apply to UAS, because an unmanned aircraft is considered an aircraft according to 49 U.S.C. 40102(a)(6). AIA said the provisions and intent of § 91.3 should apply to UAS.

Conversely, NBAA, Predesa, Planehook, and another commenter supported the FAA's proposal not to provide a remote pilot with the emergency powers available to a PIC under § 91.3(b). NBAA and Predesa concurred with the FAA's proposal but did not provide any additional justification. Planehook cited Articles 28 and 8 of the Convention on International Civil Aviation, which the commenter said creates the basis for nations to grant emergency powers to the PIC of an aircraft in distress, and Article 8, which the commenter said states that each contracting State undertakes to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be controlled so as to obviate danger to civil aircraft. Planehook contended that the granting of emergency powers to operators of unmanned aircraft would violate this existing international agreement. One commenter argued that until UAS are able to communicate, operate accurately in controlled airspace, follow in-flight restrictions and spacing requirements, and fly specific altitudes and routes, emergency powers are unnecessary.

The FAA agrees with the commenters who pointed out that there are emergency scenarios in which a remote pilot may need to deviate from certain provisions of part 107, such as altitude and visual line of sight, to avoid an unexpected and unforeseen collision with a manned aircraft or a person on the ground. The FAA also agrees that in certain emergency situations it may be safer to deviate from one or more operational requirements of part 107 (*e.g.,* regarding altitude or controlled airspace) than attempt to land the small unmanned aircraft immediately. For example, if a manned aircraft approaches the small unmanned aircraft from below, the small unmanned aircraft may be unable to immediately descend and land without risking a collision.

Accordingly, during an in-flight emergency, this rule will allow the remote pilot in command to deviate from the provisions of part 107 to the extent necessary to respond to that emergency. As the FAA previously pointed out with regard to its emergency regulations, ''the plain-meaning dictionary definition of an emergency is an unexpected and unforeseen serious occurrence or situation that requires urgent, prompt action.'' [76] Just as it does with other FAA regulations, this plain meaning will govern the agency's understanding of what constitutes an emergency for part 107 purposes.

Additionally, because part 107 will allow a deviation only during an in-flight emergency, this deviation cannot be taken for situations that were expected or foreseen prior to the takeoff of the small unmanned aircraft. If a remote pilot in command expects or foresees an emergency situation prior to aircraft takeoff, then the remote pilot in command must delay or cancel takeoff or otherwise alter the parameters of the operation to the extent necessary to ensure full compliance with part 107.

The FAA also emphasizes that the remote pilot in command must always prioritize the safety of human life above all other considerations. As such, the remote pilot in command may not endanger human life in order to save the small unmanned aircraft. To the contrary, the remote pilot in command is expected to sacrifice the small unmanned aircraft if it begins to pose a danger to human life.

The FAA further agrees with (and has included in this rule) the recommendation that, just like § 91.3, the remote pilot in command must, upon FAA request, submit a report to the FAA if he or she has exercised his or her emergency powers. This report must provide a detailed explanation of

[74] 14 CFR 91.3(b).

[75] *Id.* § 91.3(b).

[76] Letter to George K. Shaefer from Donald Byrne, Assistant Chief Counsel, Regulations Division (April 16, 1993).

what happened. This requirement will enable FAA oversight over the exercise of emergency powers by giving the agency a method to better understand the circumstances and reasons that an individual remote pilot in command had for deviating from part 107.

The FAA disagrees with the comment arguing that granting emergency powers to a remote pilot in command would violate U.S. international obligations. The FAA notes that Article 28 of the Convention of International Civil Aviation, which was the provision cited by the commenter, does not address the granting of emergency powers to remote pilots of unmanned aircraft. Article 8 of that Convention, which governs ''Pilotless aircraft,'' states that:

''No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.''

The plain language of Article 8 does not prohibit a contracting State from giving emergency powers to a remote pilot in command operating within that State. Because neither Article 8 nor any other provision of the Convention of International Civil Aviation prohibits the granting of emergency powers to a remote pilot in command, this approach will not violate U.S. international obligations.

Several commenters addressed the issue of proper emergency training for small UAS operators. One commenter said that if small UAS operators have passed a reasonable operator license exam, they can indeed be trusted to behave well in an emergency situation. The NJIT Working Group said that remote pilots need to be properly trained so they will better understand what constitutes an emergency. Pointing to the NPRM's discussion of training small UAS pilots on emergency procedures, ALPA concurred with the need for training and recommended it include considerations in the exercise of emergency authority, however remote the likelihood of emergency may be.

The FAA concurs with commenters' points that small UAS pilots must be proficient in emergency procedures and the proper exercise of emergency authority. That is why, as discussed in section III.F.2.j of this preamble, emergency procedures and emergency authority will be tested on the initial and recurrent knowledge tests. Thus, in order to pass an initial knowledge test and obtain a remote pilot certificate, applicants for a remote pilot certificate will need to acquire proficiency in these areas of knowledge. UAS-specific exercises of emergency procedures and authority will also be included in the training course that part 61 pilot certificate [77] holders will be able to take instead of the initial and recurrent knowledge tests.

One commenter recommended that the FAA conduct further analysis before providing a small UAS pilot with emergency powers in the final rule. The FAA disagrees. Emergency powers have been a longstanding feature in FAA regulations without an adverse effect on safety because they allow the PIC to respond to an emergency situation in a context-specific manner.[78] As discussed earlier in this section, deviating from certain operational requirements may, at times, be unavoidable in order to minimize risk to other people.

Two commenters suggested that the FAA prescribe specific methods to respond to an emergency situation. One commenter stated that lost link is an emergency and should be declared to ATC or on Unicom to notify other air traffic. Another commenter similarly said small UAS operators should be required to send out a distress signal to aircraft within the vicinity if there is signal loss or other operational failures.

The FAA does not mandate a specific response to an emergency, as the safest response to an emergency situation may vary based on the surrounding context. For example, the safest response to an emergency situation in a rural area may differ from the safest response to the same situation in an urban area. As such, the FAA will not limit the remote pilot in command's ability to respond to an emergency situation in a context-appropriate manner. Rather, a remote pilot in command is permitted to respond as necessary to resolve the urgent situation. There is neither a requirement nor a prohibition from declaring an emergency, either by radio communication or by other means, if doing so is appropriate under the circumstances. For example, in a lost-link scenario, the remote pilot in command may declare an emergency if it appears that the small unmanned aircraft may hit a person on the ground. Conversely, lost link may not be an emergency if there are no people or manned aircraft near the area of operation.

The FAA also disagrees with the commenter who suggested that the remote pilot in command must be required to send out a distress signal if there is signal loss or other operational failures. Due to the limited operational capabilities of small UAS, an operation failure or signal loss may not necessarily constitute a hazard to persons or property.

2. See-and-Avoid and Visibility Requirements

To ensure that the person piloting the small UAS can safely see and avoid other aircraft and people and property on the ground, the NPRM proposed that small unmanned aircraft: (1) May only be operated within visual line of sight; (2) must yield right of way to all other aircraft; (3) may only be operated between the hours of sunrise and sunset; and (4) must meet minimum weather and visibility requirements.

a. Visual Line of Sight

Currently, 14 CFR 91.113(b) imposes a generally applicable requirement that, during flight, ''vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft.'' This see-and-avoid requirement is at the heart of the FAA's regulatory structure, mitigating the risk of aircraft colliding in midair. This requirement is currently satisfied in manned-aircraft operations by a pilot on board the manned aircraft looking out from inside the aircraft to see whether other aircraft are on a collision course with the pilot's aircraft. However, the person controlling the small UAS cannot see other aircraft in the same manner because he or she is not inside the aircraft. That is why Public Law 112–95, section 333(b)(1) requires the FAA to consider, as a critical factor in this rulemaking, whether a small UAS operation is conducted ''within visual line of sight.''

To address this issue, the NPRM proposed that the operator of the small UAS must always be capable of maintaining visual line of sight of the small unmanned aircraft unaided by any technology other than glasses or contact lenses. The NPRM also proposed creating a new position of visual observer to assist the operator in maintaining visual line of sight. Under that proposal, if a visual observer is used in the operation, then the visual observer could watch the small unmanned aircraft instead of the operator. However, if a visual observer was not used in the operation, then the operator would have to exercise his or

[77] For the purposes of this rule, references to ''part 61 pilot certificate holders'' specifically refer to holders of pilot certificates other than student pilot certificates, which include sport pilot, recreational pilot, private pilot, commercial pilot and air transport pilot certificates.

[78] *See, e.g.,* 14 CFR 91.3, 121.557, 121.559, 135.19.

her visual-line-of-sight capability to watch the small unmanned aircraft.

As proposed in the NPRM, the operator or visual observer would have to be able to see the small unmanned aircraft throughout the entire flight in order to: (1) Know the unmanned aircraft's location; (2) determine the unmanned aircraft's attitude, altitude, and direction; (3) observe the airspace for other air traffic or hazards; and (4) determine that the unmanned aircraft does not endanger the life or property of another. The NPRM also proposed that even if a visual observer is used, at all times during flight, the small unmanned aircraft must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses.

For the reasons discussed below, this rule will make three changes to the NPRM visual-line-of-sight framework but will otherwise finalize it as proposed. First, because of the change in the small UAS crewmember framework (discussed in the previous section of this preamble), this rule will replace the operator with the person manipulating the flight controls of the small UAS and the remote pilot in command, who in many instances will be the same person. Second, this rule will make clarifying amendments to the regulatory text. Third, this rule will make the visual-line-of-sight requirement waivable.

A number of commenters expressed concern about whether the visual-line-of-sight framework proposed in the NPRM would sufficiently mitigate risk. Foxtrot Consulting, the Air Medical Operators Association, the Professional Helicopter Pilots Association, and several individuals asserted that the unaided human eye is not adequate to see and avoid other aircraft. Additionally, these commenters argued that the small unmanned aircraft will be too small to be seen by a manned-aircraft pilot, and, with no lighting requirement, the unmanned aircraft may be all but invisible, particularly in minimum visual-flight-rules (VFR) conditions.

Similarly, commenters, including A4A and several individuals, questioned whether small UAS remote pilots would be capable of perceiving potential conflicts and responsibly complying with the principle of ''see and avoid.'' These commenters asserted that since small UAS are unmanned, they are inherently unable to comply with current ''see and avoid'' requirements of 14 CFR 91.113(b) in visual flight conditions. The commenters argued that a remote pilot may not have sufficient perceptual accuracy to determine whether or not a small unmanned aircraft is on a collision course with another aircraft.

The Human Factors and Ergonomics Society suggested that the FAA conduct a systematic, scientific study of factors that affect an observer's ability to estimate altitude and airspeed. A joint comment from Skycatch, Clayco, AECOM, and DPR Construction suggested that rather than relying merely on an operator's eyesight, the FAA should employ a risk-based approach to allowing operations.

The FAA recognizes that one of the issues with small UAS is that a person on the ground cannot see and avoid other aircraft in the same manner as a pilot who is inside a manned aircraft. The FAA also agrees that due to relative size of aircraft, a remote pilot will most likely be able to see and avoid a manned aircraft before the manned-aircraft pilot will see the small UAS. This issue is not unique to small UAS; manned vehicles currently in the NAS range from a few hundred pounds to 1.4 million pounds and pilots have similar challenges regarding see-and-avoid. The FAA has mitigated the risk in this rule through operational parameters that reduce the risk of a midair collision. Because of the limits on their access to airspace that is controlled or at higher altitudes, small unmanned aircraft will avoid busy flight paths and are unlikely to encounter high-speed aircraft that would be difficult for the remote pilot to see-and-avoid. Additionally, as discussed below, this rule will also specify minimum requirements for weather and visibility to maximize the remote pilot's ability to see incoming manned aircraft and avoid a collision with those aircraft.

The FAA disagrees with the notion that remote pilots operating under the visual-line-of-sight framework of this rule will be incapable of perceiving potential conflicts with other aircraft. In many cases, the remote pilot's perspective from the ground may be better than the perspective of a pilot onboard an aircraft because the remote pilot is not confined to a cockpit with vision obscured by the fuselage or flight control surfaces. The remote pilot is thus able to observe airspace 360° around the unmanned aircraft, including airspace above and below. Thus, the person maintaining visual line of sight will be able to see potential conflicts with manned aircraft. Furthermore, as discussed below, this rule will require the small unmanned aircraft to always yield the right of way to other users of the NAS.

Several commenters, including the News Media Coalition, NAMIC, and Drone Labs, LLC objected to the proposed limitation that visual line of sight must be maintained unaided by any technology other than corrective lenses. These commenters suggested that the rule allow the use of first-person-view (FPV) technology, arguing that available technologies have advanced to the point that operators can use FPV to meet or exceed the visual-line-of-sight requirements proposed in the NPRM. United Parcel Service (UPS) asserted that FPV technology has been safely and effectively used in the UAS hobbyist community for many years.

The Drone User Group Network stated that FPV operations should be permitted with mandatory use of a spotter. Predesa said that a wearable heads-up display that combines the FPV from the small UAS and a wider-angle view from a ground camera located near the operator may provide the same risk mitigation as that afforded by the visual observer. The University of Washington and a joint submission by the State of Nevada Governor's Office of Economic Development, the Nevada Institute for Autonomous Systems, and the Nevada FAA-designated UAS Test Site said that current FPV technologies offer a wider field of vision than the human eye. DJI stated that existing technology already provides superior orienting abilities over visual observers. One individual referenced a 2004 test conducted by NASA that indicated that FPV cameras mounted on pan-tilt gimbals can be used to scan virtually the entire airspace. This commenter also acknowledged FPV limitations ''. . . such as the field-of-view of the camera (too wide provides less detail, too narrow limits situational awareness), total field-of-regard, clarity, and range of the transmitted video.''

Some commenters, including the University of California, the National Roofing Contractors Association, and, AIA, stated that use of a FPV device should be allowed to meet the visual-line-of-sight requirements of this rule under certain circumstances, such as when other navigation and control technologies are available in the vehicle (*e.g.,* autonomous flight, onboard geo-fencing, sense-and-avoid technology) and mitigating measures are required (*e.g.* altitude, weight, location, and speed limitations, location or the use of visual observers). Exelon and Skyview Strategies said that FAA should include specific criteria or standards under which the technology would be allowed to be used, either alone or in conjunction with other technologies and procedures.

Other commenters supported the NPRM's proposed limitation on the use

of technology to maintain visual line of sight. Commenters, including NAAA, ALPA, SkySpecs, and the U.S. Hang Gliding & Paragliding Association, pointed out that FPV technology remains unproven and unreliable and the FPV field of view is limited. ALPA specifically stated that ''[t]he use of an on-board camera cannot replace the awareness provided by direct observation by the operator/pilot or designated visual observer.''

FPV technology works by transmitting video feed from a camera carried by the small unmanned aircraft to the control station. The problem with relying on FPV technology for the ability to see and avoid other aircraft in the NAS is that an FPV camera's field-of-view is currently either very limited (narrow-field-of-view lens ≤30 degrees horizontal and 10 degrees vertical) or distorted (usually fish-eyed if using a wide-field-of-view lens). A narrow field-of-view lens poses a safety issue because it restricts the user's peripheral vision, which is used to detect incoming aircraft or other objects that may pose a safety hazard. A wide-field-of-view lens poses a safety issue because it reduces the angular resolution available to the user, making it necessary for an object in the monitor to be closer to the camera before it covers enough pixels for the remote pilot to be able to detect it. In addition, FPV relies on a video transmitter to broadcast the image to the remote pilot. These transmitter/receiver units are commonly available in several frequency bands from 900 MHz to 5.8 GHz, each frequency band having distinct advantages and disadvantages as to range, susceptibility to interference, and ability to penetrate foliage.

As of this writing, the FAA does not have validated data to indicate whether FPV can be used to safely conduct operations beyond visual line of sight and if so, what FPV performance specifications are required to support those operations. The FAA acknowledges that FPV cameras have been used by hobbyists for many years and that the technology is advancing rapidly within the growing industry. However, as discussed previously, FPV cameras have technical limitations and the FAA does not possess the data necessary to support a regulatory standard at this time.

The FAA also acknowledges the comments concerning technological or operational mitigations that could be used in conjunction with FPV. However, those mitigations have significant potential shortcomings that need to be explored prior to allowing them to be used in the NAS. For example, one of the commenters suggested the use of pan-tilt camera systems to mitigate for the shortcomings in FPV technology. While a pan-tilt system can allow a narrow-angle camera to scan a wider field of view, the system is still significantly inferior to the peripheral vision of the human eye, which can discern movement across the entire field of view, approaching 180 degrees in normal vision. Another commenter suggested the use of a wearable heads-up display. However, while a wearable heads-up display could possibly address some concerns about low-quality resolution present in wide-angle cameras, sharing the screen area with a second ground-based camera feed could further compound the resolution issue. Additionally, the ability for a camera to provide a wider field of view also generally carries with it the significant downside of needing increased radio bandwidth for the higher resolution video. This could make the video feed more susceptible to increased noise interference or it could reduce the angular resolution, affecting target discernibility.

While data on FPV technology and potential associated mitigations is currently limited, the FAA recognizes the potential for this technology to provide a means of operating a small UAS beyond visual line of sight. For this reason, the FAA is currently conducting a pathfinder initiative with BNSF Railroad to gather safety data on operating beyond the visual line of sight of the remote pilot in rural/isolated areas. The FAA is also conducting a second pathfinder initiative with PrecisionHawk to gather data on UAS flights in rural areas outside the remote pilot's direct vision. The FAA anticipates that data from these initiatives could help inform its approach to extend visual line of sight operations in future agency actions.

Further, to reflect the changing state of UAS technology and the limited data available at this time, the FAA has made the visual-line-of-sight requirements of this rule waivable. An applicant will be able to obtain a waiver for an operation conducted differently than what is required by the visual-line-of-sight requirements of part 107 if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver. The FAA also emphasizes that this rule does not prohibit the use of FPV devices as long as the device is not used to meet the visual-line-of-sight requirements of part 107.

Several commenters argued that small UAS operations should be permitted to go beyond visual line of sight when certain other technologies are used. Predesa argued that visual pattern recognition technology to detect terrain and aircraft hazards could be used to mitigate the risk associated with beyond-visual-line-of-sight operations. The Oregon Department of Aviation, the Agricultural Technology Alliance, and the New Hampshire Department of Transportation Bureau of Aeronautics (New Hampshire Department of Transportation), among others, asserted that utilizing geo-fencing to constrain unmanned aircraft flight should safely permit beyond-visual-line-of-sight operations. In addition to these, other technologies suggested by the commenters included light detection and ranging (LIDAR), Traffic Collision Avoidance System (TCAS), automatic dependent surveillance-broadcast (ADS–B), and automated navigation. The National Ski Areas Association noted that ''collision detection and avoidance systems are in development,'' and said that the final rule needs to ''recognize and accommodate'' these and other technological innovations.

Many of the technologies suggested by the commenters only partially mitigate possible hazards. For instance, automated navigation and geo-fencing could protect against terrain and ground obstructions but would not reveal manned aircraft transiting the flight area. Conversely, TCAS could reveal transponder-equipped aircraft but would be ignorant of terrain or non-transponder-equipped aircraft. Some of the mentioned technologies, such as LIDAR and visual pattern recognition, have potential to detect both ground and airborne obstacles, but no commenters provided data to support a particular standard or a testing means to validate the ability and reliability of that technology. As of this writing, the FAA does not have sufficient data to find that a technology can safely satisfy the see-and-avoid requirement of part 107. Consequently, the FAA will consider these situations on a case-by-case basis through the waiver process. The FAA will also use the waiver process as one means by which to evaluate new technologies as they become more developed.

Commenters, including Boeing Commercial Airplanes (Boeing), News Media Coalition, the Newspaper Association of America, NAMIC, Amazon, and Google, argued that a visual-line-of-sight requirement is unnecessary over certain areas such as those that are unpopulated, private property, controlled-access facilities, or where activities would be unduly restricted by a visual-line-of-sight requirement, and that operational

safeguards could be employed to ensure safe beyond-visual-line-of-sight operations. The types of unduly restricted activities could include newsgathering events where people must remain at a distance from the event, agriculture operations, underwriting or adjusting claims in dangerous locations, responses to natural disasters, firefighting, search and rescue, and law enforcement operations. The types of operational safeguards proposed could include operating under FAA-imposed restrictions on weight, range, location, and altitude; and operating along pre-programmed and pre-approved paths through the use of mapping, navigation, and contingency management software.

The FAA recognizes that the location of a small UAS flight could affect the inherent risk of the operation. However, as discussed previously, there is currently limited data concerning operations conducted beyond visual line of sight. The FAA is working to acquire additional safety data as part of its pathfinder initiatives, but that data will not be available within the timeframe envisioned by this rule. Because there are a significant number of variables involved in each individual operating environment and because the FAA has limited data on beyond-line-of-sight operations, this rule will not include a standard of general applicability for these types of operations. Instead, the FAA will consider each individual operating environment (as well as any mitigations) on a case-by-case basis as part of its consideration of a waiver application.

Several commenters, including the American Farm Bureau and the American Petroleum Institute, suggested that beyond-line-of-sight operations should be permitted over privately owned land where the operator would be able to close access to non-participants. These commenters provided examples of pipelines and utility lines.

The FAA recognizes that controlling the ground in the vicinity of the flight could mitigate hazards to persons and property on the ground. However, the primary concern underlying the visual-line-of-sight restriction in this rule is risk to other aircraft in the air. Because a property owner is generally limited in how much he or she can restrict other aircraft from operating near the property, the fact that a property is privately owned is not, by itself, sufficient to allow beyond-visual-line-of-sight operations. As discussed earlier, individuals wishing to operate beyond visual line of sight will be able to apply for a waiver, and the FAA will examine individual operating environments on a case-by-case basis as part of its evaluation of a waiver application.

AIA and JAM Aviation suggested that the first sentence of § 107.31 should be amended to read: ''With vision that is unaided by any device other than corrective lenses, the operator *and* visual observer must be able to see the unmanned aircraft throughout the entire flight.'' One individual stated § 107.31(b) should be amended to read: ''Determine the unmanned aircraft's attitude, altitude, and direction of flight.'' The commenter said the change is needed because for multi-rotor UAS, the direction of flight could be quite different from the nominal ''front'' of the aircraft. According to this commenter, the proposed wording could lead to confusion on what ''direction'' meant, whether it was the UAS's path or the direction (bearing) from the remote pilot's position.

As an initial matter, the FAA notes that, as discussed in section III.E.1 of this preamble, the NPRM-proposed position of operator has been replaced by the remote pilot in command. Additionally, the remote pilot in command is not required to be the person who manipulates the flight controls of the small UAS. Accordingly, this rule will require both the remote pilot in command and the person manipulating the flight controls of the small UAS to possess the ability to maintain visual line of sight of the small unmanned aircraft.

In response to the concerns raised by the commenters, the FAA has also clarified the regulatory text of § 107.31. As amended, § 107.31 states that the remote pilot in command, the visual observer (if one is used), and the person manipulating the flight control of the small UAS must be able to see the unmanned aircraft throughout the entire flight in order to: (1) Know the unmanned aircraft's location; (2) determine the unmanned aircraft's attitude, altitude, and direction of flight; (3) observe the airspace for other air traffic or hazards; and (4) determine that the unmanned aircraft does not endanger the life or property of another. This visual-line-of-sight ability must be exercised throughout the entire flight of the small unmanned aircraft by either: (1) The visual observer; or (2) the remote pilot in command and person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command).

Several commenters, including Modovolate, Small UAV Coalition, and Southern Company, asked the FAA to make clear that brief interruptions to visual line of sight should be permitted. One commenter asked that a quantitative limit on what qualifies as a momentary interruption should be established. Another individual asked the FAA to make clear that the remote pilot's primary mission is to scan the area for other aircraft and not to keep ''eyes on'' the small unmanned aircraft.

The FAA understands and accepts that the person maintaining visual line of sight may lose sight of the unmanned aircraft for brief moments of the operation. This may be necessary either because the small unmanned aircraft momentarily travels behind an obstruction or to allow the person maintaining visual line of sight to perform actions such as scanning the airspace or briefly looking down at the small UAS control station. For example, a remote pilot in command stationed on the ground utilizing a small unmanned aircraft to inspect a rooftop may lose sight of the aircraft for brief periods while inspecting the farthest point of the roof. As another example, a remote pilot in command conducting a search operation around a fire scene with a small unmanned aircraft may briefly lose sight of the aircraft while it is temporarily behind a dense column of smoke.

However, the FAA emphasizes that even though the remote pilot in command may briefly lose sight of the small unmanned aircraft, he or she always has the see-and-avoid responsibilities set out in §§ 107.31 and 107.37. The circumstances of what would prevent a remote pilot from fulfilling those responsibilities will vary depending on factors such as the type of UAS, the operational environment, and distance between the remote pilot and the unmanned aircraft. For this reason, the FAA declines to specify a quantitative value to an interruption of visual contact as it would have the effect of potentially allowing a hazardous interruption or prohibiting a reasonable one.

With regard to the comment concerning keeping ''eyes on'' the small unmanned aircraft, the FAA notes that the principles of scanning, long taught to manned aircraft pilots, include the dangers of ''tunnel vision'' and that an effective scan must encompass all areas of the environment a hazard could come from. The FAA agrees that to comply with § 107.31, the person maintaining visual line of sight must effectively scan the area and not necessarily be focused on constant visual contact with the small unmanned aircraft.

Several commenters suggested that the FAA impose a numerical limit on how far away a small unmanned aircraft may travel from the person maintaining

visual line of sight. ALPA, NBAA, NAAA, and the State of Nevada, Nevada Institute for Autonomous Systems and Nevada FAA-designated UAS Test Site, commenting jointly, argued that an appropriate specific numerical distance should be imposed and be based on study or test data. Predesa stated that a numerical limit can be determined by the performance of the UAS, taking into account a margin that allows for winds and wind gusts, and power characteristics of the UAS battery. FLIR Systems, Inc., Aviation Management, the City and County of Denver, Colorado,[79] and two individuals proposed specific numerical limits the FAA should impose on the area of operation. The numerical recommendations of these commenters varied widely from 1000 feet to 3 miles. An individual commenter suggested that some form of reliable and verifiable documenting of distance should be required.

The FAA declines to impose a numerical limit on how far away a small unmanned aircraft can travel from the person maintaining visual line of sight. A prescriptive numerical limit would not take into account situational-dependent operating factors and may preclude operations that could otherwise be conducted safely. Additionally, no commenter provided data to substantiate the belief that a numerical standard would provide a higher level of safety than the visual-line-of-sight standard proposed in the NPRM.

This rule will also not include a documentation requirement regarding the distance of a small unmanned aircraft. A distance documentation requirement would impose an unjustified cost on the public because the permissible distance of the small unmanned aircraft from the remote pilot in command will be situation-specific. For example, a remote pilot in command operating in excellent visibility conditions will be able to fly the small unmanned aircraft farther away from him or herself and still maintain visual line of sight. Conversely, a remote pilot in command operating in poorer visibility conditions will have a more limited area where he or she can fly the small unmanned aircraft and still maintain the required visual line of sight.

PlaneSense, Inc. and Cobalt Air, LLC, in a joint submission, stated that the rule should also require that the operator or a visual observer have line of sight to the ground over which the small unmanned aircraft is flying. However, requiring a remote pilot or visual observer to have line of sight to the ground will not enhance the safety of this rule, and may prohibit certain operations that could otherwise be conducted safely under part 107. For instance, a small UAS operation over a disaster area containing no persons or property on the ground would not need to have line of sight to the ground to ensure the safe operation of the small UAS.

Airports Council International—North America suggested that the first sentence of § 107.31 should be amended to read: ''With vision that is unaided by any device other than corrective lenses, the operator or visual observer must be able to see the unmanned aircraft *and other aircraft to which the unmanned aircraft could pose a collision risk* throughout the entire flight in order to . . . . ''

The FAA declines this suggestion because the requirement to be aware of other aircraft is already encompassed by the pertinent regulatory text of part 107. Specifically, § 107.31(a)(3) will require the remote pilot in command, the visual observer (if one is used), and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) to be able to see the unmanned aircraft throughout the entire flight in order to observe the airspace for other air traffic or hazards. Other aircraft are considered air traffic and are thus covered by the regulatory text of § 107.31(a)(3).

The Washington State Department of Transportation, Aviation Division concurred ''with the line-of-sight and reduced visibility parameters as described, with the exception that certain verified research and development operations . . . be allowed on a case-by-case basis, and for unique situations such as aerial observation to support firefighting where redundant systems may alleviate line-of-sight and visibility limitations.''

As an initial matter, the FAA notes that operations, such as those in support of firefighting, will not be subject to the provisions of part 107 if conducted as public aircraft operations. With regard to case-by-case determinations, the visual-line-of-sight restrictions of this rule will be subject to waiver. This means that a person will be able to apply for and obtain a certificate of waiver from the provisions of § 107.31 if the person establishes that the proposed operation can safely be conducted under the terms of a certificate of waiver. The FAA will evaluate waiver requests on a case-by-case basis.

Commenters including several state farm bureau federations and FLIR Systems argued that a visual-line-of-sight requirement could potentially negate the cost and time savings associated with small UAS operations conducted over large swaths of land because the requirement would necessitate multiple flights to complete the operations. According to these commenters, the potential safety risks associated with operations would also increase because more frequent takeoffs and landings would be required.

The commenters did not provide any data showing that there is increased risk or costs associated with the takeoff or landing of a small unmanned aircraft. As such, the FAA declines to change this rule on the basis suggested by the commenters. However, as discussed in sections III.E.1 and III.E.3.a.i of this preamble, this rule has been changed from the NPRM to allow: (1) The flight of a small unmanned aircraft over a sparsely populated area from a moving vehicle; and (2) a remote pilot in command to extend the area of operation by handing off control mid-flight to another remote pilot in command. Both of these changes, as well as the ability to apply for a waiver, will allow for additional operational flexibility under this rule.

A large number of commenters, including the Airborne Law Enforcement Association, Embry-Riddle Aeronautical University, and the Associated General Contractors of America, argued that visual line of sight should not apply to certain specific operations. Those operations included:

- Public safety/emergency.
- Conservation-focused operations.
- Operations by electric utilities for line inspection or for storm-damage restoration.
- Oil industry inspections.
- Property inspections.
- Agriculture.
- Newsgathering.
- Operations within a structure.

As an initial matter, the FAA does not regulate UAS operations conducted inside an enclosed structure. Similarly, as discussed earlier in this preamble, part 107 will not apply to public aircraft operations unless they voluntarily choose to operate as civil aircraft. Most public safety operations are conducted as public aircraft operations and will continue to be authorized by COA. Therefore, these types of operations, when conducted in accordance with a COA, will be unaffected by the requirements of part 107.

With regard to the other operations suggested by the commenters, there is currently no data indicating that the

[79] This commenter submitted comments on behalf of its Department of Aviation, owner and operator of Denver International Airport.

nature of the small UAS operation mitigates the risk associated with operations conducted beyond visual line of sight. The FAA recognizes that there are a variety of uses for UAS that this rulemaking will not enable. However, there are also a number of small UAS uses that will be enabled by this rule. If the FAA were to delay issuance of this rule until it had sufficient data to generally allow beyond-visual-line-of-sight operations, the societal benefits that could be realized by immediately allowing operations within visual line of sight would be delayed as well. Thus, the FAA will utilize the incremental approach discussed earlier in this preamble, under which the FAA will issue a rule for the lowest risk UAS activities while pursuing future rulemaking to expand their use. Additionally, as discussed previously, the waiver authority in this rule will enable the FAA to examine, on a case-by-case basis, any mitigation provided by the operating environment in the specific operations discussed by the commenters.

A number of commenters, including the National Roofing Contractors Association, Vail Resorts, Rocky Mountain Farmers Union, and MAPPS, suggested that small UAS operators should be permitted to extend their visual line of sight through the use of one or more visual observers who maintain visual line of sight while in constant communication with the operator. Continental Mapping Consultants, Inc. (Continental Mapping) similarly advocated for the use of one ''or many'' remote visual observers ''daisy chained'' throughout the operational area, while in constant contact with each other and the operator. The National Association of Broadcasters, the National Cable & Telecommunications Association, and Radio Television Digital News Association also asked the FAA to reconsider its proposed prohibition on a relay or ''daisy chain'' of visual observers. Specifically, the commenters said that the FAA should revise § 107.33(b) to require that either the operator or a visual observer be able to see the small UAS at all points during the flight.

The Colorado Cattlemen's Association asserted that ''adequate operational and public safety can be ensured'' if operator visual line of sight is augmented by an additional visual observer who maintains visual line of sight while in communication with the operator. The association did not advocate for an ''extensive or unlimited number'' of observers to extend the range of UAS operations, but said a reasonable balance can be reached to allow more practical uses of UAS (such as operations on cattle ranches).

Allowing remote pilots to extend their visual line of sight through the use of one or more visual observers may introduce new hazards into the operation. As discussed in the next section of this preamble, the visual observer's role in the operation is limited to simply maintaining visual line of sight and communicating what he or she sees to the remote pilot. Allowing ''daisy chaining'' of visual observers to fly the unmanned aircraft beyond line of sight of the remote pilot in command would result in a delay in the remote pilot's reaction time because the visual observer would have to verbalize any hazard and the remote pilot would be unable to look up and directly see the situation. Instead, the remote pilot would have to respond to the hazard by formulating and executing a maneuver based on his or her understanding of the information received from the visual observer rather than a direct visual perception of the hazard.

Because a delay in reaction time may introduce new hazards into the operation, this rule will retain the requirement that the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) must be able to see the small unmanned aircraft throughout the entire flight. However, as discussed earlier, the visual-line-of-sight requirements of this rule will be waivable. Additionally, the FAA notes that it is currently engaged in research and testing on how a communication error could affect the ability of the remote pilot to correctly apply avoidance maneuvers, and this data will help inform future agency actions.

Textron Systems, the National Association of Realtors, Trimble Navigation, and ArgenTech Solutions recommended that this rule provide an operator with the ability to hand off control and responsibility for flight during the course of an operation. Textron Systems recommended that the rule ''allow passing of 'operator in command' during flight operations as long as the system and the operational construct meet other requirements of the rule.'' Trimble proposed that the FAA should explicitly permit multiple operators using networked radios and control stations to operate a single UAS. Under Trimble's proposal, operators would transition control of the UAS from one operator to another while ensuring see-and-avoid concerns are met. Trimble also asserted that the technology needed to network radios and control stations is utilized in other countries for small UAS operations and has been found to be effective. The National Association of Realtors added that ''daisy chaining'' operators does not pose a safety concern because ''[t]he real-time corrections necessary to perfect an UAS flight could be made instantaneously, rather than the observer communicating with the operator and there being a lag in the time the correction is orally given and then made within the operation.'' NetMoby, on the other hand, recommended prohibiting hand-off ability because it could create an ''endless daisy chain of operators.''

The FAA agrees with the commenters who stated that transfer of control of a small UAS should be allowed between certificated remote pilots. This can be accomplished while maintaining visual line of sight of the UAS and without loss of control. Multiple certificated remote pilots handing off operational control does not raise the same safety concerns as a daisy chain of visual observers because, unlike a visual observer, the remote pilot in command will have the ability to directly control the small unmanned aircraft. Thus, two or more certificated pilots transferring operational control (*i.e.* the remote pilot in command designation) to each other does not raise the delayed-reaction-time issue that arises with visual observers having to communicate what they see to another person who actually manipulates the small UAS flight controls.

Accordingly, as discussed in section III.E.1 of this preamble, multiple certificated remote pilots may choose to transfer control and responsibility while operating a small UAS. For example, one remote pilot may be designated the remote pilot in command at the beginning of the operation, and then at some point in the operation another remote pilot may take over as remote pilot in command by orally stating that he or she is doing so. The FAA emphasizes that as the person responsible for the safe operation of the UAS, any remote pilot who will assume remote-pilot-in-command duties should be aware of factors that could affect the flight.

b. Visual Observer

For the reasons discussed below, this rule will finalize the position of visual observer as follows. First, this rule will define a visual observer as a person who assists the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person

is not the remote pilot in command) to see and avoid other air traffic or objects aloft or on the ground. Second, the visual observer will remain an optional crewmember who will not be required to obtain an airman certificate. Third, the remote pilot in command will have to ensure that the visual observer is positioned in a location that allows him or her to see the unmanned aircraft in the manner specified in § 107.31. Fourth, the visual observer, the remote pilot in command, and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) will be required to coordinate in order to: (1) Scan the airspace where the small unmanned aircraft is operating for any potential collision hazard; and (2) maintain awareness of the position of the small unmanned aircraft through direct visual observation. Finally, this rule will require the visual observer, the remote pilot in command, and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) to maintain effective communication, and it will allow the use of technology, such as radios, to assist with the communication.

i. Definition of Visual Observer

The NPRM proposed to define a visual observer as a person who assists the operator to see and avoid other air traffic or objects aloft or on the ground. Skycatch suggested that the definition of visual observer should be revised to say ''sense and avoid'' rather than ''see and avoid'' because the term ''sense and avoid'' is the term required by Congress. According to Skycatch, the term ''see and avoid'' does not appear in Public Law 112–95, whereas the term ''sense and avoid'' appears in three locations in the enabling legislation.

As discussed earlier, this rulemaking is being conducted under section 333 of Public Law 112–95. Subsection 333(b)(1) requires the FAA to determine, in pertinent part, what type of UAS operations do not ''create a hazard to users of the national airspace system.'' A critical component of that determination is whether the operation is conducted ''within visual line of sight.'' *Id.* Section 333 does not use the term ''sense and avoid.''

As discussed in the previous section, the FAA does not currently have data indicating that small UAS technology has matured to the point that would safely allow small UAS to be operated beyond visual line of sight. To reflect this fact, as well as the fact that section 333 explicitly focuses on operations within visual line of sight as a critical consideration, this rule will retain the proposed ''see and avoid'' terminology in the definition of visual observer. Accordingly, this rule will define visual observer as a person who assists the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) to see and avoid other air traffic or objects aloft or on the ground.

ii. Operational Requirements When Using Visual Observer

The NPRM also proposed a set of operational requirements for operations that use a visual observer. First, the operator and visual observer would be required to maintain effective communication with each other at all times. Under the NPRM, the operator and visual observer would not have to stand close enough to hear each other without technological assistance; instead, they could use a communication-assisting device, such as a radio, to communicate while standing farther apart from each other. Second, the operator would be required to ensure that the visual observer be positioned in a manner that would allow him or her to maintain visual line of sight of the small unmanned aircraft. Third, the operator and visual observer would be required to coordinate to: (1) Scan the airspace where the small unmanned aircraft is operating for any potential collision hazard; and (2) maintain awareness of the position of the small unmanned aircraft through direct visual observation. This rule will finalize the above provisions as proposed, but, due to the change in the crewmember framework, this rule will refer to the remote pilot in command and the person manipulating the flight controls of the small UAS instead of ''operator.''

Approximately 20 organizations and 8 individual commenters, including NRECA, AIA, and the Association of American Universities and the Association of Public Land-grant Universities, commenting jointly, agreed with the NPRM proposal that the visual observer should not be required to stand close enough to the operator to allow for unassisted verbal communication. These commenters generally agreed that the operator and visual observers should maintain effective communication with one another and added that effective communication can be achieved with the use of technology, such as a two-way radio or cell phone. NRECA stated that there is no additional safety benefit from requiring the visual observer to stand close enough to the operator to allow for unassisted verbal communication. In fact, NRECA continued, such a requirement might negatively impact safety by prohibiting a visual observer from adopting a vantage point that affords a different field of view from the operator (*i.e.,* a field of view that complements and is not merely duplicative of the operator's field of view).

Aviation Management, NBAA, and NRECA further stated that the method of effective communication should be decided by the operator and visual observer. Planehook and an individual added the operator and visual observer should have a contingency plan if electronic communications fail.

ALPA supported the use of communication-assisting devices, but asked the FAA to State (in the preamble and in advisory material) that the ability to maintain communication using any device is necessarily complicated by the fact that the pilot/operator typically uses both hands to control the small UAS. ALPA asserted that this complication limits the possibilities of using assisting devices considerably, essentially to two-way radiotelephony with a constant (*i.e.,* ''hot'') transmit-receive capability.

In contrast to the above commenters, the Colorado Agricultural Aviation Association and NAAA said that the visual observer should be able to communicate with the UAS operator ''from the most minimal distance possible.''

This rule will require the remote pilot in command, the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command), and the visual observer to maintain effective communication, but it will also allow the remote pilot in command to determine how that communication will take place. The FAA agrees that effective communication is essential, but there are circumstances where this can be accomplished at a distance through technological assistance. As the commenters pointed out, effective communication at a distance can easily be achieved using existing technology, such as a two-way radio or a cell phone.

In response to ALPA's concern that the person manipulating the small UAS flight controls may be unable to simultaneously manipulate the controls of a communication device, the FAA notes that existing technology provides a number of options for hands-free communication, such as an earpiece, a headset, or the ''speaker'' mode on a cell phone. The remote pilot in command may choose any communication-assisting technology as long as that technology: (1) Allows for effective

communication; and (2) does not interfere with the safe operation of the small UAS. The FAA also agrees that the choice of effective communication should be agreed upon by the remote pilot in command and the visual observer, and that it is a good safety practice to have a contingency plan.

The National Association of Broadcasters, the National Cable & Telecommunications Association, Radio Television Digital News Association, and MPAA asserted that proposed § 107.33(b) conflicts with the visual-line-of-sight requirements of § 107.31. These commenters asserted that proposed § 107.31 stated that either ''the operator *or* visual observer must be able to see the unmanned aircraft throughout the entire flight'' (emphasis added). However, proposed § 107.33(b) stated that when a visual observer is used, ''[t]he operator must ensure that the visual observer is able to see the unmanned aircraft.''

As explained earlier, the visual-line-of-sight framework requires the remote pilot in command, the person manipulating the flight controls of the small UAS, and the visual observer to always have visual-line-of-sight capability. The visual observer can exercise this capability instead of the remote pilot in command and person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command), but under this rule, everyone must have the visual-line-of-sight capability, even if they are not exercising it. As noted earlier, the visual observer cannot maneuver the small unmanned aircraft, so there is a potential delay in response time if the person manipulating the flight controls and the remote pilot in command are unable to see what is happening and must rely solely on the description provided by the visual observer. The FAA agrees with commenters that, as proposed, the regulatory text of § 107.31 was unclear because it implied that either the operator or visual observer (but not both) had to be positioned in a manner that allowed for visual line of sight. Accordingly, the FAA has amended the regulatory text of § 107.31 to clarify that all crewmembers must have the ability to maintain visual line of sight.

One commenter suggested that the visual observer should be required to stand close enough to the operator that the line of sight of the visual observer will not deviate from the operator's line of sight when the operator is using an FPV device. Another commenter objected to the proposed requirement that a visual observer must be positioned in a way that allows them to always maintain visual line of sight. The commenter asserted that this requirement would significantly limit the operational area for operations that use multiple visual observers because the small unmanned aircraft could only be flown in an area where the visual observers' individual lines of sight overlap so that each observer could satisfy the proposed line-of-sight requirement.

The FAA declines to add a requirement that the visual observer must stand close enough to the remote pilot in command to have the same visual line of sight. The remote pilot in command, the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command), and the visual observer will be able to satisfy their see-and-avoid responsibilities if they are each positioned in a manner where they have sufficient visual line of sight of the unmanned aircraft and surrounding airspace (as specified in § 107.31). This can be accomplished without each person having the same exact line of sight as the other people involved in the operation. The FAA also emphasizes that even though part 107 will not prohibit the use of an FPV device by the remote pilot in command, FPV may not be used to meet the visual-line-of-sight requirements of this rule.

With regard to the use of multiple visual observers, the FAA acknowledges the concern raised by the commenter. As noted by the commenter, § 107.33(b) requires that when a person is acting as a visual observer, he or she must be positioned in a location where he or she can perform the visual-line-of-sight duties of the visual observer. However, this rule does not require that a person remain in the role of a visual observer for the entire duration of the small UAS operation. When a person is not acting as a visual observer, he or she is not required to perform the duties of a visual observer and need not be placed in a location where he or she can maintain visual line of sight of the small unmanned aircraft. This provides significant operational flexibility because the remote pilot in command can activate and deactivate pre-positioned visual observers to assist with maintaining visual line of sight. The FAA emphasizes, however, that the remote pilot in command is responsible for the small UAS operation and must ensure that any hand-off of visual observer responsibility is done safely and in compliance with §§ 107.31 and 107.33.

TTD asked the FAA to clarify the proposed requirement that the operator and visual observer must coordinate so that they ''maintain awareness of the position of the small unmanned aircraft through *direct visual observation.''* (Emphasis added.) TTD pointed to an NPRM statement that it would be permissible for one's line of sight to be temporarily obstructed by an object and asked the FAA to clarify when and to what degree obstruction of one's visual observation is permitted under § 107.33(d)(2).

As discussed in the previous section of the preamble, this rule allows for the possibility that the person maintaining visual line of sight may briefly lose sight of the small unmanned aircraft. As noted in that section, the FAA declines to impose quantitative limits on visual-line-of-sight interruptions. Instead, an interruption to line-of-sight of the small unmanned aircraft is permissible if: (1) It is brief; and (2) the person maintaining visual line of sight is still capable of complying with the see-and-avoid responsibilities of §§ 107.31, 107.33 (if applicable), and 107.37.

iii. Optional Use of a Visual Observer

Under the proposed rule, a visual observer would be an optional crewmember who could be used to augment the small UAS operation. For the reasons discussed below, this rule will finalize this NPRM provision as proposed.

Several commenters argued that a visual observer should always be required in order to satisfy the visual-line-of-sight requirements of part 107. ALPA and TTD asserted that small unmanned aircraft are difficult to observe given their size and speed capabilities, and that this difficulty, combined with the remote pilot's need to look down at the controls periodically, makes a visual observer a critical crewmember for the safe operation of a small unmanned aircraft. Similarly, NAAA stated that the FAA's proposal not to require a visual observer is at odds with the fundamental see-and-avoid and visual-line-of-sight principles of the rule. NAAA argued that the NAS would be endangered by the absence of a visual observer in those situations in which the remote pilot temporarily lacks the ability to see and avoid other aircraft.

Several commenters stated that in the absence of a visual observer, a remote pilot would not be able to maintain situational awareness of activities in the air and on the ground. JAM Aviation stated that a remote pilot cannot easily monitor conditions in the air and on the ground simultaneously, and that a visual observer is needed to assist the remote pilot in doing so. Texas A&M University-Corpus Christi Lone Star

UAS Center of Excellence & Innovation (Texas A&M University-Corpus Christi/LSUASC) stated that a visual observer should be required until technology comes into existence, such as first-person view, that would provide ''situational awareness and [a] level of risk-mitigation comparable to that of a pilot in the cockpit of a commercial aircraft.'' Similarly, another commenter argued that a visual observer should be required ''unless some form of situational awareness aid is available which would allow the operator to simultaneously determine [small UAS] status and health as well as scan the surrounding airspace[.]''

It is not necessary to require a visual observer for all small UAS operations. Under the visual-line-of-sight framework of this rule, a visual observer can act as a limited substitute for the remote pilot in command and the person manipulating the flight controls with regard to maintaining visual line of sight of the small unmanned aircraft. The visual observer position will allow the person manipulating the small UAS flight controls and the remote pilot in command to perform tasks that require looking away from the small unmanned aircraft for a significant period of time or use observational technology (such as FPV) that limits their peripheral vision; which they can do if a visual observer is present because the visual observer will observe the small unmanned aircraft with the naked eye.

However, there are some small UAS operations in which the person manipulating the UAS flight controls (if that person is not the remote pilot in command) and the remote pilot in command will simply observe the small unmanned aircraft themselves throughout the entire operation. In those types of operations, there is no need for a visual observer to be present to maintain visual line of sight of the unmanned aircraft. In response to concerns about the ability of the remote pilot to maintain see and avoid if there is no visual observer present, the FAA notes that, as discussed previously, the person maintaining visual line of sight will have the same (if not better) ability to see and avoid other aircraft as a manned-aircraft pilot looking out the windshield of the manned aircraft. The fact that the person maintaining visual line of sight may briefly look away from the small unmanned aircraft to conduct other tasks such as scanning the surrounding airspace does not affect this conclusion because the ''look away'' will be brief. This situation is similar to manned-aircraft operations where a pilot can look away from the windshield to conduct another task such as scanning or manipulating the instrument panel.

As such, this rule will not require that a visual observer be present in all small UAS operations conducted under part 107. The FAA emphasizes, however, that if a visual observer is not present, then the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) must be the ones to exercise the visual-line-of-sight capability required by § 107.31. The FAA also emphasizes that the remote pilot in command will ultimately be responsible for the safe conduct of the small UAS operation. If the remote pilot in command determines, as part of the preflight assessment of the operating area required by § 107.49, that his or her particular small UAS operation cannot be conducted in a safe manner without a visual observer, then the remote pilot will be obligated to conduct the flight with a visual observer.

One commenter stated that the operation of a small unmanned aircraft is too complex to be conducted by just one person, and that a visual observer is needed to share the duties. According to this commenter, a visual observer should be used to ''assist the operator focusing on monitoring aviation air band radio transmissions, flight heights, distances, see-avoid aircraft requirements, spotting, etc.''

The FAA disagrees with the suggestion that the operation of a small UAS is too complex to be conducted by one person. Many small UAS operating under this rule are simple to control and will be limited to a confined area of operation. The remote pilot in command is responsible for the safe operation of the flight and can make a determination as to whether a visual observer or another certificated remote pilot is necessary based on the nature of the operation. For example, a remote pilot operating a small unmanned aircraft in a sparsely populated area at an altitude lower than nearby trees and buildings could safety conduct the operation without any other crewmembers.

iv. No Airman Certification or Required Training of Visual Observer

The NPRM proposed to not require airman certification or other mandatory testing or training for a visual observer. The FAA explained that because a visual observer would not be permitted to exercise independent judgment or operational control and because the visual observer's role in the operation would be limited simply to communicating what he or she is seeing to another person, the visual observer would not be an airman as defined by statute and would therefore not be statutorily required to obtain an airman certificate. The NPRM also explained that because of the limited role of the visual observer, there would be no need to exercise the FAA's regulatory authority to require the visual observer to obtain an airman certificate.[80] For the reasons discussed below, this rule will not require visual observers to be certificated or to satisfy any other qualification requirements.

Several commenters expressed support for the FAA's proposal to not require airman certification for visual observers on the basis that certification is unnecessary. Many submissions, including those from NRECA, the Nez Perce Tribe, and the National Association of Realtors, supported the FAA's proposal because a visual observer is optional for part 107 operations and is not responsible for operating the device. The Property Drone Consortium, NetMoby, Predesa, the National Association of Wheat Growers, and the American Petroleum Institute generally commented that a visual observer should not have to satisfy airman requirements. The Professional Society of Drone Journalists added that the only requirement for visual observers should be that they are capable of visually observing the small UAS and communicating with the remote pilot.

Other commenters suggested that airman certification should not be required for visual observers because the limited safety benefits of requiring certification would not justify the burden. Commenters including the University of Arkansas, Division of Agriculture and State Farm asserted that the costs of requiring visual observer airman certification would outweigh the benefits.

The Oklahoma Governor's Unmanned Aerial Systems Council said that imposing additional regulatory requirements on visual observers could increase safety risks since organizations would then be incentivized to minimize the number of visual observers due to cost and logistical issues. Similarly, NRECA suggested that the imposition of certification requirements could discourage the use of visual observers.

Multiple commenters expressed the opposite view and asserted that visual observers should be certificated by the FAA. NAAA stated that the visual observer should be certificated and should clearly understand his or her

[80] 49 U.S.C. 44701(a)(5) gives FAA the power to prescribe regulations that it finds necessary for safety in air commerce and national security.

role. CAPA recommended that only UAS remote pilots, licensed as such, be able to participate as visual observers. CAPA also raised the question of who would be held responsible if an accident were to occur due to an uncertificated visual observer's negligence. Textron Systems suggested that visual observers with safety-of-flight responsibilities may be considered to be flight crewmembers and should be certificated as such.

A few individuals generally argued that the same testing requirements should apply to all participants in small UAS operations, including the remote pilot and visual observer. One individual commented that a certificated visual observer could act as a safety redundancy backup for the operator. Another commenter suggested that UAS operator teams should follow a process similar to the traditional airman certification process. A third individual suggested that a visual observer should be required to hold a certificate similar to the ones held by air traffic controllers.

Under this rule, a visual observer will act only in a flight-support role to the remote pilot in command who will exercise operational control over the small UAS and will have final authority for the flight. Part 107 will not place any responsibility on the visual observer for the safety of the flight operation, as that responsibility falls on the remote pilot in command. Rather, the intended function of the visual observer under this rule will be to assist the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) with situational awareness during the flight as needed by observing, among other things, the small unmanned aircraft's location, other air traffic, obstacle clearance, and people on the ground, and effectively communicating those observations to the remote pilot in command.

The FAA emphasizes that this rule will not give a visual observer the power to act on his or her observations because the visual observer will not share in the operational control of the aircraft. Rather, the visual observer's role will be simply to convey his or her observations to the person who has operational authority and/or control of the small UAS and can act on those observations. Because the visual observer's role is limited to simply conveying his or her observations to other people, the visual observer does not need special mandatory training, testing, or certification in order to safely carry out that role. The FAA also finds that, due to the very limited role that the visual observer has in the small UAS operation, the visual observer is not an airman, within the meaning of the FAA's statute, and is thus not statutorily required to obtain an airman certificate.[81]

In response to CAPA's comment concerning liability due to a visual observer's negligence, the person who violates the pertinent regulations would be the one held liable. The FAA also notes that, depending on the circumstances, the remote pilot in command may be held responsible as he or she has final authority over the small UAS operation.

Several commenters suggested that visual observers should be required to complete mandatory training. The University of North Georgia stated that visual observers must be trained on basic FAA rules and proximity awareness. Similarly, Federal Airways & Airspace remarked that visual observers should have a training course, such as a see-and-avoid course. The University of North Dakota's John D. Odegard School of Aerospace Sciences recommended that visual observers complete a training syllabus and be tested in the same areas of knowledge as the remote pilot. AIA commented that visual observer training should be required prior to assuming duty. Another commenter suggested that visual observers should be trained on the applicable sections of part 91.

ALPA recommended development of guidance material outlining appropriate background and training for the visual observer, defining appropriate subjects for the operator/pilot to discuss with the visual observer prior to flight, and clarifying what constitutes visual observation in the context of safe UAS operation. Similarly, TTD requested that the FAA issue guidance indicating the training that visual observers should complete, and asserted that, without any requirement to display skill proficiency or determine vision quality, neither the visual observer, pilot, nor FAA can be sure that the visual observer is reliable. NAAA stated that having a set of untrained eyes does little to enhance safety if the visual observer sees a safety threat that the remote pilot does not see.

As discussed previously, the role of a visual observer is limited to simply communicating what he or she is seeing to the person manipulating the flight controls (if that person is not the remote pilot in command) and the remote pilot in command. Special training and testing is not necessary for a person to be able to communicate what he or she is seeing to another person. Thus, this rule will not require visual observers to complete special training courses or pass a test prior to serving as a visual observer. While the FAA has not included provisions in the rule to require visual observer airman certification or training, the FAA may, in the future, issue guidance to assist remote pilots who choose to utilize the visual observer function.

The FAA also emphasizes that under the other requirements of this rule, the remote pilot in command must, prior to flight, provide important information to the visual observer. This information will include an understanding of the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards. The remote pilot in command must also ensure that the visual observer understands and can properly utilize the method by which he or she will be maintaining effective communication with the remote pilot in command and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command).

Many commenters generally emphasized the remote pilot's responsibility to ensure that the visual observer is competent and appropriately trained. SWAPA supported the use of visual observers but emphasized that under the FAA's proposal, the onus would be on the remote pilot to ensure any visual observers used in the operation were familiar with all aspects of the operation. Similarly, Aerius Flight encouraged the FAA to require the remote pilot to ensure that the visual observer has become familiar with the critical aspects of the operation prior to assuming duties. NBAA stated that the remote pilot should ensure that a visual observer, if used, understands the limits of small UAS operations.

Planehook stated that training and certification of visual observers should be an internal function unique to companies and organizations that regularly require the use of visual observers for their commercial operations. Another commenter emphasized that the UAS remote pilot is responsible for all aspects of each

[81] *See* 49 U.S.C. 40102(a)(8). This statute defines an airman as an individual: ''(A) in command, or as pilot, mechanic, or member of the crew, who navigates aircraft when under way; (B) except to the extent the Administrator of the Federal Aviation Administration may provide otherwise for individuals employed outside the United States, who is directly in charge of inspecting, maintaining, overhauling, or repairing aircraft, aircraft engines, propellers, or appliances; or (C) who serves as an aircraft dispatcher or air traffic control-tower operator.'' The visual observer's limited role in the operation of a small UAS does not meet any of these criteria.

flight and must be in charge of selecting and training visual observers.

Additionally, several commenters, including Aviation Management and the Colorado Cattlemen's Association, mentioned that remote pilots should be responsible for briefing visual observers. Aviation Management emphasized the requirement for the remote pilot to ensure that all persons involved in the small UAS operation receive a briefing that includes operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards.

The FAA agrees that the remote pilot in command, in his or her role as the final authority over the small UAS operation, has ultimate responsibility for the safety of the operation and therefore should be responsible for selecting, training, and informing the visual observer (if one is used). The FAA also agrees with the commenters that a visual observer should be informed and understand all critical aspects of the small UAS operation prior to flight. That is why this rule will require the remote pilot in command to ensure that all persons directly participating in the small UAS operation, including the visual observer, are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards.

A joint submission from the State of Nevada, the Nevada Institute for Autonomous Systems, and the Nevada FAA-designated UAS Test Site said that the visual observer should be required to self-certify that he or she has the aeronautical knowledge and visual acuity necessary to safely perform the small UAS operation. AUVSI, Prioria Robotics, the Professional Society of Drone Journalists, and several other commenters said that the visual observer should be required to hold a valid U.S.-issued driver's license or an FAA-issued medical certificate, which would ensure a visual test but not be overly burdensome. Planehook stated that the remote pilot should determine the medical suitability of any visual observer to perform pre-briefed duties.

The FAA disagrees that a driver's license should be a prerequisite to serving as a visual observer. As discussed in section III.F.2.a of this preamble, according to the DOT Office of Highway Policy Information, 13 percent of the population aged 16 or older does not hold a State-issued driver's license.[82] Thus, requiring a U.S. driver's license would create an undue burden for many visual observers without a significant increase in safety because the skills necessary to obtain a driver's license are not the same skills needed to serve as a visual observer in a small UAS operation.

The FAA also disagrees that self-certification concerning aeronautical knowledge and visual acuity by a person acting as a visual observer should be required by this rule because, as discussed elsewhere in this preamble, this rule does not impose any aeronautical knowledge or visual acuity requirements on visual observers. A visual observer cannot self-certify that he or she meets requirements that do not exist in this rule.

Finally, the FAA declines the suggestion to impose a specific duty on the remote pilot in command to determine the medical suitability of a visual observer. This rule does not require the remote pilot in command to be a doctor or have any medical training. As such, evaluating the potentially complex medical condition of another human being could be beyond the remote pilot in command's expertise. The FAA notes, however, that it expects the remote pilot in command to exercise his or her authority when a potential visual observer is clearly incapable of carrying out his or her assigned duties. For example, the remote pilot in command would not be ensuring a safe small UAS operation if he or she designates a visual observer who clearly is incapacitated or is under the influence of alcohol or drugs at the time of the operation.

c. Additional Visibility Requirements

To further ensure that the person maintaining visual line of sight in a small UAS operation can see and avoid other aircraft, this rule will: (1) Limit small UAS operations conducted outside of daylight hours; and (2) impose weather-minimum and visibility requirements.

i. Daytime Operations

Due to the reduced visibility associated with nighttime operations, the NPRM proposed to prohibit the operation of a small UAS outside the hours of official sunrise and sunset. For the reasons discussed below, this rule will maintain the prohibition on nighttime operations but will allow small UAS operations to be conducted during civil twilight if the small unmanned aircraft has lighted anti-collision lighting visible for at least 3 statute miles. The nighttime-operations prohibition in this rule will also be waivable.

Approximately 25 commenters generally supported the proposed prohibition on operations outside the hours of official sunrise and sunset. ALPA noted that the prohibition is consistent with the ARC recommendations. The Minneapolis-Saint Paul Metropolitan Airports Commission (Metropolitan Airports Commission) asserted that nighttime operations introduce a number of visual illusions, and unlike manned-aircraft pilots, small UAS operators will not be required to complete comprehensive training programs that teach pilots how to deal with these illusions. The City and County of Denver, Colorado noted that allowing operations only in the lightest of conditions will increase the probability of avoidance in the event of a conflict.

Federal Airways provided some conditions and limitations under which they would support nighttime operations of UAS, but ultimately noted that if the goal is to be as least burdensome as possible, limiting operating hours to daylight hours only would eliminate the need for further specification in lighting requirements. The American Association of Airport Executives and Barrick Gold of North America, Inc. concurred with the nighttime operation prohibition, but added that in the future, technological advances may provide the opportunity to allow nighttime operations.

Other commenters objected to the proposed prohibition on nighttime operations. Skycatch, Clayco, AECOM and DPR Construction, commenting jointly, and several individuals, suggested that the proposed prohibition on nighttime operations be entirely eliminated from the final rule. Cherokee Nation Technologies and The Information Technology and Innovation Foundation asserted that nighttime operations can be safer than daytime operations because there is less air traffic and there are fewer people on the ground. EEI and AUVSI suggested that nighttime UAS operations are safer and less disruptive than nighttime manned-aircraft operations such as helicopters circling overhead. Virginia Commonwealth University Honors Students said the proposed ban on nighttime operations ignores the use of other senses, particularly sound, to detect and avoid other aircraft. DJI stated that because manned aircraft operating at night are required to be equipped with lighting, UAS operators would be able to satisfy their see-and-

[82] *See https://www.fhwa.dot.gov/policyinformation/pubs/hf/pl11028/chapter4.cfm* (stating that 87% of the population aged 16 or older holds a driver's license).

avoid requirements, even when operating at night.

A large number of commenters who opposed the daytime-only restriction of small UAS operations proposed several methods of mitigating hazards. The mitigation strategies were generally related to improving visibility to support see-and-avoid, augmenting see-and-avoid with technology, implementing additional restrictions for operations at night, and requiring additional certification or training. For example, the Airborne Law Enforcement Association, NBAA, and the National Ski Areas Association said nighttime operations of small UAS could be conducted safely if the aircraft is equipped with proper lighting. The National Association of Broadcasters, National Cable & Telecommunications Association and Radio Television Digital News Corporation, commenting jointly, and the Associated General Contractors of America supported nighttime operations in well-lit areas, such as closed sets or sites of sporting events. The Kansas State University UAS Program cited preliminary research that, it argued, indicates that UAS equipped with navigation lights are often easier to see at night than during the day.[83]

Nighttime operations pose a higher safety risk because the reduced visibility makes it more difficult for the person maintaining visual line of sight to see the location of other aircraft. While the existence of other lighted manned aircraft may be apparent due to their lighting, the distance and movement of small unmanned aircraft relative to the distance and movement of those aircraft is often difficult to judge due to the relative size of the aircraft. In addition, visual autokinesis (the apparent movement of a lighted object) may occur when the person maintaining visual line of sight stares at a single light source for several seconds on a dark night. For this reason, darkness makes it more difficult for that person to perceive reference points that could be used to help understand the position and movement of the lighted manned aircraft, the small unmanned aircraft, or other lighted object.

The lack of reference points at night is problematic for small UAS subject to part 107 because they are not required to have any equipage that would help identify the precise location of the small unmanned aircraft. As such, a remote pilot in command operating under this rule will generally rely on unaided human vision to learn details about the position, attitude, airspeed, and heading of the unmanned aircraft. This ability may become impaired at night due to a lack of reference points because all a remote pilot may see of his or her aircraft (if it is lighted) is a point of light moving somewhere in the air. For example, a lighted small unmanned aircraft flying at night may appear to be close by, but due to a lack of reference points, that aircraft may actually be significantly farther away than the remote pilot perceives. An impairment to the remote pilot's ability to know the precise position, attitude, and altitude of the small unmanned aircraft would significantly increase the risk that the small unmanned aircraft will collide with another aircraft.

In addition to avoiding collision with other aircraft, remote pilots in command must also avoid collision with people on the ground, as well as collision with ground-based structures and obstacles. This is a particular concern for small UAS because they operate at low altitudes. When operating at night, a remote pilot may have difficulty avoiding collision with people or obstacles on the ground which may not be lighted and as a result, may not be visible to the pilot or the visual observer. As such, this rule will not allow small UAS subject to part 107 to operate at night (outside of civil twilight) without a waiver.

The Motion Picture Association of America (MPAA) and several individuals recommended that small UAS operations be permitted between civil dawn and civil dusk. The commenters stated that there is sufficient light during civil twilight to see and avoid ground-based obstacles. One commenter compared UAS to ultralight vehicles, citing precedent in § 103.11(b), which allows ultralight vehicles to be operated during civil twilight, provided the vehicle is equipped with an operating anti-collision light visible for at least 3 statute miles. The Drone User Group Network suggested that with appropriate lighting, a small UAS would in fact be more visible in low light than during the day, thus enabling the remote pilot to exercise his or her visual-line-of-sight responsibility. Many of the comments cited photography as a type of operation that could be conducted during twilight hours.

Civil twilight is a period of time that, with the exception of Alaska,[84] generally takes place 30 minutes before official sunrise and 30 minutes after official sunset. The FAA agrees with commenters that operations during civil twilight could be conducted safely under part 107 with additional risk mitigation because the illumination provided during civil twilight is sufficient for terrestrial objects to be clearly distinguished during clear weather conditions. As a result, many of the safety concerns associated with nighttime operations are mitigated by the lighting that is present during civil twilight. That is why current section 333 exemptions permit twilight UAS operations. Accordingly, this rule will allow a small UAS to be operated during civil twilight.

However, while civil twilight provides more illumination than nighttime, the level of illumination that is provided during civil twilight is less than the illumination provided between sunrise and sunset. To minimize the increased risk of collision associated with reduced lighting and visibility during twilight operations, this rule will require small unmanned aircraft operated during civil twilight to be equipped with anti-collision lights that are visible for at least 3 statute miles.

A remote pilot in command may reduce the intensity of the anti-collision lights if, because of operating conditions, it would be in the interest of safety to do so. For example, the remote pilot in command may reduce the intensity of anti-collision lights to minimize the effects of loss of night vision adaptation. The FAA emphasizes that anti-collision lighting will be required under this rule only for civil twilight operations; a small unmanned aircraft that is flown between sunrise and sunset need not be equipped with anti-collision lights.

The FAA acknowledges that current exemptions issued under Public Law 112–95, section 333 allow civil twilight operations without a requirement for anti-collision lighting. However, the section 333 exemptions do not exempt small UAS operations from complying with § 91.209(a), which requires lighted position lights when an aircraft is operated during a period from sunset to sunrise (or, in Alaska, during the period a prominent unlighted object cannot be seen from a distance of 3 statute miles or the sun is more than 6 degrees below the horizon). As such, UAS currently operating under a section 333

[83] The comment provided a link to a news article containing a short summary of the Kansas State University UAS Program's preliminary analysis of its research but did not provide the actual research. The linked article also did not include all of the assumptions and methodology used in the research or the data collected during testing. Finally, the article concluded by noting that ''more analysis is needed.'' As a result, the FAA does not currently have sufficient information to evaluate the research cited in the comment.

[84] Civil twilight in Alaska is discussed later in this section of the preamble.

exemption have lighting requirements when operating during civil twilight.

However, while current section 333 exemptions rely on position lighting, it would be impractical for this rule to prescribe specifications for position lighting for civil twilight operations because a wider range of small unmanned aircraft will likely operate under part 107. Position lighting may not be appropriate for some of these aircraft. Thus, instead of position lighting, small unmanned aircraft operating under part 107 will be required to have anti-collision lights when operating during civil twilight.

The FAA also notes that meteorological conditions, such as haze, may sometimes reduce visibility during civil twilight operations. Accordingly, the FAA emphasizes that, as discussed in the following section of this preamble, this rule also requires that the minimum flight visibility, as observed from the location of the ground control station, must be no less than 3 statute miles.

Several commenters, including the Nature Conservancy, MPAA, Commonwealth Edison Company, the American Fuel & Petrochemical Manufacturers, and the Newspaper Association of America, suggested that certain types of operations should be exempt from the proposed nighttime prohibition. These operations include: Emergency operations, public service operations, hazardous material response, railroad incident management, public utility inspection and repair, pipeline monitoring, thermal roof inspections using infrared technology, conservation-related operations in sparsely populated areas, ski area operations where people and property can be easily avoided, news-reporting, and filming in controlled, well-lit areas. The American Farm Bureau and several other commenters claimed that certain UAS operations are best conducted at night. These operations include research and humanitarian operations, crop treatments, wildfire fighting, nocturnal wildlife monitoring, infrastructure monitoring, and operations using infrared and thermal imaging cameras. The Property Drone Consortium stated that a daylight-only requirement would restrict the ability of its members to conduct thermal imaging using small UAS.

Commonwealth Edison stated that the proposed restriction to daylight-only operations would constrain the ability to use small UAS to respond to emergencies that occur outside of daylight hours. Similarly, NRECA stated that the restriction to daylight operations would severely impede its members' ability to respond to electrical grid emergencies caused by weather. Both Commonwealth Edison and NRECA suggested that the final rule include deviation authority to allow nighttime operations if it can be shown that such operations can be conducted safely. Similarly, Boeing, the University of North Dakota's John D. Odegard School of Aerospace Sciences, and DJI recommended that the proposed nighttime-operation prohibition be amended to allow waivers to be authorized by the Administrator to accommodate time-critical and emergency operations that may need to be conducted at night if those operations can be conducted safely.

The FAA agrees with commenters that there could be benefits to allowing certain small UAS operations at night, such as search and rescue or firefighting operations when those operations are conducted as civil operations. As such, the nighttime-operation prohibition in this rule will be waivable. The FAA will consider granting a certificate of waiver allowing a nighttime small UAS operation if an applicant can demonstrate sufficient mitigation such that operating at night would not reduce the level of safety of the operation.

The American Petroleum Institute recommended an exception for Alaska's North Slope, an area of significant operations for the oil and gas industry. The commenter noted that there are no daylight hours for approximately 3 months of the year in that area.

The same safety concerns exist in northern Alaska as they do anywhere in the United States during periods of darkness. However, as discussed previously, this rule will allow small UAS operations to be conducted during civil twilight. This will add significantly greater flexibility to Alaska operations because for the northernmost portions of Alaska, the sun never rises for as many as 64 days a year. By allowing operations to take place during civil twilight, this rule will allow small UAS operations year round, even in Alaska's North Slope. In addition, as discussed previously, the FAA will consider granting a certificate of waiver for specific nighttime operations if the applicant can demonstrate that operating at night will not reduce the safety of the operation.

Qualcomm, FLIR Systems, the Drone User Group Network, and several individuals supported operations at night utilizing technology such as night-vision cameras to allow the aircraft to be safety piloted. The Association of American Railroads contended that risks associated with nighttime operations could be mitigated by requiring small unmanned aircraft to be equipped with sense-and-avoid technology approved by the FAA. Kapture Digital Media and another commenter asserted that night-vision-enabled FPV cameras are available that would aid in seeing-and-avoiding other aircraft and hazards at night. The South Dakota Department of Agriculture suggested that the FAA prescribe a performance-based standard in lieu of daylight-only restrictions, thus allowing for the integration of new risk-mitigating technologies as they are developed and refined. The Colorado Cattlemen's Association suggested that risks related to low-light and nighttime operations could be mitigated through technological equipage.

For the reasons discussed earlier in this preamble, existing vision-enhancing devices, such as FPV, do not currently provide a field of vision sufficient for the user to safely see and avoid other aircraft. Current sense-and-avoid technology would also insufficiently mitigate the risk associated with flying at night because this technology is still in its early stages of development. As of this writing, there is no sense-and-avoid technology that has been issued an airworthiness certificate. The FAA will keep monitoring this technology as it develops and may incorporate it, as appropriate, into certificates of waiver, future UAS rules, or possible future revisions to part 107.

Several commenters suggested permitting nighttime operations by further segmenting the small UAS category of aircraft by lesser weights or lower operational altitudes. However, even a relatively light small unmanned aircraft could cause a hazard by colliding with another aircraft in the NAS or an object on the ground. As discussed previously, these safety risks are more prevalent at night due to reduced visibility. While low weight could be one mitigation measure that a person could use to support a waiver application, this factor, by itself, would be unlikely to mitigate the additional risk associated with a nighttime small UAS operation.

Embry-Riddle and the Florida Department of Agriculture, Consumer Services' UAS Working Group (Florida Department of Agriculture) proposed allowing operators possessing additional certification to fly at night. Textron Systems and several individuals recommended additional training for night operations.

As discussed previously, this initial small UAS rulemaking effort is intended to immediately integrate the lowest risk small UAS operations into the NAS. The

FAA plans to address higher risk operations and the mitigations necessary to safely conduct those operations, such as the mitigations suggested by the commenters, in future agency actions. The FAA will consider the commenters' recommendations as part of future rulemaking efforts to integrate higher-risk UAS operations, such as nighttime operations, into the NAS.

AUVSI, Prioria Robotics, and a joint submission from Skycatch, Clayco, AECOM, and DPR Construction pointed to Australia and New Zealand as examples of countries where nighttime operations have been safely conducted in areas with established UAS regulations. In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to ICAO SARPs to the maximum extent practicable. However, there are currently no ICAO SARPs that correspond to the nighttime-operation provisions of these regulations. Because the integration of UAS into the NAS is an incremental process, the FAA will continue expanding UAS operations to include those that pose greater amounts of risk, utilizing data gleaned from industry research, the UAS test sites, and international UAS operations.

Matternet and the Mercatus Center at George Mason University cited § 101.17, stating that kites and moored balloons operate safely at night, with specific lighting requirements, even though they are not equipped with the kinds of sense-and-avoid technologies likely included in small UAS systems.

As discussed previously, sense-and-avoid technology does not currently provide sufficient mitigation to enable nighttime operations. In addition, while kites and moored balloons operated under part 101 are permitted to operate at night, § 101.15 requires the kite or moored balloon operator to notify the nearest ATC facility of the details of the operation at least 24 hours prior to each operation. Because kites and moored balloons governed by part 101 operate in a fixed location, this ATC notification allows ATC to disseminate details of the operation to other aircraft in the area. Conversely, with some exceptions, small UAS operating under part 107 in Class G airspace will not be required to communicate with ATC prior to or during the operation.

One commenter suggested that small UAS operations be limited to the period between one half hour after official sunrise and one half hour before official sunset, arguing that it is not uncommon for small unmanned aircraft to have low-visibility color schemes. However, it is not necessary to further reduce operations conducted near sunset or sunrise to mitigate the risk of small UAS operations in low light conditions. As discussed previously, low-light conditions provide sufficient lighting to mitigate many of the safety concerns underlying the prohibition on nighttime operations.

ii. Weather/Visibility Minimums

The NPRM also proposed additional visibility and cloud-clearance requirements to ensure that the person maintaining visual line of sight has sufficient visibility to see and avoid other aircraft. Specifically, the NPRM proposed a minimum flight visibility of at least 3 statute miles from the location of the ground control station. The NPRM also proposed that the small unmanned aircraft must maintain a minimum distance from clouds of no less than: (1) 500 feet below the cloud; and (2) 2,000 feet horizontally away from the cloud. This rule will finalize these minimum-flight-visibility and cloud-clearance requirements as proposed in the NPRM but will make those requirements waivable.

Commenters including NAAA, ALPA, and Commonwealth Edison Company supported the proposed minimum flight visibility and distance-from-clouds requirements. Commonwealth Edison asserted that the proposed visibility requirements, in combination with the other proposed operational requirements, would ''safeguard safety while recognizing reasonable commercial interests in such a rapidly evolving technological environment.'' NAAA stated that the proposed requirements are consistent with the VFR visibility requirements under 14 CFR 91.155 and 91.115. The Professional Helicopter Pilots Association strongly agreed that ''weather minimums be at least basic VFR.'' ALPA also agreed that all operations must take place in visual meteorological conditions (VMC) with the identified cloud clearances. ALPA further recommended that it be made clear that the 3-mile visibility requirement for VMC does not mean that the visual-line-of-sight required elsewhere in the proposed regulation can necessarily be maintained at 3 miles.

Modovolate Aviation, NAMIC, the Property Drone Consortium, and a few individuals generally opposed the imposition of minimum flight visibility and distance-from-cloud requirements. The commenters asserted that such requirements are unnecessary, given the visual-line-of sight requirement of § 107.31. Modovolate stated that it is unlikely that an operator can keep a small UAS in sight at a distance of 3 miles, so a separate weather-visibility requirement is redundant. Modovolate also stated that a small UAS operator cannot maintain visual contact with his small UAS if it is flown in a cloud, but he would be able to fly his small UAS closer than 500 or 1,000 feet to a well-defined cloud without risk.

The Professional Society of Drone Journalists (PSDJ), and Edison Electric Institute, individually and jointly with NRECA and APPA, recommended the removal of the cloud distance requirements altogether. PSDJ asserted that the proposed cloud distance requirements would render many types of weather coverage and research projects impossible and would also make it impossible for small UAS to replace high-risk manned flights, ''such as inspecting tower, bridges, or other structures,'' as contemplated by the NPRM. The Travelers Companies, Inc. recommended the removal of the requirement that small UAS maintain a distance of no less than 2,000 feet horizontally from a cloud, claiming it is not relevant or workable for pilots flying small UAS from the ground. Aerial Services added that the safety concerns associated with cloud clearance will be alleviated with automation, the maximum altitude restriction, and the restriction on the use of small UAS in the vicinity of airports.

Several other commenters generally supported the imposition of minimum flight visibility and cloud clearance requirements, but said the proposed minimum requirements should be reduced. Commenters including State Farm, AUVSI, the Unmanned Safety Institute, and DJI, argued that the minimum flight visibility and cloud distance should be reduced to 1 statute mile and changed to ''remain clear of clouds.'' AUVSI asserted that this reduced requirement will reflect the small size, low speeds, and additional operating limitations of small UAS.

EEI said the proposed regulation is too restrictive, especially in areas prone to low cloud cover. The commenter argued that, as long as the operator maintains visual line of sight with the small UAS, the aircraft should be permitted to navigate up to 500 feet, regardless of the elevation of the clouds above 500 feet. In a joint comment, EEI, NRECA, and APPA noted that under the proposed visibility rules, for every foot cloud cover dips below 1,000 feet, the small UAS dips a foot below 500 feet, so that cloud cover at 500 feet would ground all small UAS operations. The commenters suggested that operations in Class G airspace should be allowed up to 500 feet AGL, or the height of

cloud cover, whichever is lower. Exelon Corporation further suggested the rule include permission to operate on the transmission and distribution rights-of-way at altitudes not to exceed the tops of the structures plus 50 feet without weather visibility restrictions. The News Media Coalition suggested eliminating the flight-visibility and cloud-clearance requirements for UAS operated within the parameters in the blanket COA for section 333 exemptions.[85]

As discussed earlier, under this rule, the remote pilot in command will be responsible for observing the operating environment for other aircraft and, if necessary, maneuvering the small unmanned aircraft to avoid a collision with other aircraft. However, there is a significant speed difference between a manned aircraft and a small unmanned aircraft. Under part 91, a manned aircraft flying at low altitude could travel at speeds up to 230 to 288 miles per hour (mph).[86] On the other hand, a small unmanned aircraft operating under this rule will have a maximum speed of 100 mph and many small unmanned aircraft will likely have a far lower maximum speed.

Because of this difference in maximum speed, the remote pilot in command will need time to respond to an approaching manned aircraft. A minimum flight visibility requirement of 3 statute miles is necessary to ensure that the remote pilot in command can see far enough away to detect a manned aircraft near the area of operation in time to avoid a collision with that aircraft. Additionally, cloud clearance provisions that require the small unmanned aircraft to maintain a distance of at least 500 feet below the cloud and 2,000 feet horizontally away from cloud are necessary to reduce the possibility of having a manned aircraft exit the clouds on an unalterable collision course with the significantly slower small unmanned aircraft. Accordingly, this rule will retain the proposed minimum-flight-visibility requirement of 3 statute miles and minimum cloud-distance requirements of 500 feet below the cloud and 2,000 feet horizontally away from the cloud.

In response to ALPA's concern, the FAA clarifies that the minimum-flight-visibility and visual-line-of-sight requirements of this rule are separate requirements that must both be satisfied. The visual-line-of-sight requirement of § 107.31 is intended to ensure that the person maintaining visual line of sight can see the small unmanned aircraft and the immediately surrounding airspace. It is unlikely that a person will be able to maintain visual line of sight of a small unmanned aircraft in compliance with § 107.31 if that aircraft is 3 miles away from him or her. Conversely, the 3-mile visibility requirement of § 107.51 is intended simply to ensure that the person at the control station is able to see relatively larger manned aircraft that may rapidly be approaching the area of operation.

Southern Company suggested that small UAS operations should mirror the VFR weather minimums for manned-helicopter flight and that the Special VFR minimums under 14 CFR 91.157 should also apply to small UAS operations to the extent available for helicopters. The commenter suggested that small UAS operations would satisfy the requirements for Special VFR flight, because only ATC authorization is necessary before Special VFR flight and all small UAS must receive an ATC clearance when operating in controlled airspace. The commenter also asserted that the use of helicopter minimums is appropriate in this rule because, like helicopters, a small UAS is highly maneuverable and easier to land than fixed-wing aircraft. The Small UAV Coalition similarly suggested that the FAA adopt the helicopter cloud-clearance test for small UAS.

The FAA acknowledges that the part 107 visibility requirements for small UAS operations in Class G airspace will be more stringent than the requirements of part 91. Part 91 allows aircraft operating in Class G airspace to operate with 1 statute mile visibility and simply requires the aircraft to keep clear of clouds. However, as numerous commenters pointed out, small UAS operating under this rule may, as a result of their size, be difficult to see for manned-aircraft pilots. Additionally, unlike manned aircraft, small unmanned aircraft will not be required to carry equipage, such as TCAS and ADS–B, that aids in collision avoidance. Because of the additional challenges with collision avoidance raised by small UAS operating under part 107, a more stringent visibility requirement is necessary than the one imposed by part 91 on manned-aircraft operations in Class G airspace.

Vail Resorts asked the FAA to reduce or eliminate cloud clearance requirements in certain terrain, or with certain mitigation in place (*e.g.,* a lighting system on the small UAS). The commenter stated that the minimum-flight-visibility and distance-from-cloud requirements are unnecessarily restrictive in a high alpine environment where the potential for interaction with manned aircraft is incredibly remote, and can be mitigated by other limitations. Venture Partners asserted that its products will contain onboard technology and capabilities that will allow UAS to operate in adverse weather conditions.

The FAA agrees that there could be operations in areas where the likelihood of interaction with manned aircraft is reduced or in which the risk of collision with a manned aircraft is mitigated by other means (such as technological equipage). Accordingly, the FAA has made the visibility and cloud-clearance requirements of part 107 waivable and will consider individual operating environments and other mitigations as part of its review of a waiver request. The FAA plans to use data acquired as part of the waiver process to inform future agency actions that will further integrate UAS into the NAS.

The Airborne Law Enforcement Association requested an exception from the 3-mile minimum flight visibility requirement for public safety operations, saying that, with the visual-line-of-sight restriction, ''there are many opportunities to safely utilize UAS technology to the benefit of public safety operations.'' The Organization of Fish and Wildlife Information Managers recommended a disaster-response exemption from the 3-mile flight visibility requirement, asserting that UAS flights in conditions with less than 3 miles of visibility could be integral in protecting human life and natural research welfare in the event of a man-made or natural disaster.

As discussed earlier, this rule will not apply to public aircraft operations unless the operator chooses to conduct the operation as a civil aircraft. Thus, public aircraft operations, such as public safety operations conducted by law enforcement agencies, will not be subject to part 107. With regard to the other specific types of operations mentioned in the comments, as discussed previously, the minimum-flight-visibility and cloud-clearance requirements of this rule will be waivable. Thus, operations conducted for salutary purposes, such as the ones mentioned by the commenters, could be authorized through the waiver process if the remote pilot establishes that the operation can safely be conducted under the terms of a certificate of waiver.

[85] The specific parameters suggested by the commenter consisted of flight at or below 200 feet AGL and at least (a) 5 nautical miles from an airport having an operational control tower; (b) 3 nautical miles from an airport with a published instrument flight procedure, but not an operational tower; (c) 2 nautical miles from an airport without a published instrument flight procedure or an operational tower; or (d) 2 nautical miles from a heliport with a published instrument flight procedure.

[86] 14 CFR 91.117.

The Metropolitan Airports Commission, Airports Council International-North America, the American Association of Airport Executives, and Exelon Corporation recommended that the requirement for 3 miles of visibility be from the location of the small unmanned aircraft and not from the location of the ground control station. The Metropolitan Airports Commission stated that the 3-mile visibility requirement is based on a manned aircraft pilot's vantage point positioned inside the aircraft, which provides a 3-mile observation radius around the aircraft to see and avoid potential hazards. Airports Council International-North America claimed that a 3-mile visibility requirement from the unmanned aircraft instead of the ground control station will prevent cases where the UAS operator operates an aircraft at the limit of the operator's line of sight. Lloyd's Market Association and the International Underwriting Association said the 3-mile minimum flight visibility requirement may be difficult to administer and police, and wondered if maximum wind speeds have been taken into account.

This rule will retain the requirement that the minimum visibility must be measured from the control station. The reason for this requirement is to allow the person manipulating the flight controls of the small UAS to see other aircraft that could be entering the area of operation. The person manipulating the small UAS flight controls will be located at the control station (since the control station is the interface used to control the flight), and thus the minimum-visibility requirement must be measured from the control station. With regard to the comment arguing that the 3-mile minimum flight visibility requirement may be difficult to administer and police, the remote pilot in command must, among other things, ensure that the small UAS operation complies with part 107.

This rule will not impose prescriptive requirements on maximum permissible wind speed because there is a wide range of small UAS that could be operated under part 107. These UAS will have varying ability to respond to wind and a prescriptive regulatory requirement would be more stringent than necessary on certain small UAS while being less stringent than necessary on other UAS. Instead, § 107.49(a)(1) will require the remote pilot in command to assess local weather conditions as part of the preflight assessment required by § 107.49. If the remote pilot in command determines that the wind speed is too high to safely conduct the small UAS operation, then he or she will have to either reschedule the operation or implement mitigations to ensure the safety of the operation.

One commenter asked the FAA to clarify whether the 3-mile flight visibility requirement is horizontal visibility or slant angle visibility. The commenter asserted that there are many situations where radiation or advection fog might obscure horizontal visibility yet bright blue sky is visible above the fog.

The 3-mile flight visibility requirement is based on a slant angle from the control station. In other words, a person standing at the control station of the small UAS must be able to see at a diagonal distance of 3 miles into the sky in order to detect other aircraft that may be approaching the area of operation. This requirement ensures that the remote pilot in command can effectively observe the airspace for presence of other aircraft, and reduces the possibility of the remote pilot or visual observer losing sight of the unmanned aircraft. To further clarify this concept, the FAA has amended § 107.51(c) to explain that flight visibility refers to the average slant distance from the control station at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

The University of North Dakota's John D. Odegard School of Aerospace Sciences suggested that the rule prohibit small UAS operations above clouds because those operations could endanger manned aircraft flying under instrument flight rules (IFR). In response, the FAA notes that a person is unlikely to be able to maintain visual line of sight of a small unmanned aircraft that is flying above the clouds.

Schertz Aerial Services, the Permanent Editorial Board of the Aviators Model Code of Conduct Initiative, and the City and County of Denver, Colorado suggested that the proposed flight-visibility and minimum-cloud-distance requirements be increased. Schertz Aerial Services said that because UAS are so much smaller than manned aircraft, the proposed 3-mile flight visibility requirement, which was developed for manned aircraft, is not adequate for UAS and should be increased to 5 statute miles. Denver also recommended increasing the minimum flight visibility requirement to 5 statute miles, but only in controlled airspace. The commenter additionally recommended the imposition of a 2,000-foot ceiling for operations in controlled airspace. ''Those visibility enhancements,'' Denver continued, ''will maximize opportunities for both the operator and other aircraft pilots to successfully employ the see-and-avoid technique.''

One commenter said the minimum flight visibility requirement should be increased to 10 to 12 miles and the distance-from-cloud requirements should both be increased by 1,000 feet. Another commenter said the FAA should set a specific percentage or range for cloud coverage to be allowed during flight, in addition to the distance-from-cloud requirements.

The FAA recognizes the fact that increased flight visibility would provide more time for the remote pilot in command to maneuver away from other aircraft. However, the likelihood of the remote pilot seeing other small UAS, other smaller aircraft, or other hazards such as power lines or antennas from a distance of five or more miles is not probable, so such a requirement would not create an additional safety buffer. A 5-mile visibility requirement above 10,000 feet mean sea level (not including the surface to 2,500 feet above ground level) is imposed by part 91 because manned-aircraft pilots have a need for increased visibility at that higher altitude due to permitted airspeeds above 288 mph. A remote pilot in command, on the other hand, will remain on the ground and will have to deal with ground obstacles that impede vision. The remote pilot in command will also be looking into the sky at a slant angle from the ground rather than horizontally in the manner of a manned-aircraft pilot. This means that a remote pilot will generally be challenged to perceive useful information from his or her vision beyond three miles. An increase in the cloud distance requirements poses the same dilemma, unless the object is large enough or distinct enough it will not likely be visible early enough to provide the opportunity to avoid or change course sooner.

PlaneSense and Cobalt Air, commenting jointly, recommended prohibiting a remote pilot from operating a small UAS if the ceiling is lower than 1000 feet MSL. The commenters contended that for manned aircraft, the pilot is in the aircraft and is therefore better able to make a determination about the distance to a cloud from the aircraft than an operator on the ground positioned 1/4 mile away from the unmanned aircraft.

The FAA declines to prohibit small UAS operations when cloud ceilings are

lower than 1,000 feet AGL.[87] Specifically, the FAA disagrees that the remote pilot in command will not be in a position to determine whether the unmanned aircraft is positioned sufficiently far enough from a cloud to meet the requirements of § 107.51(d). While this rule does not require specific technological equipage to determine altitude of the unmanned aircraft, nothing in this rule precludes the remote pilot in command from doing so as a means to mitigate the risk of cloud clearance requirements. A remote pilot in command may also opt to operate the unmanned aircraft at a sufficiently low altitude that he or she can easily determine the aircraft's altitude. Further, cloud ceilings can be determined through nearby AWOS/ASOS/ATIS reports, visual cloud observations, or observation of obscuration of nearby prominent landmarks of a known elevation. If a remote pilot in command cannot ensure that the unmanned aircraft will maintain sufficient cloud clearance in accordance with § 107.51(d), that person may not conduct operations until weather conditions improve. As such, no minimum ceiling requirement is necessary in this rule.

Noting that the NPRM would not require a qualified weather observer, one commenter questioned who is responsible for determining visibility at the time of the operation. The commenter further questioned if the regulation has a requirement for the airman trained and certificated for small UAS to receive training and demonstrate competence in making accurate visibility determinations. Another commenter also questioned who determines visibility, and recommended that FAA require as a minimum that VMC exist and that the closest Official Weather Reporting Station be used.

Under this rule, the remote pilot in command is ultimately responsible for determining whether a flight can be conducted safely. As part of the preflight assessment required by § 107.49, the remote pilot in command must evaluate local weather conditions, which includes an evaluation of whether those conditions are sufficient to meet the requirements of § 107.51(c) and (d). With regard to competence, as discussed in section III.F.2.j of this preamble, knowledge of aviation weather sources that can be used to inform the small UAS operation will be tested on both the initial and recurrent aeronautical knowledge test. The initial aeronautical knowledge test will also test the airman certificate applicant's knowledge of effects of weather on small unmanned aircraft performance. For the reasons discussed in section III.F.2.e of this preamble, formal training and practical testing requirements are not a necessary component of this rule.

iii. Yielding Right of Way

For the reasons discussed below, this rule will finalize the NPRM-proposed requirement that small unmanned aircraft must yield the right of way to all other users of the NAS but will make that requirement waivable. As discussed in the NPRM, the smaller visual profile of the small unmanned aircraft, the lack of collision-avoidance technology on the aircraft, and the difference in speed between the unmanned and manned aircraft increases the difficulty for manned-aircraft pilots to see and avoid the small unmanned aircraft. As such, this rule will require that the small unmanned aircraft always be the one to initiate an avoidance maneuver to avoid collision with any other user of the NAS. This rule will also include the NPRM-proposed requirement prohibiting the operation of a small unmanned aircraft so close to another aircraft as to create a collision hazard.

Approximately 20 commenters agreed with the proposal that small unmanned aircraft must always yield the right of way to all other users of the NAS. Several commenters stated that the requirement is sensible because small unmanned aircraft are more difficult to see than manned aircraft. Numerous other commenters, including NAAA, stated that small unmanned aircraft are more maneuverable than manned aircraft and therefore would have less difficulty taking evasive action to avoid a collision with a manned aircraft.

On the other hand, the Small UAV Coalition suggested that in certain circumstances it may be preferable to have a manned-helicopter yield to a small unmanned aircraft. The Small UAV Coalition presented a scenario where a small UAS is being operated to film a newsworthy event. If a manned helicopter were to arrive later to also film the event, under the proposed rule, the small UAS would be required to yield right of way to the helicopter. The commenter suggested that safety would be better served if both the manned and unmanned aircraft maintained awareness so as to see and avoid each other and proposed that part 107 adopt the right-of-way rules currently used in part 91. Another commenter suggested that the FAA should consider creating different right-of-way rules for different classes of NAS users.

Requiring small unmanned aircraft to always yield the right of way to all other users of the NAS is a critical component of the see-and-avoid framework of part 107. As discussed in the NPRM, the small size associated with small unmanned aircraft will make those aircraft more difficult to detect for manned-aircraft pilots. Additionally, small UAS operating under this rule will not be required to be equipped with collision avoidance technology, such as transponders or TCAS, that would make it easier for manned-aircraft pilots to detect a small unmanned aircraft operating in their vicinity. Conversely, because of the far larger size and higher noise profile of manned aircraft, the person maintaining visual line of sight as part of a small UAS operation will be in a far better position to detect other users of the NAS and initiate maneuvers to avoid a collision.

As such, this rule will retain the proposed requirement that the small unmanned aircraft must always be the one to initiate an avoidance maneuver to avoid collision with any other user of the NAS. This rule will make this requirement waivable for individual small UAS operations (if the proposed operation can safely be conducted under the terms of a certificate of waiver), but will otherwise retain the right-of-way requirement as proposed in the NPRM.

When yielding the right of way, the small unmanned aircraft should optimally yield to manned aircraft in such a manner that the manned aircraft is never presented with a see-and-avoid decision or the impression that it must maneuver to avoid the small unmanned aircraft. The FAA also emphasizes that in extreme situations where collision is imminent, the remote pilot in command must always consider the safety of people first and foremost over the value of any equipment, even if it means the loss of the small unmanned aircraft.

An individual suggested that the FAA clarify that it is the remote pilot's responsibility, more so than that of a manned aircraft pilot, to exercise due diligence to prevent other aircraft from having to take evasive action to avoid the small unmanned aircraft.

The FAA emphasizes that it is the responsibility of all users of the NAS to avoid a collision. However, this rule places a duty on the small unmanned aircraft to always yield the right of way to other users of the NAS because the remote pilot in command will have a better ability to detect those users. Specifically, due to size, noise, and equipage considerations that apply to manned aircraft, it will be easier for a

[87] The commenters referred to 1,000 feet MSL, but the FAA assumes the commenter intended to recommend a prohibition of operations with a ceiling less than 1,000 feet AGL.

remote pilot to detect a manned aircraft operating in his or her vicinity than for a manned aircraft pilot to detect a small unmanned aircraft.

The Small UAV Coalition sought clarification on what it means to ''give way to the other aircraft or vehicle and may not pass over, under, or ahead of it unless well clear.'' The Air Medical Operators Association, HAI, and an individual noted that the NPRM does not define the term ''well clear.'' The Small UAV Coalition asserted that ''this explanation would permit a sUAS operator to take precedence over a manned helicopter provided the UAV remain 'well clear' of the manned helicopter.''

Under this rule, yielding the right of way means that the small unmanned aircraft must give way to the other aircraft or vehicle and may not pass over, under, or ahead of the other aircraft/vehicle unless well clear. The term ''well clear'' means that the small unmanned aircraft is far enough away from the other aircraft or vehicle that it no longer presents a hazard to that aircraft or vehicle. Thus, if a manned aircraft enters the area of operation, the small unmanned aircraft must initiate maneuvers to ensure that it maintains a distance from the manned aircraft such that there is no risk of collision with that aircraft. In response to the Small UAV Coalition, the FAA notes that there is no right-of-way issue if two aircraft are far enough apart that they do not present a hazard to each other.

One commenter suggested that this rule allow the remote pilot in command to determine the specifics of how to yield the right of way to another aircraft.

The FAA declines to allow a remote pilot in command to pass over, under, or ahead of a manned aircraft if the small unmanned aircraft is not well clear of the manned aircraft. Compared to a pilot onboard a manned aircraft, it may be more difficult for a remote pilot in command to judge the relative altitude of another aircraft in flight. Further, the remote pilot will generally be limited to a maximum operating ceiling of 400 feet AGL, as specified in § 107.51(b), and the manned aircraft will likely be moving significantly faster than the small unmanned aircraft. As such, it is critical that the remote pilot in command not attempt to maneuver the unmanned aircraft to pass over, under, or ahead of a manned aircraft unless well clear, as doing so may present a hazard to the manned aircraft.

Several commenters, including the Property Drone Consortium, Southern Company, and several individuals generally focused on right-of-way situations involving two or more small unmanned aircraft. The Property Drone Consortium and two individuals questioned how two unmanned aircraft could yield the right of way to each other. Southern Company proposed that the FAA treat ''conflicts between small UAS as conflicts between aircraft of the same category.''

This rule will not treat conflicts between two small unmanned aircraft the same manner that the FAA has traditionally treated conflicts between two aircraft of the same category because the rules that apply to aircraft of the same category (§ 91.113(d) and (e)) are not easily applied to small UAS. For example, under § 91.113(d), when two aircraft of the same category are converging, the aircraft to the other's right has the right of way. For manned aircraft, it is easy for a pilot to distinguish whether an aircraft is to the pilot's right or left. For unmanned aircraft, however, a remote pilot's perspective depends on where the remote pilot is located on the ground relative to his or her small unmanned aircraft. Therefore, applying the traditional manned-aircraft right-of-way rules to small UAS may cause confusion.

Instead of imposing a specific right-of-way requirement on conflicts between two small unmanned aircraft, this rule will require the remote pilot in command to use his or her best judgment to avoid other small unmanned aircraft in the NAS. Specifically, under § 107.37(b), each remote pilot in command will have to take whatever maneuvers are necessary to ensure that his or her small unmanned aircraft is not flying so close to other unmanned aircraft as to create a collision hazard.

NAAA, Raebe Spraying Service, Boeing, the Property Drone Consortium, the Colorado Agricultural Aviation Association, and an individual expressed concern regarding the proximity of unmanned aircraft to manned-aircraft operations. Each commenter proposed resolving the conflicts with a specified range requirement. NAAA suggested that UAS operations be prohibited within a 2-mile vicinity of ongoing aerial application operations due to the seemingly unpredictable flight patterns and ''unique nature of ag operations.''

This rule will not impose a prescriptive numerical range requirement on small unmanned aircraft because the distance needed to remain well clear of another user of the NAS will vary depending on the specific small UAS and manned aircraft involved, as well as the operating environment. The FAA understands that agricultural operations may present seemingly unpredictable flight patterns to an observer. However, the visual-line-of-sight requirements of this rule ensure that the remote pilot in command will be able to visually observe the small unmanned aircraft at all times during the operation. This direct observation will allow the remote pilot to react appropriately to any other users in the NAS that may approach his or her small unmanned aircraft. The right-of-way requirements ensure that the remote pilot yields to any other users of the NAS and prioritizes the safety of people above preventing any damage to the small unmanned aircraft.

Aviation Management, State Farm, Prioria Robotics, and an individual commented on aspects of technology that would affect right-of-way rules. Aviation Management, State Farm, and another commenter suggested that the FAA modify the language of the rule to take into account prospective use of technology to aid in the deconfliction of manned and unmanned aircraft.

The FAA agrees that there is much promise for technology to aid in the deconfliction of manned and unmanned aircraft, but that technology (referred to as ''sense and avoid'' technology) is still in its infancy. As of this writing, the FAA does not have data indicating that sense and avoid technology has matured to the point needed to allow a small unmanned aircraft to reliably avoid a collision with a manned aircraft. The FAA notes that the visual-line-of-sight and see-and-avoid requirements of part 107 are both waivable and that the waiver process will allow the FAA to allow the use of sense-and-avoid technology on a case-by-case basis. The FAA intends to use the data acquired from the waiver process to inform future agency actions to further integrate small UAS into the NAS.

One commenter asked the FAA to amend proposed § 107.37(a)(2) to require the small unmanned aircraft to also avoid a collision with ground-based obstacles. The FAA declines to categorically limit how close a small unmanned aircraft may get to a ground-based obstacle. Some small UAS operations, such as bridge and tower inspections, may need to fly closely to a ground-based obstacle in order to successfully conduct the operation. Unlike collision with a manned aircraft, there could be instances where collision with a ground-based obstacle does not endanger human life. However, the FAA emphasizes the requirement of § 107.23(a), which prohibits a person from operating a small UAS in a careless or reckless manner so as to endanger the life or property of another.

d. Additional Technology/Conspicuity Requirements

While the NPRM did not propose to require any technological equipage for small UAS operating under part 107, several commenters suggested either adding these requirements to part 107 or otherwise recognizing small UAS that may be equipped with technology that mitigates the safety concerns underlying the provisions of part 107. Commenters also suggested imposing conspicuity requirements on small unmanned aircraft. For the reasons discussed below, this rule will not impose additional conspicuity requirements on small UAS operating under part 107 nor will it require those UAS to have any technological equipage. The FAA will consider any technologically based mitigations equipped on a small UAS as part of the waiver process.

i. ADS–B, Transponders, and TCAS

Some commenters, including Daniel Webster College, NAAA, CAPA, and the Air Medical Operators Association, stated that there should be a requirement for small UAS to be equipped with ADS–B. Daniel Webster College, NAAA, the California Aviation Agricultural Association, and the Colorado Aviation Agricultural Association (CoAAA) recommended an ADS–B Out equipment requirement to increase small UAS visibility. NAAA and CoAAA said ADS–B Out technology, or the like, should be required pending its effectiveness and usability to track UAS.

Several of the commenters who supported an ADS–B requirement addressed the availability of ADS–B systems for small UAS. NAAA and CoAAA stated that ADS–B Out equipment is currently available on the market for use in UAS. NAAA asserted that these units weigh as little as 300 grams and cost as little as $1,200. Airware also asserted that ADS–B Out transponders currently exist that are small and cost effective enough for small UAS. The company noted, however, that this technology is only suitable for uncontrolled airspace because transponders are not currently certificated by the FAA. One commenter said that a technologically and economically feasible option would be to use ''the more inexpensive, heavy, and power-hungry ADS–B transponder[s]'' by placing them on the ground near the operator. This would work, the commenter said, because most missions include a reliable command and control data link between a UAS and its ground operator.

Modovolate recommended ADS–B Out and In requirements for small UAS weighing between 20 and 55 pounds. The company noted that the purpose of ADS–B In (*i.e.,* equipment to receive and present ADS–B information to the small UAS operator) is to alert the operator to manned aircraft in the general vicinity, so that the operator can take precautionary action to avoid the manned aircraft once it is within the operator's line of sight. An individual similarly recommended that all small UAS over 1.5 kilograms should have a capability for ADS–B In for operators to be able to sense and avoid other aircraft.

Several commenters discussed an ADS–B requirement for small UAS in the context of the FAA's 2020 deadline for equipping manned aircraft with the same technology. The Air Medical Operators Association and Schertz Aerial Services recommended the same deadline be imposed for small UAS. Schertz Aerial Services said that five years ''will provide an adequate amount of time for ADS–B Out to miniaturize and lower in cost, so that ADS–B Out can be more practically incorporated into UAS.'' The Metropolitan Airports Commission pointed out specifically that the 2020 deadline would apply to manned aircraft operating in Class B airspace, and recommended that FAA ''strongly consider'' an ADS–B Out requirement for small UAS operating in Class B airspace. The Commission noted that, because ADS–B equipment is developed in larger quantities, the cost to equip small UAS may become reasonable.

AMA and the Experimental Aircraft Association (EAA) also noted the 2020 deadline for manned aircraft to be equipped with ADS–B Out equipment, and said any requirement for ADS–B Out in small UAS should not ''justify further equipment requirements for GA aircraft.'' The commenters stressed ''the importance of maintaining the current timeline and requirements for ADS–B.''

Several commenters recommended ADS–B requirements in certain circumstances. CAPA stated that ADS–B (along with TCAS with a mode S transponder) should be the minimum standard for UAS operations above 400 feet and within airport airspace. Another commenter said small UAS should have ADS–B Out to operate ''within the Class B mode-C veil and/or inside Class D airspace.'' A few individuals said ADS–B should be required for all operations above a certain number of feet AGL—*i.e.,* 100 feet, 200 feet, and 400 feet AGL. Another individual proposed that ADS–B be ''encouraged'' for ''small'' UAS (*i.e.,* rotary craft less than 2 kg, fixed wing less than 6 kg), be required for ''medium'' UAS (*i.e.,* rotary craft, less than 4 kg, fixed wing 6–12 kg), and be required for ''large'' UAS (rotary craft less than 20 kg, fixed wing 12–24 kg).

The FAA acknowledges the concerns raised by the commenters, but notes that the risk associated with the operation of an aircraft need not always be mitigated through technological equipage. While there are benefits associated with technological equipage, there can also be significant costs in the form of installation, airworthiness certification (to ensure that the equipage is functional, reliable, and properly installed), maintenance, and, ultimately, replacement of the equipage. The FAA considered imposing equipage requirements in this rule, but ultimately decided against this because the risk associated with certain small UAS operations (*i.e.* the operations subject to part 107) can be mitigated through operational restrictions without any equipage requirements.

As discussed earlier, this rule mitigates the see-and-avoid risk associated with small UAS use by requiring that: (1) The small unmanned aircraft remain within visual line of sight; (2) the small unmanned aircraft yield right of way to all other users of the NAS; (3) the minimum flight visibility must be at least 3 statute miles; and (4) the small unmanned aircraft maintain a minimum distance away from clouds. The FAA recognizes that there are many small UAS operations that will seek to go beyond these operational parameters, and equipage requirements may be one measure that the FAA uses to mitigate the risk associated with those operations when it integrates them into the NAS.

However, as discussed earlier in this preamble, there are numerous small UAS operations that can be conducted within the operational parameters of part 107. By mitigating the risk associated with those operations through operational restrictions, this rule will realize the societal benefits of integrating the lowest-risk small UAS operations without imposing the costs associated with equipage requirements. The FAA also notes that many of the operational restrictions in this rule are waivable. Technology such as ADS–B may be a mitigation that a person uses to support his or her waiver application by showing that the operation could safely be conducted under the terms of a certificate of waiver.

Commenters including CAPA, the Professional Helicopter Pilots Association, the American Association for Justice, and the Center for Democracy and Technology,

recommended the inclusion of a transponder requirement for small UAS. The American Association for Justice asserted that ''[a]mple evidence exists to suggest that small UAS should be required to have transponders or other position tracking equipment to ensure our airspace remains safe.'' The association noted that in the last year, there have been at least 25 reports of near misses between commercial, passenger-carrying planes and UAS. According to the association, these reports indicated that, because the UAS do not have transponders and are too small to show up on radar or anti-collision warning systems, they appeared suddenly and only became visible when it is too late for the pilot of the manned aircraft to change course.

Another commenter said it was ''not prudent'' to only rely on ''visual line of sight separation by a UAS team'' to conduct operations in the NAS. ''Inclusion of mini transponders created for UAS only,'' as well as the use of beacon lights and high visibility markings, the commenter continued, ''should be a good start toward increasing the safety in the NAS.'' Another individual noted that operations in controlled airspace ''would be enhanced by UAS specific transponders and TCAS equipment.'' Even with this technology, however, the commenter noted that operations in some locations within Class B, C, D and E airspace ''might not be appropriate or allowed.'' The Professional Helicopter Pilots Association said operations in Class B airspace should only be permitted if the UAS is equipped with a ''certified transponder or other certified multi-dimensional position-locating device'' that is operational at least above 200 feet AGL. The association also said this requirement should eventually be applied to all UAS being flown in all U.S. airspace. Noting the absence of a transponder requirement for small UAS, the Human Factors and Ergonomics Society expressed concern about UAS inadvertently entering Class B airspace (particularly in places where Class G airspace underlies Class B airspace), although it did not go so far as to say a transponder should be required.

Several supporters of a transponder requirement addressed the availability of transponders for small UAS, which the NPRM stated are currently too large and too heavy to be used in small UAS. An individual commenter said transponder technology does not yet exist to be put on UAS. Several other individuals and Airware, on the other hand, said such technology does exist. One individual said there are manufacturers of miniature transponders on the market today and that all UAS should have such transponders, ''so that ATC can track the operations to ensure safety of the NAS.'' Another individual said the ''technical ability to provide a[] unique transponder signal for each aircraft exists at this time.'' The commenter said a transponder requirement will ''lead to accountability,'' making it more difficult ''for a headless operator to create a violation . . . without being identified.'' Another commenter said there are transponder/ADS–B units that are designed for small UAS and weigh 100 grams.

As of this writing, no small scale transponders have received FAA or FCC certification for use on small UAS. Additionally, as discussed earlier, the person maintaining visual line of sight of the small unmanned aircraft will have the same (if not better) ability to see incoming aircraft as a pilot onboard a manned aircraft. With regard to the near-misses (better known as near mid-air collisions) cited by the American Association for Justice, this rule will require the small unmanned aircraft to be the one to initiate a maneuver to avoid collision with a manned aircraft. Thus, there would be little safety benefit to requiring a small unmanned aircraft operating under part 107 to carry equipage to notify manned-aircraft pilots of its presence, as the manned aircraft pilots will not be required to yield right of way to the small unmanned aircraft.

Turning to concerns about operations in controlled airspace, this rule will prohibit small UAS operations in Class B, Class C, Class D, and within the lateral boundaries of the surface area of Class E airspace designated for an airport without prior authorization from the ATC facility having jurisdiction over the airspace. The FAA factors information such as traffic density, the nature of operations, and the level of safety required when determining whether to designate controlled airspace. The requirement for small UAS to receive approval from the ATC facility with jurisdiction over the airspace in which the remote pilot in command would like to conduct operations allows local ATC approval to provide a safer and more efficient operating environment.

Because these other provisions of part 107 provide a sufficient safety margin, a transponder equipage requirement is not necessary in this rule. In the aggregate, this regulatory framework equally accommodates all types of small UAS with the least complexity and burden, while ensuring the safety of the NAS.

Several commenters addressed applying certain provisions of part 91 stipulating that an aircraft cannot operate in controlled airspace unless it is equipped with an operable transponder and ADS–B equipment. WaDOT pointed out that, with some exceptions, § 91.215 requires registered aircraft to have an operational transponder when operating in controlled airspace. Transport Canada questioned whether the FAA would require UAS to carry transponders when operating in transponder-required airspace, or, alternatively, whether the FAA was considering either a relief to the requirement or a prohibition on small UAS operations in transponder-required airspace. GAMA stated that the transponder rules in § 91.215 and the ADS–B Out rules in §§ 91.225 and 91.227 apply to small UAS because they are aircraft according to 49 U.S.C. 40102(a)(6). GAMA expressed the view that small UAS must therefore meet the future transponder and ADS–B equipage requirements to operate in specified airspace despite the statements in the proposed rule that the FAA is not establishing equipment requirements for small UAS.

As the commenters pointed out, part 91 currently prohibits aircraft from entering certain airspace, such as Class B or C airspace, without a transponder.[88] Additionally, after January 1, 2020, a person will also need ADS–B equipment to enter certain airspace, such as Class B or C airspace.[89] However, part 91 gives ATC the ability to authorize aircraft to enter the pertinent airspace without the normally required transponder or ADS–B equipment.[90] Similarly, by requiring the remote pilot in command to obtain ATC authorization prior to flying the small unmanned aircraft into Class B, C, or D airspace, or within the lateral boundaries of the surface area of Class E airspace designated for an airport, this rule will provide ATC with the same authority that it has under part 91 to determine whether an aircraft operation lacking a transponder or ADS–B can safely be conducted in controlled airspace.

The City of Phoenix Aviation Department and CAPA stated that small UAS should also have or support some type of collision prevention equipment to assist the small UAS operator in maintaining a safe distance from manned aircraft in airspace adjacent to

[88] *See* 14 CFR 91.215(b)(1).

[89] 14 CFR 91.225(d)(1).

[90] *See* 14 CFR 91.215(b) and 91.225(d).

airports. Specifically, the City of Phoenix Aviation Department noted that small UAS wanting to operate adjacent to airports should support awareness enhancing equipment (collision prevention equipment). CAPA stated that a small UAS operating above 400 feet above ground level and within airport airspace should have TCAS with a Mode S transponder (in addition to anti-collision lighting and an ADS–B system).

Several individuals also supported a TCAS requirement for UAS. One commenter, for example, said ''larger UVA [sic] aircraft'' should be required to be equipped with transponders and TCAS, and that ''the UAV should be programmed to automatically turn away from conflicting TCAS targets to avoid collision.''

As discussed earlier, this rule will mitigate the risk associated with small UAS operations primarily through operational restrictions rather than more costly technological equipage requirements. Additionally, transponder equipment on small UAS to support TCAS on other aircraft may have adverse consequences to the NAS. The transponder spectrum is already significantly strained during peak traffic times in high density areas such as the Northeast corridor. Adding a potentially large number of small vehicles into this environment on transponder frequencies would potentially make these frequencies unusable for ATC and other users. The FAA needs to study the effects such operations will have on our existing ATC surveillance using ADS–B and secondary surveillance radar, and airborne surveillance operations using ADS–B, TIS–B and TCAS to determine whether the potential benefits of adding small UAS to this transponder spectrum would justify the potential costs to the NAS and its users.

ii. Radio Equipment

Southern Company supported the fact that the proposed rule did not establish a requirement for radio communications for small UAS operating in controlled airspace. The company stated that receiving local ATC approval and working closely with FAA could result in a safer and more efficient operating environment at minimal cost to the operator.

Conversely, Transport Canada questioned whether the statement in the NPRM that the proposed rule would not establish equipment requirements included radio equipment when operating in areas where ATC coordination/communication is a requirement. The commenter asserted that radio communication is a large contributor to the situational awareness of all pilots, and asked whether the FAA is considering mandating radio equipment, either on the aircraft or at the ground station, for operations in these areas.

The Professional Helicopter Pilots Association and NAAA went one step further, recommending that small UAS operations in controlled airspace be required to meet part 91 requirements, which include a requirement for two-way radio communication with ATC. The Professional Helicopter Pilots Association stated that, at a minimum, the operator of a small UAS flying in controlled airspace should be required to monitor ATC frequency in the area in order to maintain situational awareness.

The County of Los Angeles Department of Public Works recommended that FAA require small UAS operations to maintain two-way radio contact with ATC while operating in close proximity to an airport (airport influence area) or within Class B, C, or D airspace. PlaneSense and Cobalt Air similarly recommended that operators of small UAS operating in the airspace of an airport be required to have a radio to monitor air traffic at the airport and communicate with ATC.

The Port of Los Angeles encouraged the FAA to consider requiring operators of small UAS to have two-way radio capability during all operations, not just those occurring in controlled airspace. The commenter noted the importance of radio communication between pilots, saying that the ability of small UAS operators to communicate with pilots of manned aircraft is particularly critical due to the relatively small size of the small unmanned aircraft and the difficulty pilots of manned aircraft may have in seeing and tracking small unmanned aircraft while airborne. The Colorado Agricultural Aviation Association also recommended a more general requirement for all UAS operators to be trained and equipped with an aviation radio.

An individual said UAS weighing more than 10 pounds should be equipped with an FCC-approved VHF radio transmitter for the purposes of aiding identification from the ground or air, for manned-aircraft awareness of drone proximity, and to aid search and rescue operations. The commenter also recommended detailed specifications for the radio transmitter. Another commenter asked FAA to consider requiring that all small UAS transmit their GPS location, speed, and direction of flight on a shared radio channel. The commenter noted that the FLARM system used by glider pilots is capable of transmitting this, and other, information.

NAAA, PlaneSense, and Cobalt Air asserted that cost of radio equipment for small UAS is low. NAAA noted that UAS operators could obtain relatively low-cost ground-based radio equipment, as opposed to more costly aircraft-mounted systems. PlaneSense and Cobalt Air similarly asserted that the cost of a hand-held radio is not so expensive as to override the safety benefits of requiring its use in airport airspace.

As discussed in section III.E.5 of this preamble, this rule mitigates the risk between small UAS and manned aircraft in controlled airspace by requiring the remote pilot in command to obtain permission from ATC before entering Class B, C, or D airspace or the lateral boundaries of the surface area of Class E airspace designated for an airport. In considering whether to grant permission to a small UAS to fly in controlled airspace, ATC will consider the specific nature of the small UAS operation and risk the operation poses to other air traffic in that controlled airspace. ATC facilities have the authority to approve or deny aircraft operations based on traffic density, controller workload, communications issues, or any other type of operation that would potentially impact the safe and expeditious flow of air traffic. Additionally, as discussed in section III.F.2.f of this preamble, an applicant for a remote pilot certificate who does not possess a part 61 pilot certificate or has not completed a flight review within the previous 24 calendar months will be required to pass an initial aeronautical knowledge test that will include knowledge of radio communication procedures.

With regard to operations near an airport, as discussed in section III.E.5.e of this preamble, this rule will prohibit the small unmanned aircraft from interfering with air traffic at an airport. The FAA also notes that almost all airports in Class G airspace lack ATC facilities for the remote pilot in command to communicate with via radio. As such a prescriptive radio equipage requirement would not add sufficient risk mitigation to the other requirements of this rule (when taken as a whole) to justify the cost of imposing this additional requirement.

The FAA also declines to generally require small UAS operations to have radio equipage. As discussed earlier, this rule will require small unmanned aircraft to always yield the right of way. The remote pilot in command need not communicate with the manned-aircraft pilot to accomplish this task; the remote pilot can simply maneuver the small

unmanned aircraft away from the manned aircraft. As such, requiring all small unmanned aircraft to carry radio equipment would be needlessly burdensome.

Turning to search and rescue operations, because this rule limits operations of small UAS to low altitudes within visual line of sight of the remote pilot and visual observer, the FAA does not anticipate that it will be necessary to conduct a search and rescue operation to find a small unmanned aircraft. Additionally, a small unmanned aircraft will not have any people onboard who would need to be found and rescued in the event of a crash.

The FAA acknowledges the usefulness of FLARM systems for gliders and UAS in foreign countries. However this technology has not been proven or certificated for use in the NAS. As such, the FAA will not mandate that this technology be equipped on small UAS operating under part 107.

Aerius Flight objected to the proposed rule's reliance on restricting operations to a confined area to mitigate the risks associated with a loss of positive control. The company asserted that this reliance fails to acknowledge that loss of positive control could result in a departure from the vertical boundaries of a confined area, which could be dangerous due to the nearly nationwide presence of low-level military training routes and low altitude special use airspace. With that in mind, Aerius recommended that the FAA conduct analysis of small UAS operations that may warrant a requirement that an operator have a mobile radio transceiver at the control station to contact ATC having authority for overlying airspace.

The FAA agrees that a radio transceiver may assist a remote pilot in responding to a loss-of-positive-control situation. However, a radio transceiver (or other technology) would not be a necessary mitigation for all situations and, thus, the FAA declines to impose it as a requirement. For example, a remote pilot in command could mitigate loss-of-positive-control risk through non-technological means by selecting an area of operation with natural obstacles such as trees or mountains that would stop the small unmanned aircraft from flying away if the remote pilot loses positive control of the aircraft. Because there is a wide variety of small UAS and small UAS operations, this rule will not mandate a specific means of mitigating loss-of-positive control risk. Instead, this rule will require the remote pilot in command to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft and will allow the remote pilot to select the specific method of achieving this result within the confined area of operation.

iii. Lighting

Several commenters, including the Air Medical Operators Association, AirTractor, and CropLife America, recommended that FAA require small unmanned aircraft to be equipped with strobe lights to increase visibility. NAAA, Colorado Agricultural Aviation Association, Reabe Spraying, and Plu's Flying Service recommended a strobe light requirement for both the small unmanned aircraft and its associated operator's ground vehicle. GAMA suggested that FAA ''undertake a specific review'' to consider, among other things, ''whether specific additional steps should be taken to increase visibility of small UAS for agricultural pilots,'' including through the use of equipment such as strobe lights. Another commenter asserted that technology is commercially available to equip even the smallest UAS with an 8 gram LED strobe light, which can be powered off a ship's battery beyond the duration of flight.

Remote pilots can effectively see-and-avoid other aircraft during daytime operations without an additional lighting requirement. By keeping the unmanned aircraft within visual line of sight of the remote pilot in command and visual observer with sufficient visibility, the remote pilot in command will be able to see the relatively large manned aircraft that may be entering the area of operation. The remote pilot in command will then have to give right of way to manned aircraft and ensure that the unmanned aircraft does not pose a hazard to aircraft operating nearby. While remote pilots are encouraged to make their aircraft as visible as possible, the diverse range of aircraft that may operate under part 107 make prescriptive lighting requirements for all types of operations impractical. Thus, as described in section III.E.2.c.i of this preamble, the FAA will only require lighting for small unmanned aircraft operating during periods of civil twilight.

The Professional Helicopter Pilots Association suggested requiring small UAS to be equipped with a lighting system ''intense enough to be visible during daylight and under bright sunlight conditions.'' An individual stated that each UAS should have ''identification beacon lights,'' which are unique to UAS but similar to manned aircraft. The United States Ultralight Association said UAS should be required to have a ''visual anti-collision beacon'' that will make the UAS visible for 3 miles during daylight operations.

Due to the diverse nature of small unmanned aircraft, intense lighting systems may prove impractical in many cases due to weight and size limitations. As discussed in the previous section, the remote pilot in command is directly responsible for yielding the right of way to any manned aircraft and ensuring that the small unmanned aircraft will pose no undue hazard to other aircraft. Further, the remote pilot must fly the aircraft in such a way that the pilot or the visual observer is able to observe the airspace for other conflicting traffic. Because the remote pilot will have the ability to see and avoid other aircraft under the visual-line-of-sight framework of part 107, this rule will not require lighting during daytime operations.

A few commenters recommended requirements for specific lighting color schemes. Two individuals recommended requiring green and red lights. One of those commenters noted that this is the standard for marine navigation lights, which enables other vessels to determine if a ship is approaching or departing and if it is moving left or right. The other commenter also recommended the use of white lights for landing and white flashing lights for emergency situations. Another individual asserted that hobbyists already use high-intensity LED and/or strobe lights for orientation assistance, and that blue and red provide the greatest contrast on small models. Yet another commenter recommended ''a pattern of 3 rapid red (.5 second intervals) a 1 second delay then 3 rapid white'' while the pilot is in control, and in the event of a lost link, ''a continuous red white at .5 second intervals to indicate that the pilot has no command.''

Position and navigation lights on an aircraft allow other pilots to observe the visible lights and determine the relative position of the aircraft and direction of flight. For many small unmanned aircraft, such as quadcopters, there is not a clearly defined relative position on the aircraft, so navigation lights would not be practical. The FAA disagrees that lighting requirements are necessary for an emergency situation because the risk associated with loss of aircraft control is mitigated by the other provisions of this rule.

To ensure airspace division near airports, CAPA recommended requiring small UAS operating above 400 feet and within airport airspace to have minimum equipment requirements,

including ''anti-collision lighting.'' However, as discussed in section III.E.3.a.ii of this preamble, with one exception, this rule will not allow small unmanned aircraft to operate higher than 400 feet AGL. With regard to airports, remote pilots operating in the vicinity of airports, heliports, or seaplane bases in uncontrolled airspace may not operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns. Further, the small unmanned aircraft may not enter controlled airspace without ATC permission.

iv. Conspicuity

Many commenters asserted that small unmanned aircraft may be difficult to see, both from the ground and from other aircraft operating in the NAS. For example, ALPA pointed out that many models of UAS are monochromatic or nearly so (either all black or all white), making them difficult to see against a non-contrasting background. The association urged FAA to develop conspicuity standards or advisory material discussing the factors influencing the ability to maintain visual contact.

Another commenter stated that a commercial UAS is likely more difficult to see than other R/C model aircraft because model aircraft are usually painted with bright colors and flown in predictable locations. This commenter also said quadcopters and hexacopters, in particular, may be harder to see due to their ability to move very slowly and hover. The commenter added that these types of small unmanned aircraft are capable of climbing directly into the flight path of a manned aircraft, which may not see them because they are in an area obstructed by the nose of the manned aircraft.

To resolve these issues, a number of commenters, including CoAAA, the California Agricultural Aircraft Association (CAAA), and the Permanent Editorial Board of the Aviators Model Code of Conduct Initiative, recommended a requirement for small unmanned aircraft to be coated in ''highly visible'' or ''high visibility'' colors to contrast them from surrounding airspace and the ground. NAAA argued that FAA should require colors that make the unmanned aircraft ''readily distinguishable'' from the background.

NAAA pointed out that the FAA's advisory circular on obstruction marking and lighting recommends ''[a]lternate sections of aviation orange and white paint should be used as they provide maximum visibility of an obstruction by contrast in colors.'' CAAA and Raebe also supported standardized markings of white and orange paint. Schertz Aerial Services recommended a paint scheme where the underside of the UAS is painted black, the top is painted mostly white, and at least two areas of the UAS are painted ''florescent/aviation orange.'' An individual suggested alternating aviation orange and red paint. Another individual recommended bright neon orange, red, or green.

The FAA currently has no data indicating what color(s), if any, would enhance the conspicuity of small unmanned aircraft. Small unmanned aircraft operating under part 107 vary significantly by size, shape, and profile. As such, color patterns viable for one unmanned aircraft may not work for another unmanned aircraft. Additionally, contrasting colors cannot always be seen with varying light, weather, and cloud coverage, nor will specific colors always provide a contrasting effect. Very small unmanned aircraft also may not have the surface area or reflectivity to accept color patterns that would easily be seen by others not involved with the operation.

Because of these considerations and in light of the fact that the risk of a midair collision is mitigated by the other provisions of this rule, the FAA will not require small unmanned aircraft to be painted in a specific color scheme. However, this rule does not restrict small UAS owners or remote pilots in command from painting a small UAS in a conspicuous manner if doing so would increase safety in their specific operating environment. The FAA will consider any conspicuity-enhancing measures as a potential mitigation in support of an application for a waiver from the operating restrictions of part 107.

3. Containment and Loss of Positive Control

As discussed above, one of the issues unique to UAS operations is the possibility that during flight, the remote pilot in command may become unable to directly control the unmanned aircraft due to a failure of the control link between the aircraft and the remote pilot's control station. This failure is known as a loss of positive control. Because the remote pilot's direct connection to the aircraft is funneled through the control link, a failure of the control link could have significant adverse results.

To address this issue, the NPRM proposed a performance-based standard built around the concept of a confined area of operation. Confining the flight of a small unmanned aircraft to a limited area would allow the remote pilot in command to become familiar with the area of operation and to create contingency plans for using the environment in that area to mitigate the risk associated with possible loss of positive control. For example, the remote pilot in command could mitigate loss-of-control risk to people on the ground by setting up a perimeter and excluding people not involved with the operation from the operational area. The remote pilot in command could also mitigate risk to other aircraft by notifying the local air traffic control of the small UAS operation and the location of the confined area in which that operation will take place.

The following subsections discuss the concepts involved in the confined area of operation. Those concepts consist of: (1) The boundaries of the confined area of operation, and (2) mitigation of loss-of-positive-control risk within the confined area of operation.

a. Confined Area of Operation Boundaries

The following subsections discuss: (1) The horizontal boundary of the confined area of operation and moving vehicles; and (2) the vertical boundary (maximum altitude) of the confined area of operation.

i. Horizontal Boundary and Moving Vehicles

With regard to the horizontal boundary of the confined area of operation, the visual-line-of-sight requirement discussed in section III.E.2.a of this preamble will create a natural horizontal boundary on the area of operation. Due to the distance limitations of human vision, the remote pilot in command or visual observer will be unable to maintain visual line of sight of the small unmanned aircraft sufficient to satisfy § 107.31 if the aircraft travels too far away from them. Accordingly, the visual-line-of-sight requirement in § 107.31 will effectively confine the horizontal area of operation to a circle around the person maintaining visual contact with the aircraft with the radius of that circle being limited to the farthest distance at which the person can see the aircraft sufficiently to maintain compliance with § 107.31.

However, one way in which the horizontal area-of-operation boundary tied to the remote pilot in command's line of sight could be expanded is for the remote pilot to be stationed on a moving vehicle or aircraft. If the remote pilot is stationed on a moving vehicle, then the horizontal area-of-operation boundary tied to the remote pilot's line

of sight would move with the pilot, thus increasing the size of the small unmanned aircraft's area of operation. To prevent this scenario, the NPRM proposed to prohibit the operation of a small UAS from a moving aircraft or land-borne vehicle. However, the FAA included an exception for water-borne vehicles in the NPRM reasoning that there are far fewer people and less property located on or over areas of water than on land. Consequently, a loss of positive control that occurs over water would present a significantly smaller risk of injuring a person or damaging property than a loss of positive control that occurs over land.

For the reasons discussed below, this rule will maintain the proposed prohibition on operating a small UAS from a moving aircraft. This rule will, however, allow operation of a small UAS from a moving land-based or water-borne vehicle if the small unmanned aircraft is flown over a sparsely populated area. The prohibition against operating a small UAS from an aircraft and the limitations on operations from moving vehicles will be waivable as long as the small unmanned aircraft is not transporting another person's property for compensation or hire.

Several commenters, including ALPA, Aerius, and Drone User Group Network, concurred with the FAA that the operator should not be allowed to operate the small UAS from a moving vehicle or aircraft. NetMoby said the next generation of regulations can address this type of operation once a large database of information concerning the first generation of UAS operations has been developed. CAPA argued that the final rule should prohibit operation from all moving vehicles, including watercraft. The Professional Society of Drone Journalists stated that operations from any moving vehicle should only be permitted with special training and safeguards.

A large number of other commenters, including MPAA, NAMIC, EEI, and MAPPS, specifically opposed a blanket prohibition on operations from moving land-based vehicles. AIA said that FAA should conduct ''robust'' risk analysis to determine if small UAS can be operated safely from moving land-based vehicles. NBAA stated that the FAA has not sufficiently justified the proposed prohibition of operations from moving land-based vehicles.

Commenters provided a variety of reasons for why small UAS operations should be permitted from moving land-based vehicles. Modovolate asserted that such operations may be safer than operations from a stationary position because the operator can maintain a position closer to the small UAS. The Associated General Contractors of America and UPS claimed that operations from a land-based moving vehicle can be as safe as operations from a water-based moving vehicle, noting that both types of operations could lead to the small UAS flying over land. Vision Services Group said that allowing operations from a moving vehicle (with authorization from ATC or a COA issued by the FAA) will give the FAA an opportunity to begin collecting documentation on the safety of such operations in low-risk scenarios, as well as give commercial and public entities an opportunity to test the technology and practicality of moving land/water-based ground station operations.

Several commenters pointed to the beneficial operations that could be conducted if small UAS operators are permitted to extend the visual line of sight by operating from a moving land-based vehicle. EEI, Exelon Corporation, and Southern Company pointed to the inspection of objects that extend for miles, such as power lines, pipelines, railway lines, highways, and solar and wind farms as such beneficial operations. State Farm pointed to surveying catastrophe scenes. Aviation Management pointed to safety scouts leading and surveying railroad tracks in front of trains, and surveying for road hazards in front of trucks and emergency vehicles. Vision Services Group pointed to wetland and shoreline monitoring, and Modovolate pointed to photography and motion picture filming as beneficial operations that could be conducted from a moving land-based vehicle.

The proposed rule would have allowed operation from watercraft due to the fact that water is typically sparsely populated. However, that is not always the case because some waterways are constantly or intermittently congested with watercraft, float planes and people. On the other hand, as pointed out by the commenters, not all land areas are congested; some areas of land, such as unpopulated areas or large open fields, are sparsely populated. ''Sparsely populated'' is not defined in FAA regulation—rather, it is typically fact-dependent. In a 2010 legal interpretation, the FAA cited *Mickalich* v. *United States,* 2007 WL 1041202 (E.D. Mich.) for a discussion of what constitutes a sparsely populated area.[91] The court found that twenty people on a ten acre site would be considered sparsely populated under 14 CFR 91.119(c). Additionally, in other legal opinions by the FAA, the agency has emphasized that it would adopt a case-by-case analysis in determining when a pilot violates § 91.119, which includes determining when an area is ''sparsely populated.'' [92]

In reviewing the comments and reexamining its proposal, the FAA determined that the safety-relevant factor for the moving-vehicle provision of part 107 is population density not terrain. Therefore, this rule will allow small UAS operation from moving land- or water-based vehicles, as long as the small unmanned aircraft is flown over sparsely populated land or water areas.[93] The FAA anticipates that this change will enable additional small UAS operations such as utility inspection, disaster response, and wetland and shoreline monitoring.

A number of commenters, including ALPA, AUVSI, American Insurance Association, and MPAA, said operations from moving land-based vehicles should be permitted as long as the operator is not also driving the vehicle.

As discussed previously, this rule will allow operation of small UAS from land and water-based vehicles over sparsely populated areas. However, the FAA emphasizes that this rule will also prohibit careless or reckless operation of a small UAS. The FAA considers flying a small UAS while purposely distracted by another task to be careless or reckless. The FAA cannot envision at this time an instance of a person driving a vehicle while operating a small UAS in a safe manner that does not violate part 107. Additionally, other laws, such as State and local traffic laws, may also apply to the conduct of a person driving a vehicle. Many states currently prohibit distracted driving and State or local laws may also be amended in the future to impose restrictions on how cars and public roads may be used with regard to a small UAS operation. The FAA emphasizes that people involved in a small UAS operation are responsible for complying with all applicable laws and not just the FAA's regulations.

Planehook argued that until such time as sense-and-avoid systems are accepted by the FAA, implemented by manufacturers, and installed by trained operators, operations from moving land-based vehicles should only be permitted

[91] *Legal Interpretation to Leanne Simmons* (2010).

[92] *Legal Interpretation to Gary S. Wilson* (2006); *Legal Interpretation to Anderson* (2009).

[93] The FAA notes that the small unmanned aircraft flight will also have to comply with all other applicable requirements of this rule, including the prohibition on flight over people who are not directly participating in the small UAS operation (discussed in section III.E.3.b.iv of this preamble).

by waiver. Commenters including the Small UAV Coalition, State Farm, Aviation Management, and DJI also said that small UAS operations should be permitted from moving land-based vehicles on a case-by-case basis, via waiver or deviation authority. Skycatch and FLIR Systems recommended allowing operations from moving land-based vehicles as long as the UAS features a software protocol that ensures the operator is present and has positive control. An individual recommended allowing operations from moving land-based vehicles as long as the UAS is equipped with a telemetry system so the operator knows the range/bearing of the UAS. Another individual recommended allowing operations from moving land-based vehicles if the UAS is operating in ''follow-me'' mode.

The primary risk associated with an operation from a moving vehicle is that the remote pilot in command will lose positive control of the small unmanned aircraft and that aircraft will collide with a person on the ground. Part 107 mitigates this risk by restricting small UAS operations from moving vehicles to sparsely populated areas, which generally have a very low population density. Thus, there is no need to impose additional restrictions on moving-vehicle operations in a sparsely populated area. The FAA considered eliminating the sparsely populated restriction but ultimately determined that operations from a moving vehicle over an area that is not sparsely populated pose a higher risk to non-participating persons and property due to changing topography, obstructions, and un-anticipated persons that enter/exit the operational area.

However, the FAA acknowledges that technological innovation may allow small UAS to be operated safely from moving vehicles in areas that are not sparsely populated. Accordingly, the restriction on operation from moving vehicles will be waivable. The FAA will consider waiver applications on a case-by-case basis to determine whether the applicant has established that his or her operation can safely be conducted under the terms of a certificate of waiver. However, as discussed in section III.C.1 of this preamble, the FAA will not grant a waiver to allow the use of a moving vehicle to allow UAS-based transportation of another person's property for compensation or hire.

One individual suggested that the FAA consider allowing operation of small UAS from a moving aircraft.

In most instances, a manned aircraft is not as maneuverable and cannot be stopped in flight with the same ease as a land- or water-based vehicle. Thus, a remote pilot in command who is onboard a manned aircraft in flight has a more limited ability to respond to situations that may arise during the small UAS operation. Additionally, because manned aircraft generally operate at significantly higher speeds than small unmanned aircraft, there is a higher likelihood that a remote pilot in command onboard a manned aircraft will lose sight of the small unmanned aircraft. Accordingly, this rule will retain the proposed prohibition on operating a small UAS from a moving aircraft. This prohibition will, however, be waivable if the remote pilot in command demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.

ii. Vertical Boundary (Maximum Altitude)

Next, we turn to the vertical boundary of the confined area of operation. Because most manned aircraft operations take place higher than 500 feet above ground level (AGL), the NPRM proposed a 500-foot operating ceiling for small UAS operations. For the reasons discussed below, this rule will reduce the operating ceiling to 400 feet AGL unless the small unmanned aircraft: (1) Is flown within a 400-foot radius of a structure, and (2) does not fly higher than 400 feet above the structure's immediate uppermost limit. This operating-ceiling provision will be waivable.

Several commenters, including the Professional Photographers of America, ALPA, Boeing, Google, and State Farm, supported the 500-foot altitude limit proposed in the NPRM. Some noted that a 500-foot ceiling for UAS operations would strike a positive balance between flexibility for the UAS operator and the safety of manned aircraft operating in the NAS.

Other commenters, including Barrick Gold of North America, argued that the altitude restrictions in the rule are unnecessary because the current airspace stratification and operating rules already provide the requisite level of safety. Barrick added, however, that it would support a buffer of 200 feet below the terminus of Class G airspace.

An altitude limit for small UAS operations is necessary in this rule. Given the expected proliferation of small UAS in the NAS, and the safety implications for manned aircraft, the FAA must address the safe use of small UAS in the NAS. Moreover, Congress has directed the FAA to establish a regulatory framework to safely integrate small UAS operations into the NAS. Allowing unrestricted small unmanned aircraft to operate at high altitude without the benefit of additional equipment (for example, transponders and altimeters) and the provision of air traffic services introduces a significant threat of collision to manned aircraft operating in the NAS. Most manned aircraft operations transit the airspace at or above 500 feet AGL, and an altitude limitation provides a necessary barrier between small unmanned aircraft and a significant majority of manned aircraft operations in the NAS. However, as discussed below, this rule will make an exception to the altitude restriction for small UAS operations that are conducted close to a structure.

Other commenters, including Northrop Grumman Corporation, AOPA, EAA, and HAI, recommended a reduction in the proposed 500-foot altitude limit. These commenters were concerned about the potential for conflict with manned aircraft operating in the NAS. The United States Ultralight Association and the U.S. Hang Gliding and Paragliding Association expressed general concern regarding the volume of manned aircraft traffic below 500 feet and the potential for collisions with small unmanned aircraft.

While some commenters did not recommend a specific alternate maximum altitude, most that did favored a 400-foot operating ceiling. Commenters offered a variety of reasons to support a 400-foot altitude limit. One commenter justified a lower altitude by noting it is difficult for the operator to maintain visual contact with the small unmanned aircraft when operated above 500 feet, and a 400-foot limit would provide an added margin of safety. Most commenters stated that a 400-foot altitude limit would provide a reasonable buffer between UAS and manned aircraft operating in the NAS. NAAA remarked that recent narrowly averted collisions involving agricultural aircraft and UAS aircraft justify the establishment of a 400-foot limit. NAAA also noted the importance of the missions performed by aircraft at lower altitude, including agricultural and air ambulance operations. Northrop Grumman and the Aviation Division of the Washington State Department of Transportation asserted that a 500-foot altitude does not provide an adequate buffer between UAS operations and those conducted by manned aircraft.

Other commenters, including the North Central Texas Council of Governments, noted that the 100-foot difference between the limits for model aircraft and UAS aircraft, which would result from the proposed 500-foot altitude ceiling, would create confusion. These commenters pointed out that because it is difficult to distinguish

between UAS and model aircraft, the two should have similar altitude restrictions.

Some commenters identified lower ceilings for UAS operations in other countries. For example, one commenter noted that Australia has established a 400-foot limit for UAS operations. Further, Transport Canada cited a similar approach for UAS operations in Canada, noting that a 400-foot operating ceiling provides a margin of safety that considers barometric altimeter error and cold weather temperature corrections.

Some commenters, however, asserted that even a 400-foot maximum altitude is too high. The Professional Helicopter Pilots Association recommended a limit of 200 feet to provide an adequate altitude buffer between UAS and rotorcraft operations. One commenter suggested a 200-foot limit until ADS–B is mandated for UAS. Positive air traffic control was also recommended as a requirement for operations above 200 feet.

In contrast, several commenters, including those from the media and agricultural communities, asserted that the proposed 500-foot altitude limit for small unmanned aircraft operations is overly restrictive. One commenter stated that the 500-foot altitude ceiling increases the risk for striking terrain, power lines, or other structures. A commenter also noted that the proposed altitude restriction may contribute to a loss of communication with the aircraft due to terrain and other obstructions.

The most frequently cited reason for raising the altitude limit was to allow the small unmanned aircraft to more effectively perform missions such as search and rescue, aerial surveys, and other applications for industries ranging from agriculture to petroleum, as well as inspections of buildings, bridges and other structures. In addition, several commenters asserted that a 500-foot limit is impractical for radio-controlled soaring. Aerobatic operations would also be severely limited by a 500-foot restriction.

Other commenters highlighted the needs of the media industry, remarking that a 500-foot restriction limits the utility of UAS for certain newsgathering operations. Commenters noted that for these activities, the ability to operate at higher altitudes increases their ability to film news events and access other areas beyond normal reach.

Some commenters, including the Nebraska Farm Bureau Federation, suggested that the 500-foot operating ceiling could be lifted under certain circumstances in remote areas given the uncongested airspace above remote areas. The American Petroleum Institute agreed that a case-by-case process is needed for approval to fly at higher altitudes. In its comments, API noted that the proposed rule effectively eliminates lower-resolution surveillance operations where larger ground sample distances would have value for a variety of activities over broad areas, such as pipeline right-of-way surveying and metocean (meteorology and physical oceanography used in offshore and coastal engineering) data gathering. In addition, in areas with high vegetation, this restriction acts to limit distances across which pre-programmed flights may function even if the visual-line-of-sight restriction were modified. One commenter noted this would be similar to what is now codified in 14 CFR 91.119(b) and (c), and to the precedent established by 14 CFR part 101.

Many commenters, such as Boeing and the News Media Coalition, also focused on the need to permit higher operating altitudes in proximity to certain structures. This would allow small unmanned aircraft to be used to perform inspections and other tasks that would traditionally place persons in harm's way. The Exelon Corporation noted the need to allow for inspection of tall structures. An individual recommended that the FAA allow operations at higher altitudes within a 2,000-foot radius of certain towers. NoFlyZone.org asserted that UAS operations above 500 feet should be permitted within 250 feet of a structure as long as the operator has permission from that structure's owner. Skycatch asked that operations above 500 feet be permitted under specific circumstances, such as bridge or building inspections as proposed by AUVSI. The Professional Society of Drone Journalists stated that the airspace above and around buildings should be considered to be the domain of legal UAS operations.

Commenters also recommended mechanisms to allow operations above 500 feet ranging from pilot training and equipment requirements (such as transponders and ADS–B), to the establishment of flight restriction areas or a waiver process. The American Insurance Association requested that UAS aircraft be allowed to operate above 500 feet if accompanied by a visual observer on the ground aided by a mechanical enhancement of his or her sight.

Other commenters noted that an increase in altitude may be appropriate in areas where the threat to manned aircraft is minimal. For example, one commenter proposed that in Class G airspace, the ceiling for UAS operations be raised to the base of the overlying controlled airspace. A variety of other altitudes were proposed. Clean Gulf Associates stated that 1,000 feet is an appropriate altitude, allowing for oil spill skimming targeting operations, where the mid-air threat over water is lower. Prioria Robotics also proposed 1,000 feet. The American Fuel & Petrochemical Manufacturers noted that technical developments in the near future will allow for operations up to 1,000 feet with additional equipage and procedural safeguards. Another commenter stated that if an under-10-pound category of UAS aircraft could be created, an altitude of 1,000 feet should be permitted.

Another commenter offered that an increase in maximum altitudes is appropriate as size of the UAS aircraft increases. For example, a rotorcraft up to 4 kgs or a fixed-wing aircraft between 6 and 12 kgs would be able to fly up to 700 feet AGL. Rotorcraft up to 20 kgs and fixed wing up between 12 and 24 kgs would be able to fly up to 3,000 feet AGL. These altitude limits would be accompanied by pilot medical and training requirements, as well as additional equipage requirements, such as ADS–B.

One commenter noted that the rule is harsh toward non-hazardous UAS operations. This commenter argued that low-altitude quad copter operations should be given relief to operate at altitudes similar to those used for a commercial moored balloon or kite.

The Resource Stewardship Consortia proposed an extension up to 1,400 feet for a proof of concept trial performed in places where the threat of collateral damage is minimal should a failure occur, and for operations that would benefit from a higher altitude.

In response to comments addressing the specific altitude limit, the FAA agrees that a 400-foot ceiling will allow for a significant number of applications for the small UAS community, while providing an added level of safety for manned-aircraft operations. A ceiling of 400 feet AGL will provide an additional 100-foot margin of safety between small UAS operations and a majority of aircraft operations in the NAS. This additional 100-foot buffer will help maintain separation between small unmanned aircraft and most manned aircraft in instances such as the remote pilot losing positive control of the small unmanned aircraft or incorrectly estimating the altitude of the aircraft.

Further, the revised limit addresses other concerns regarding potential confusion between model aircraft and small unmanned aircraft. Specifically, limiting operations to 400 feet is consistent with FAA guidance on model aircraft best practices identified in AC

91–57A, thus standardizing operating altitudes for the majority of small unmanned aircraft flying in the NAS. A 400-foot altitude ceiling is also consistent with the approach adopted in other countries. Specifically, Canada, Australia, and the United Kingdom all set a 400-foot or lower altitude limit on UAS operations conducted in those countries.[94]

While the FAA considered the lower altitudes proposed by commenters, it ultimately determined that these lower limits would unnecessarily restrict small UAS operations without a commensurate increase in safety because the concentration of manned aircraft below 400 feet AGL is much lower than the concentration of manned aircraft at or above 500 feet AGL. The FAA also considered the comment recommending positive air traffic control above 200 feet. The FAA ultimately rejected this recommendation because it is overly burdensome to both remote pilots and the air traffic control system. Air traffic controllers could not reliably provide positive separation for operations at this altitude throughout the NAS, and the benefits to users from such separation efforts would not justify the significant additional workload placed on air traffic controllers or the equipment and training costs to remote pilots. In addition, without additional equipment mandates, the provision of positive air traffic control would be unachievable.

To address the concerns expressed by commenters requesting higher operating altitudes in proximity to buildings, towers, power lines, and other tall structures for the purposes of inspections and repair, the FAA is establishing new provisions in the final rule that will enable those operations in a way that does not compromise aviation safety. Specifically, the FAA notes that 14 CFR 91.119 generally prohibits manned aircraft from operating in close proximity to structures. Section 91.119 requires manned aircraft to stay 500 to 1,000 feet away from the structure, depending on whether the area is congested. Because manned aircraft are not permitted to operate in close proximity to structures, this rule will allow a small unmanned aircraft to fly higher than 400 feet AGL as long as that aircraft remains within a 400-foot radius of a structure up to an altitude of 400 feet above the structure's immediate uppermost limit. Allowing higher-altitude small UAS operations within a 400-foot lateral limit of a structure will enable additional operations (such as tower inspection and repair) while maintaining separation between small unmanned aircraft and most manned aircraft operations.

The FAA disagrees that a further increase in altitude is justified. Higher-altitude small unmanned aircraft operating in airspace that is transited by most manned aircraft operations would no longer be separated from those manned aircraft, which would greatly increase the risks of a collision. Most remote pilots of small UAS would also benefit very little from an additional increase in altitude because the visual-line-of-sight restrictions of this rule and the equipment limitations of a small UAS would, in many cases, limit the ability or need to operate at altitudes higher than what is provided for by this rule. Such a limited benefit would not be commensurate with the added risk that a higher altitude would impose upon other users of the NAS.

However, the FAA recognizes that new technologies may increase the feasibility of higher altitude operations. Therefore, to provide flexibility to accommodate new developments, the altitude limitation of this rule will be waivable. Thus, if a remote pilot demonstrates that his or her high-altitude small UAS limitation will not decrease safety, the FAA may allow that operation through a certificate of waiver. This will enable a number of operations, such as research and development for higher-altitude small UAS operations. The FAA is committed to working with the stakeholder community to pursue such options when it is deemed appropriate.

With regard to search and rescue operations, most of these operations are conducted by government entities under COAs as public aircraft operations. Those operations will therefore not be subject to the altitude limitations of this rule.

Several commenters raised concerns regarding a remote pilot's ability to discern the altitude of the small unmanned aircraft. Commenters including AOPA and GAMA asserted that current UAS lack accurate altimetry systems, making compliance with any altitude restriction difficult. GAMA asked that the FAA clarify how an operator determines the UAS altitude in flight. Similarly, one individual stated that while the altitudes proposed in the rule are in principle sound, they are unenforceable. Other commenters asserted that it is impossible to judge altitude, particularly over precipitous terrain, and that altitude restrictions of any kind may only be relied upon if UAS were required to have altitude-limiting devices. The Permanent Editorial Board of the Aviators Model Code of Conduct proposed that the FAA require the use of a practical technique for UAS operators to estimate their altitude with sufficient accuracy or require the use of a technical solution to ensure compliance.

Remote pilots have effective techniques to determine altitude without mandating the installation of an altimetry system. For example, with the unmanned aircraft on the ground, a remote pilot in command may separate him or herself 400 feet from the aircraft in order to gain a visual perspective of the aircraft at that distance. Remote pilots may also use the known height above the ground of local rising terrain and/or structures as a reference. The FAA acknowledges that these methods of estimating altitude are less precise than equipment-based altitude determinations, which is one of the reasons this rule will increase the separation between manned and small unmanned aircraft by reducing the maximum altitude for small unmanned aircraft to 400 feet AGL.

Additionally, the FAA will provide, in its guidance materials, examples of equipment options that may be used by remote pilots to accurately determine the altitude of their small unmanned aircraft. One example is the installation of a calibrated altitude reporting device on the small unmanned aircraft. This device reports the small unmanned aircraft's altitude above mean sea level (MSL). By subtracting the MSL elevation of the control station from the small unmanned aircraft's reported MSL altitude, the aircraft's AGL altitude may be determined. The installation of a GPS altitude-reporting device may also provide for a requisite level of altitude control. The FAA emphasizes, however, that this equipment is simply one means of complying with the altitude restrictions in this rule.

One commenter asked if the proposed 500-foot limit represents the altitude above the launch point or the height of the UAS altitude above the ground. The commenter noted that some topographical features present dramatic changes in altitude. Glider operators raised similar questions regarding altitude over sloping terrain.

The maximum altitude ceiling imposed by this rule is intended to limit the height of the aircraft above the ground over which it is flying (AGL). It is incumbent upon the remote pilot in command to maintain flight at or below this ceiling regardless of the topography.

[94] United States Government Accountability Office, *Unmanned Aerial Systems: FAA Continues Progress toward Integration into the National Airspace,* at 32 (July 5, 2015).

Several commenters stated that the 500-foot altitude restriction does not address the public's expectation that airspace (up to 500 feet) above private property is under their control and may not be penetrated without permission. Event 38 Unmanned Systems stated that the FAA should attempt to set a reasonable altitude requirement for overflight of property not controlled by any UAS operator. This commenter proposed a 100-foot limit for incidental incursions and a 300-foot limit for intentional flight across private property without permission. Another commenter suggested requiring small UAS to operate between 400 and 500 feet AGL when flying above private property, unless the remote pilot has obtained the property owner's permission. Other commenters, including the NJIT Working Group and the Kansas Livestock Association, commented on the relationship between the final rule requirements and trespass and nuisance protections for private landowners.

Adjudicating private property rights is beyond the scope of this rule. However, the provisions of this rule are not the only set of laws that may apply to the operation of a small UAS. With regard to property rights, trespassing on property (as opposed to flying in the airspace above a piece of property) without the owner's permission may be addressed by State and local trespassing law. As noted in section III.K.6 of this preamble, the FAA will address preemption issues on a case-by-case basis rather than doing so in a rule of general applicability.

The North Central Texas Council of Governments opposed a 500-foot maximum altitude, stating it is inconsistent with Public Law 112–95 and the 400-foot ceiling identified in Advisory Circular (AC) 91–57.

Public Law 112–95 directs the Department to establish requirements for safe integration of UAS operations into the NAS but does not specify the altitude parameters of such operations. AC 91–57A is advisory in nature and pertains to model aircraft not subject to part 107. However, the 400-foot maximum altitude imposed by this rule is similar to the 400-foot maximum altitude suggested as a best practice for modelers by AC 91–57A.

One commenter stated that the COA process should be maintained for operations outside of class G airspace and altitudes above 500 feet. However, with the exception of flight that is within 400 feet of a structure, small unmanned aircraft seeking to fly higher than 400 feet AGL will have to obtain a waiver to do so.

Several commenters recommended the creation of specialized airspace for UAS operations. This may include designated airspace for certain clubs, or the establishment of special airways or corridors. Farris Technology and the University of Washington promoted the use of corridors or dedicated airways that will allow UAS flights above 500 feet.

Creation of UAS-specific airspace is beyond the scope of this rule because the NPRM did not propose to create any new airspace classifications or reclassify existing airspace.

One commenter suggested that the 500-foot restriction in Class G airspace should only be in place for rotorcraft UAS. However, after careful consideration, the FAA could not find a compelling reason to differentiate between fixed-wing and rotorcraft UAS for the purposes of altitude restrictions. For both aircraft, the threats posed to the NAS are similar. The UAS aircraft class itself does not mitigate those threats in any calculable manner. Therefore, a distinction based on UAS aircraft class is unwarranted.

ALPA recommended a change to the preamble discussion regarding the maximum altitude. As currently written, the preamble to the NPRM states that a small unmanned aircraft is prohibited from ''travel higher than 500 feet AGL.'' [95] ALPA recommended replacing the word ''travel'' with ''fly'' or ''operate.''

For added clarity, the FAA will use the terms ''fly'' or ''operate'' in discussing the maximum altitude limitation in this preamble.

Several commenters, including Green Vegans, stated that the proposed 500-foot operating ceiling would make it impossible to comply with 14 CFR 91.119, which prescribes minimum altitudes for part 91 operations. Green Vegans questioned how a small UAS operator could remain in compliance with both part 107 and section 91.119.

Except where expressly stated to the contrary, the provisions of part 107 will replace the provisions of part 91 for small UAS operations subject to this rule. Consequently, a small UAS operating under part 107 will not be required to comply with § 91.119.

b. Mitigating Loss of Positive Control Risk

Now that we have defined the confined area of operation, we turn to the question of how loss-of-positive-control risk can be mitigated within that area of operation. There is significant diversity in both the types of small UAS that are available and the types of operations that those small UAS can be used in. Accordingly, remote pilots in command need significant flexibility to mitigate hazards posed by their individual small UAS operation, as a mitigation method that works well for one type of small UAS used in one type of operation may not work as well in another operation that uses another type of small UAS. For example, in a loss-of-positive-control situation, a rotorcraft that loses pilot inputs or power to its control systems would tend to descend straight down or at a slight angle while a fixed wing aircraft would glide for a greater distance before landing. Since the loss-of-positive-control risk posed by different types of small unmanned aircraft in various operations is different, the NPRM proposed to create a performance-based standard under which, subject to certain broadly applicable constraints, remote pilots in command would have the flexibility to create operational and aircraft-specific loss-of-control mitigation measures.

The broadly applicable constraints proposed by the NPRM consisted of: (1) A limit on the maximum speed of the small unmanned aircraft; (2) a prohibition on the simultaneous operation of more than one small unmanned aircraft; (3) a restriction on flight over people; and (4) a requirement for a preflight briefing for people who are directly participating in the small UAS operation. The NPRM also proposed to create a separate micro UAS category of UAS operations that would not be subject to a restriction on flight over people. Within these broadly applicable constraints, the NPRM proposed a two-part performance standard under which the remote pilot in command would conduct a preflight assessment of the operating area and then use the knowledge gained during that assessment to ensure that the small unmanned aircraft would not pose an undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason.

The following sections discuss the above components of the NPRM. The following sections also discuss the comments that the FAA received regarding automation within the confined area of operation and the use of equipage to mitigate the risk associated with loss of positive control.

i. Maximum Speed

The NPRM proposed a maximum air speed limit of 87 knots (100 mph) for small unmanned aircraft. The FAA explained that this speed limit is necessary because if there is a loss of positive control, an aircraft traveling at

[95] 80 FR at 9563.

high speed poses a higher risk to persons, property, and other aircraft than an aircraft traveling at a lower speed. The NPRM also noted that a speed limit would have safety benefits outside of a loss-of-positive-control scenario because a small unmanned aircraft traveling at a lower speed is generally easier to control than a higher-speed aircraft. For the reasons discussed below, this rule will impose an 87-knot (100 mph) speed limit. This rule will, however, make the pertinent speed measurement the groundspeed rather than the airspeed of the small unmanned aircraft. The speed limit will also be waivable.

Commenters including NAMIC, the Drone User Group Network, and the Remote Control Aerial Platform Association supported the proposed maximum airspeed. These commenters generally noted that the speed limitation of 100 mph seems reasonable for small UAS operating within visual line of sight.

Other commenters, including the Air Medical Operators Association, the Virginia Department of Aviation, and SWAPA, stated that FAA should lower the maximum permissible airspeed (*e.g.,* to 50 or 75 mph) because, the commenters argued, the proposed speed of 100 mph is too high and would pose undue risks. Several commenters, including Texas A&M University, HAI, the Virginia Department of Aviation and others, asserted that the NPRM failed to demonstrate the safety of the proposed speed limitation. These commenters argued that it would be extremely difficult to maintain positive control of a small unmanned aircraft flying at 100 mph.

Some commenters, including the American Association for Justice, the United States Ultralight Association, and the State of Nevada, asserted that the kinetic energy of a 55-pound object moving at 100 mph could cause significant damage to large aircraft. The US Hang Gliding & Paragliding Association, the Metropolitan Airports Commission, and Predesa stated that a lower maximum speed would provide additional time for UAS operators and pilots of manned aircraft to see and avoid each other. Several of these commenters, including the Metropolitan Airports Commission and Kansas State University UAS Program, stated that a 100 mph speed limit would make it extremely difficult (if not impossible) for an operator to maintain visual line of sight with the unmanned aircraft. NBAA, the Airports Council International—North America and the American Association of Airport Executives recommended that the FAA conduct further study and risk assessment regarding appropriate speed limitations for this type of UAS. The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative argued that FAA should establish a lower maximum speed that will create no greater harm than is caused by most birds (approximately 30 knots) until such time as further data demonstrates the safety of a higher speed limitation.

A speed limit of 87 knots (100 mph) must be viewed within the context of the overall regulatory framework of part 107. In other words, a small unmanned aircraft may reach a speed of 87 knots only if the remote pilot in command can satisfy all of the applicable provisions of part 107 while flying the small unmanned aircraft at 87 knots. For example, since this rule requires small UAS operations to be conducted within visual line of sight, a remote pilot in command may not allow the small unmanned aircraft to reach a speed where visual-line-of-sight cannot be maintained in accordance with § 107.31.

Additionally, as discussed in section III.E.3.b.vi of this preamble, the remote pilot in command must, prior to flight, assess the operating environment and consider risks to persons and property in the vicinity both on the surface and in the air. The remote pilot in command must also ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason. Thus, if the remote pilot in command plans to have an operation in which the small unmanned aircraft will travel at 87 knots, that remote pilot will, as part of the preflight assessment process, need to take precautions to ensure that the unmanned aircraft will not pose an undue hazard to other aircraft, people, or property on the ground. Those precautions will likely be greater than the precautions that a remote pilot in command will need to take for a small unmanned aircraft traveling at a lower speed. Accordingly, a maximum speed limit of 87 knots is appropriate because the remote pilot in command will have to implement mitigations commensurate with the risk posed by his or her specific small UAS operation.

Other commenters, including Textron Systems recommended no limitations regarding airspeed, arguing that as long as the operator can maintain visual line of sight and control of the UAS, there should be no performance limitations.

A speed limit is generally necessary for small unmanned aircraft because an aircraft traveling at high speed poses a higher risk to persons, property, and other aircraft than an aircraft traveling at lower speed. As discussed earlier, the other parameters of this rule (such as visual line of sight and the preflight assessment conducted by the remote pilot in command) mitigate this risk for small unmanned aircraft traveling at speeds up to 87 knots. However, those parameters do not address the risk posed by small unmanned aircraft traveling at speeds faster than 87 knots. Accordingly, this rule will retain the proposed 87-knot speed limit but will make that limit waivable. As part of the waiver process, the FAA will consider operation-specific mitigations to address additional risk posed by higher-speed small UAS operations.

The Kansas State University UAS Program and SWAPA questioned whether there would be any commercial applications of small UAS that would necessitate a 100 mph airspeed. Further, several commenters, including Modovolate Aviation, asserted that many small UAS, such as those employing multi-rotor technology, may not need to or may not be able to reach a speed of 100 mph.

The FAA agrees that there will likely be small unmanned aircraft incapable of reaching a speed of 87 knots. The FAA also agrees that there will likely be small UAS operations that are incapable of satisfying the other provisions of this rule, such as visual line of sight, at a speed of 87 knots. However, that is not a sufficient justification for reducing the maximum permissible speed for all small unmanned aircraft because there may be small UAS operations that can reach a speed of 87 knots and operate safely at that speed in compliance with all applicable provisions of part 107.

The New Hampshire Department of Transportation noted that the FAA did not propose any specific equipage requirements for small UAS that would be used to determine airspeed. Similarly, CAPA stated that the NPRM does not require or define how the operator will maintain operations below a specified airspeed other than visually, which the commenter said would be very difficult to do when operating in congested airspace and scanning for other conflicts.

Aerius recommended that the FAA amend the proposed regulatory text to make any speed limitations based on groundspeed because many UAS are not equipped with a system that would provide airspeed to the small UAS operator. Several individuals noted that multi-rotor helicopter UAS cannot sense airspeed, only groundspeed. Another individual suggested that the regulatory text be amended to reference GPS-generated airspeed because all UAS do

not have the equipment to provide airspeed to the operator.

As noted by the commenters, the provisions of this rule will not require small UAS to be equipped with a system that would provide calibrated airspeed to the remote pilot in command. The FAA also notes that the groundspeed of the small unmanned aircraft is what is pertinent to the safety of a small UAS operation because that is the information that specifies how quickly the aircraft is moving relative to the ground in proximity to where the remote pilot is located. Because changing the standard to groundspeed rather than calibrated airspeed would not have a detrimental effect on safety and because many unmanned aircraft may not have the equipage necessary to measure calibrated airspeed, the FAA agrees with the commenters and has changed the maximum airspeed standard to be a function of groundspeed. A small unmanned aircraft's groundspeed could be determined by measures such as GPS-based speed, visual estimation, a radar gun, or timed travel across a fixed distance. This rule will retain the maximum speed limit of 87 knots (100 mph), but that limit will be a measure of groundspeed rather than airspeed.

A few individuals (who self-identified as recreational operators of model aircraft) said the proposed maximum speed would preclude them from holding certain types of model aircraft competitions. In response, the FAA emphasizes that, as discussed in section III.C.4 of this preamble, part 107 will not apply to model aircraft operations that meet the criteria of section 336 of Public Law 112–95.

ii. Operating Multiple Unmanned Aircraft

The NPRM proposed that an operator or visual observer would be limited to operating no more than one small UAS at the same time. The NPRM explained that performing the duties required of a crewmember in real time is a concentration-intensive activity and as such, it is necessary to place a limitation on the number of UAS that a person can operate simultaneously. For the reasons discussed below, this rule will retain the proposed prohibition on the simultaneous operation of multiple small unmanned aircraft. This prohibition will be waivable if a person establishes that his or her simultaneous operation of more than one small unmanned aircraft can safely be conducted under the terms of a certificate of waiver.

NAAA, the California Agricultural Aircraft Association, NAMIC, Colorado Agricultural Aviation Association, and Schertz Aerial Services supported limiting operators or visual observers to operating only one small UAS at a time. The International Brotherhood of Teamsters urged the FAA to maintain all operational limits and safeguards presented in the NPRM, including the limit of one UAS per operator, until there is technological certainty that no workers, or the general public, would be at risk from automated package delivery.

Other commenters disagreed with the proposed limitation on the number of small UAS that a person can operate simultaneously. Several commenters asserted that technology currently exists to allow for the safe operation of multiple small UAS by a single operator. The Mercatus Center at George Mason University said existing and developing technologies ''can more than compensate to the diminished concentration that operators might apply to each individual aircraft.'' AirShip Technologies stated that it currently incorporates technology that will allow clusters of UAS with similar missions to be pre-programmed and controlled by one operator. Boeing and Aviation Management similarly said that current technology allows a group or swarm of multiple vehicles to operate safely and efficiently in highly automated modes.

The commenters also claimed that new operator consoles have been shown to be able to safely control multiple small UAS systems. The NJIT Working Group pointed to the Navy Low-Cost UAV Swarming Technology (LOCUST), which it said could be used for non-military purposes, such as first responder and search and rescue operations. Vision Services Group said multiple small UAS operations should be permitted if both the operator and visual observer possess a Permit to Operate and a valid Third Class Medical Certificate.

As discussed in the visual-line-of-sight section of this preamble, the remote pilot in command, the person manipulating the flight controls of the small UAS, and the visual observer (if one is used) are required to maintain visual awareness of the small unmanned aircraft and the surrounding airspace in order to minimize the risk of a mid-air collision with a manned aircraft. This activity requires active attention and operating more than one unmanned aircraft at the same time would split the concentration of the small UAS crewmembers. By decreasing the amount of attention that the remote pilot in command, person manipulating the flight controls, and visual observer can dedicate to each small unmanned aircraft, the operation of multiple small unmanned aircraft at the same time may introduce additional risk into the NAS. This risk would further be compounded if larger numbers of aircraft are operated at the same time because each aircraft would receive an even smaller fraction of each person's attention.

The FAA recognizes that technology may allow a remote pilot in command to operate multiple small unmanned aircraft as one system. While such a system may, in some circumstances, help address the split-attention problem discussed above, it would introduce significantly more risk into the operation because of the remote pilot's potentially reduced ability to resolve multiple aircraft or system failures to a safe outcome. For example, if one small unmanned aircraft in a multi-aircraft system loses its link to the control station, it may cause the whole system to break down, resulting in loss of positive control of multiple small unmanned aircraft and significantly increasing the risk to the NAS. The FAA notes that, at this time, none of the technologies cited by the commenters have established a necessary level of reliability through a nationally recognized formal testing process such as through ASTM International, SAE International, or civil aviation airworthiness certification. Accordingly, this rule will prohibit a person from manipulating the flight controls of more than one unmanned aircraft or acting as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time. However, as discussed below, this prohibition will be subject to waiver.

Commenters including Aviation Management, Boeing, the Small UAV Coalition, and AIA said that the FAA should revise the rule to create the framework for the agency to be able to administratively approve multi-UAS operations. Several of those commenters, as well as Google, Amazon, and AUVSI, among others, supported allowing the operation of multiple small UAS per operator in certain cases using a risk-based approach. Amazon, for example, said the proposed provision should be revised to specifically permit the operation of multiple small UAS by a single operator ''when demonstrated that this can be done safely.'' The Small UAV Coalition said approval for the operation of multiple small UAS by a single operator would be based on a demonstration of operator ability and technological capabilities of the UAS.

DJI said it may be possible for an operator to operate more than one small UAS at a time if there are sufficient

visual observers or detect-and-avoid technology. An individual said the rule should allow for the use of multiple small UAS by a single operator if all of the UAS are within the visual line of sight of either the operator or visual observer or if there is some other means of compliance for see-and-avoid for all small UAS involved in the operation.

Other commenters said the final rule needs to have the flexibility to accommodate emerging technology in this area. The Utah Governor's Office of Economic Development stated that ''[t]here must be a road map to, and provisions for, multiple UAS per operator to allow this technology to be tested and eventually implemented.'' The University of Illinois at Urbana-Champaign said there should be an exception to the proposed restriction for research into developing technology to allow multiple drones to successfully navigate together. MPAA asserted that ''as control systems improve it may become possible to operate more than one system at a time.'' MPAA urged the FAA to provide a mechanism in the rules to allow additional flexibility for filming in controlled environments as such technology advances. The National Association of Broadcasters, National Cable & Telecommunications Association, and Radio Television Digital News Association said that given the speed at which technology is developing, the FAA should be open to considering automated systems that contemplate one person controlling multiple small UAS that demonstrate an equivalent level of safety to the requirements of the final rule.

The FAA acknowledges the points raised by the commenters that the risks discussed above may, at some point in the future, be mitigated through technology. However, as of this writing, the FAA does not have data on which to base a safety finding that the available technology for multiple simultaneous small unmanned aircraft operations by one person has matured to the extent necessary to allow these types of operations in a rule of general applicability. The FAA also acknowledges the benefits of research and development associated with the simultaneous operation of multiple unmanned aircraft and agrees that additional flexibility is called for in this rule so that the agency can administratively allow these types of operations based on operation-specific mitigations. Accordingly, the FAA has made the prohibition on the simultaneous operation of multiple small unmanned aircraft waivable on a case-by-case basis. To obtain a waiver, a person will have to demonstrate that his or her simultaneous operation of more than one small unmanned aircraft can safely be conducted under the terms of a certificate of waiver. The FAA recognizes the potential of one person being able to operate multiple small unmanned aircraft and will evaluate operations conducted under FAA-issued waivers to help inform future agency actions to enable the simultaneous operation of multiple small UAS.

Amazon asserted that the proposed restriction is based on the flawed premises that small UAS must be operated under constant manual control and that FAA-recognized mitigation measures like flight termination systems are not already available today. Aerial Services and MAPPS stated that the FAA should allow the operation of swarms of UAS if the flight management system is capable of supporting it and each aircraft has rigid automated procedures in case of loss of signal.

As discussed previously, swarms of multiple small unmanned aircraft that are linked up to a single system introduce additional risk into the NAS because a single unmanned aircraft losing its link to the control system may destabilize the system and result in loss of positive control of multiple aircraft. Additionally, the FAA does not currently have data on which to base a finding that the pertinent technology has matured to the extent necessary to allow the safe operation of multiple small unmanned aircraft in a rule of general applicability. As such, the FAA will consider the use of this technology on a case-by-case basis via the waiver process.

AirShip Technologies and the NJIT Working Group cited military and non-military uses for clusters, swarms, and multiple UAS. These include combat, first responder missions, mapping, and search and rescue operations. Skycatch, Clayco, AECOM, DPR Construction, and AUVSI noted that the use of multiple UAS in a single operation allows for more efficient completion of complex tasks to include work over job sites without increasing the amount of time in flight or recharging of batteries.

The FAA agrees with the commenters that the operation of multiple unmanned aircraft may provide a valuable and broad spectrum of services. However, the technology necessary to mitigate risk associated with this type of operation is still in its infancy and has not yet been proven to meet a level of reliability sufficient to allow that technology to be relied on for risk mitigation in a rule of general applicability. As discussed previously, the waiver process will continue to be available for small UAS operations that fall outside the operational parameters of part 107.

The International Center for Law and Economics and Tech Freedom said the proposed restriction ''fails to reflect the 'best reasonably obtainable scientific, technical, economic, and other information,' '' as required by Executive Order 12866. The commenters further stated that the FAA has a constitutional obligation to explore the adequacy of simultaneous operation technology. Otherwise, the commenters continued, the rule will greatly increase the cost of operating UAS, thus limiting their availability for both commercial and non-commercial uses that are protected by the First Amendment.

The FAA received over 4,500 comments on this rulemaking and none of the commenters (including the International Center for Law and Economics and Tech Freedom) submitted any data establishing the safety or maturity of simultaneous-operation technology. Based on the number and high quality of the comments submitted, the FAA believes that this lack of data was not an oversight but, rather, evidence of the fact that existing data about this technology is very limited at this time. The FAA will continue exploring the feasibility of this technology in future agency actions that will be informed, in part, by small UAS operations that will take place under a part 107 waiver allowing the operation of multiple small unmanned aircraft at the same time.

iii. Micro UAS

The NPRM raised the possibility of creating a separate micro UAS classification for UAS weighing no more than 4.4 pounds (2 kilograms). The NPRM went on to list the following restrictions that the FAA was considering for such a micro UAS classification:

- Require that the micro UAS be made out of frangible materials that break, distort, or yield on impact.
- Require that the unmanned aircraft weigh no more than 4.4 pounds.
- Impose a maximum airspeed of 30 knots.
- Impose a maximum altitude of 400 feet AGL.
- Restrict flight distance to 1,500 feet from, and within the visual line of sight of, the operator.
- Ban the use of first person view during operations.
- Require the operator to maintain manual control of the flight path of the micro UAS and, therefore, ban the use of automation to control the flight path.
- Limit operations to Class G airspace.
- Require the micro UAS to maintain a distance of at least 5 nautical miles from any airport.

With these additional operating restrictions, the NPRM proposed to: (1) Allow micro UAS to fly over people not involved with the operation; and (2) create a separate airman certificate with a micro UAS rating.

Many commenters addressing the issue supported the creation of a separate micro UAS classification, noting that the reduced regulatory requirements associated with the classification are consistent with the lower hazards posed by micro UAS. Commenters in research/academia and the agricultural, news/media, insurance, and construction industries, among others, also noted the value of being able to operate micro UAS under the lesser restrictions contemplated in the NPRM.

However, a number of commenters, including ALPA, NAAA, NetMoby, Aerius, Planehook, Green Vegans, and NextGen Air Transportation Program at NC State University, opposed the creation of a separate micro UAS classification. Reasons for their opposition included concerns about: (1) The safety of flying over people not involved in operations; (2) an airman certificate issued on the basis of self-certification; and (3) the lack of data available on the safety of micro UAS operations. UAS America Fund and the Property Drone Consortium recommended that micro UAS operators should be required to obtain liability insurance for their operation.

Other commenters, including the Small UAV Coalition, National Association of Broadcasters, Skycatch, DJI, Predesa, the Nez Perce Tribe, and the New Hampshire Department of Transportation opposed the operational limitations that the NPRM proposed for micro UAS. These commenters argued that many of the proposed limitations such as the frangibility requirement, the prohibition on use of FPV devices, the prohibition on autonomous operations, and the prohibition on operating within five miles of an airport, would be unduly restrictive and would significantly impair micro UAS operations.

Still other commenters, including the Association of American Universities, the Electronic Frontier Foundation, Associated General Contractors, Southern Company, and the Oklahoma Governor's Unmanned Aerial Systems Council argued that micro UAS should be exempted from some of the other operational restrictions of part 107 (not just flight over people). Commenters suggested that micro UAS be exempted from the visual-line-of-sight restriction, the limitation to daylight-only operations, the prohibition on simultaneous operation of multiple aircraft, and the minimum visibility requirements.

The FAA agrees with the commenters who pointed out that many of the micro UAS limitations proposed in the NPRM, such as the requirement to remain more than five miles away from an airport and the prohibition on autonomous operations would, if finalized in this rule, significantly impair micro UAS operations. At the same time, the FAA acknowledges the concerns raised by ALPA, NAAA, and other commenters who pointed out that, even though micro UAS are smaller than other small UAS, they can still pose a safety risk. This concern is particularly troubling given the limited safety data currently available with regard to micro UAS operations and the fact that almost all other countries that currently regulate UAS generally do not allow small unmanned aircraft to fly over people or congested areas.[96]

Thus, after consideration of the comments that the proposed micro UAS restrictions would limit the utility of such operations and safety concerns that remain even with the operating limitations proposed in the NPRM, the FAA has determined that a different framework to regulate micro UAS is called for. Because the public has not yet been given an opportunity to comment on an alternate framework for micro UAS operations, the FAA has determined that a new comment period should be provided for the micro UAS component of this rule. Accordingly, the FAA chartered a new ARC to provide the FAA with recommendations regarding Micro UAS. On April 2, 2016, the FAA received the Micro UAS ARC's recommendations, and is moving to expeditiously issue an NPRM. In the meantime, the FAA will finalize the remainder of this rule to immediately integrate all other small UAS operations into the NAS.

While the micro UAS NPRM rulemaking is pending, micro UAS will remain subject to the same provisions as all other small UAS. However, the FAA notes that many of the operational restrictions of part 107 are subject to waiver. A very low-weight unmanned aircraft may be one mitigation that could, in conjunction with other mitigations, be used to help support a safety finding as part of a waiver-application evaluation.

[96] Some countries, such as the United Kingdom, allow approval for flight in congested areas on a case-by-case basis. *See* GAO, *Unmanned Aerial Systems: FAA Continues Progress toward Integration into the National Airspace* at 32 (July 2015).

iv. Flight Over People

The NPRM proposed to prohibit the operation of small unmanned aircraft over a person unless that person is either directly participating in the small UAS operation or is located under a covered structure that would protect the person from a falling small unmanned aircraft.[97] This rule will finalize this provision with two changes. First, this rule will allow a small unmanned aircraft to be operated over a person who is inside a stationary covered vehicle. Second, this rule will make the restriction on operating a small unmanned aircraft over people waivable.

Many commenters, including NAAA, International Brotherhood of Teamsters, and Professional Photographers of America, supported the flight-over-people provision as proposed in the NPRM. Other commenters objected to the proposed requirement.

DronSystems stated that the proposed ban on operations over non-involved persons would impact e-commerce and ''a number of other sectors,'' and would be difficult to enforce. The University of Washington said that banning operations over non-operators is over-burdensome. WAG said the proposed prohibition ''could have a significant chilling effect on both the commercial application of sUAS technology as well as the future development of sUAS technology,'' and is inconsistent with the ''model aircraft'' protections afforded by part 101 and section 336 of Public Law 112–95. Similarly, Foxtrot Consulting suggested that adequate training and a performance evaluation is a better mitigation measure because it ensures that remote pilots can operate their small UAS safely, regardless of what is below.

The Small UAV Coalition, Aeromarine, and an individual commenter stated that the proposed prohibition is unduly restrictive because there is no prohibition on manned aircraft flying over people. The Coalition also asserted that, given the consequent reduction in risk associated with the visual-line-of-sight and see-and-avoid requirements, a small UAS may safely be operated over persons.

The International Center for Law and Economics and TechFreedom claimed

[97] Title 14 CFR 1.1 defines ''person'' as ''an individual, firm, partnership, corporation, company, association, joint-stock association, or governmental entity. It includes a trustee, receiver, assignee, or similar representative of any of them.'' Because the term ''person'' is defined in 14 CFR 1.1, part 107 uses the term ''human being'' in the regulatory text to capture only an individual human being. For readability, the preamble uses the terms ''person'' and ''human being'' interchangeably.

that by prohibiting UAS operation over people who are not directly involved in the operation, the FAA is ''essentially limiting commercial UAS operations to unpopulated or extremely sparsely populated areas,'' and thus is ''improperly ignor[ing] the important incentives for innovation suggested by Executive Order 12866 without apparent corresponding benefit.''

The Consumers Energy Company (CEC) stated that the likelihood of injury from contact with a small UAS is low given the restrictions on the size of small UAS, as well as the fact that they use small rotors and carry small fuel loads. With respect to the maintenance of power lines, poles, and related facilities, in particular, CEC pointed out that most operations occur in remote or rural locations with low population densities, where the risk of contact between a small UAS and a non-involved person is minimal. CEC said the FAA needs to consider ''whether the risk perceived from small UAS usage really justifies a restriction that could have a substantial impact on the ability to use sUAS on a commercial scale.''

Manned aircraft are generally permitted to fly over people because manned aircraft are formally evaluated for airworthiness through the airworthiness certification process. This process ensures that the manned aircraft has a level of reliability that would allow it to, among other things, safely fly over a person.

This rule does not require airworthiness certification. Because small unmanned aircraft have not been tested for reliability through the airworthiness certification process, they will likely have a higher failure rate than certificated aircraft. A small unmanned aircraft that fails may fall on a person standing under it at the time of failure, which is why this rule restricts small unmanned aircraft flight over people.

With regard to the risk caused by small UAS operations, the FAA agrees that, to date, the number of actual fatalities caused by small UAS operation has been low. However, that may be a function of the fact that, until recently, commercial civil small UAS operations have been prohibited in the United States. As discussed in the Regulatory Impact Assessment, the FAA expects the use of small UAS to increase after issuance of this rule, and thus, the agency has to ensure that part 107 implements appropriate mitigation to address potential risk caused by small unmanned aircraft flight over people.

The FAA agrees with WAG and Foxtrot Consulting that the knowledge that remote pilots in command will acquire during the certification process will help mitigate against small UAS accidents caused by human error. However, the safety concern underlying the flight-over-people restriction is not human error, it is mechanical failure. While a remote pilot in command may be able to detect some signs of potential mechanical failure during the preflight check, the preflight check does not, by itself, assure a level of mechanical reliability established by the formal airworthiness and maintenance processes that apply to other aircraft in the NAS. The appropriate mitigation to address this discrepancy, especially for heavier small unmanned aircraft, is an operational restriction on flying over people who could be hurt in the event of a mechanical failure.

The FAA disagrees with WAG's assertion that model aircraft are subject to a lower flight-over-people standard than part 107 operations. In order to operate under section 336 of Public Law 112–95, a model aircraft must, among other things, be ''operated in accordance with a community based set of safety guidelines and within the programming of a nationwide community-based organization.'' [98] Today, the largest nationwide community-based organization that operates model aircraft is the Academy of Model Aeronautics (AMA). AMA's safety code specifically prohibits ''flying directly over unprotected people, vessels, vehicles or structures.'' [99]

Several commenters, including the American Council of Engineering Companies, AUVSI, and Consumer Electronics Association, urged the FAA to implement a risk-based approach to allow operations over people.

AUVSI asserted that ''by allowing sUAS operations over human beings following a risk-based approach, the FAA would foster industry innovation to develop the proper equipment and software necessary to meet safety standards regarding such operations.'' CEA provided an example of such a risk-based restriction used by another country that it said ''would permit operations in less populated environments and continue to allow industry to gain experience and innovate.'' Specifically, CEA noted that the Swiss have successfully used a permitting system for UAS operations over ''gatherings of people,'' defined as ''several dozen people standing in close proximity to one another'' or within a radius of 100 meters of such gatherings. Drawing on that example, CEA recommended the FAA ''tailor the rules to prohibit operations over mass gatherings, such as concerts and sporting events.'' Although CEA commended the FAA for rejecting as ''unduly burdensome'' a prohibition against the operation of small UAS over any person, it nevertheless asserted its belief ''that the proposal is just as burdensome and that small UAS incorporate sufficient safety measures that make the prohibition unnecessary under the new rules.''

Boeing similarly recommended that the FAA reconsider proposed § 107.39 and ''develop criteria using a risk-based approach to this issue, based upon population density and overflight, to take into account agriculture as well as law enforcement uses.'' The Professional Helicopter Pilots Association suggested allowing small UAS to be operated over persons or property if they do so in a safe manner.

DJI pointed out that ''the proposed performance standards already impose an obligation on the operator to familiarize himself with the operating environment and take steps to assure the operation does not present an 'undue hazard'.'' Depending on the nature of the operation, DJI continued, ''the risk associated with an inadvertent loss of positive control may require that there be no third parties exposed to any risk,'' or ''the risk may be so minimal as to merit notification but not evacuation or taking cover,'' or ''the required safety measure may fall within this range of options.'' As such, DJI suggested that ''the best way to address the risk to individuals not directly involved in the operation is through the proposed performance standard.''

Trimble Navigation proposed the FAA rely on a performance-based regime for operations over persons. Noting that the onus and obligation should be primarily on the small UAS operator to assess the overall safety environment before operating over persons, the company said the FAA ''should avoid trying to specify precise design-based criteria in favor of a general standard of care that requires the operator to take into account the full range of operational safety protections and procedures at the site in question.''

A commenter suggested the final regulations should discern between UAS weighing 5 pounds or less (which could be operated over ''populated'' areas at a maximum speed of 40 mph), UAS weighing between 5 and 25 pounds (which could be operated over ''sparsely populated'' areas at a maximum speed of 70 mph), and UAS weighing between 25 and 55 pounds (which could be operated according to

[98] Public Law 112–95, sec. 336(a)(2).

[99] Academy of Model Aeronautics National Model Aircraft Safety Code, § B(1).

the limitations imposed in the NPRM). The commenter further suggested that COAs be available for UAS between 25 and 55 pounds to be operated in populated and sparsely populated areas.

The FAA agrees that for certain types of small unmanned aircraft, a more performance-based set of operational mitigations may be appropriate because the lighter weight or other characteristics of those aircraft may result in less impact force if they should collide with a person. That is why, as discussed in the previous section, the FAA will be issuing an NPRM inviting public comment on a framework under which micro UAS will be allowed to operate over people. However, other small unmanned aircraft that do not meet the characteristics of a micro UAS may result in more impact force if they should collide with a person and that greater force may seriously injure or kill the person.

The risk associated with flight over people is due to mechanical reliability issues that a remote pilot in command may have a limited opportunity to evaluate without airworthiness certification or a more extensive maintenance process. At this time, the FAA has no data establishing how that risk could be mitigated through operational constraints (whether performance-based or otherwise), other than a prohibition on flight over people. Accordingly, this rule will retain the general prohibition on flight over people. However, as discussed below, this prohibition will be waivable to allow the FAA to consider case-specific mitigations. The FAA will use data and operating experience gained as a result of the waiver process to help inform future UAS rulemakings.

A number of commenters said the proposed restriction should be narrowed to apply only to certain crowded or heavily populated areas. The American Petroleum Institute urged the FAA not to apply the prohibition in cases of ''intentional acts to disrupt lawful UAS operations'' (*e.g.,* anti-oil and gas activists placing themselves in generally accessible areas of operation to frustrate or halt routine activities). Event 38 Unmanned Systems proposed that ''certain events and other areas with high people concentration locations be designated as no-fly zones,'' instead of a total ban on operations over non-participants. The company suggested that local and State entities could be involved in this part of the rulemaking.

Matternet similarly recommended that the only overhead operations that should be restricted are operations ''over an open air assembly of persons if such operation endangers the life or property of another.'' The company compared the proposed regulation to regulations for ultralight vehicles (ULV)—which weigh up to 250 pounds, plus the weight of the person, and are permitted to be operated over persons—and suggested that a device weighing less than one-sixth the weight of a ULV with a passenger, and operated at an altitude of only 500 feet or less (compared to thousands of feet for the ULV), poses far less risk to persons on the ground. Several individuals also recommended that the final rule prohibit any operation in congested areas or over open-air assemblies of people.

As an initial matter, the FAA notes that there is a significant difference between the terms ''congested area'' and ''open-air assembly of people.'' While the term ''open-air assembly of people'' applies only to a large group of people, the term ''congested area'' could apply to an area that has no people in it. For example, a town's commercial/business district can be considered a congested area, even in the middle of the night when there are no people in the area.[100]

As pointed out by the commenters, a number of existing operations that take place in the NAS, such as the operation of ULV, are prohibited from taking place over congested areas.[101] The FAA considered imposing a similar restriction on small UAS operations conducted under this rule. However, the FAA ultimately rejected this approach as needlessly restrictive because it would prohibit small UAS operations over certain parts of a town even when there are no people in the area of operation who could be hurt by a small unmanned aircraft.

With regard to operations that are not conducted over an open-air assembly of people, the FAA agrees that this may be a consideration for some small unmanned aircraft that pose a lower injury risk if they collide with a person, consistent with the micro UAS ARC's recommendations. Accordingly, the FAA may consider this approach as part of the micro UAS rulemaking. However, other small unmanned aircraft pose a higher injury risk and in the event of a mechanical failure, those aircraft could seriously injure or kill a person in their path, even if that person is not part of a larger group. Accordingly, this rule will not allow flight over people even when they are not part of an open-air assembly. We will continue to evaluate this issue and address it in rulemaking in response to the Micro UAS ARC recommendations, as noted earlier.

The FAA declines to add an exception for intentional acts to disrupt lawful small UAS operations. A person who is standing under an uncertificated small unmanned aircraft is subject to the same amount of risk regardless of his or her subjective motivation for standing under the aircraft. The FAA notes, however, that State and local laws, such as trespassing, may provide a remedy for companies whose small UAS operations are deliberately interfered with by people entering the area of operation without permission.

Finally, with regard to State and local entity involvement in this rulemaking, the FAA notes that the comment period for the NPRM was open to everyone, including State and local entities. The FAA received a number of comments from State and local entities, and it considered those comments when formulating this final rule.

Several commenters, including the Small UAV Coalition, Google, and Statoil, suggested that the prohibition on flight over people should be subject to waiver or some other type of deviation authority. The Small UAV Coalition urged the FAA to revise proposed § 107.39 to allow the Administrator or his delegate to authorize small UAS operations over non-participating persons through exemption, deviation authority (certificate of waiver or authorization), or certification, ''upon a showing that any risk to persons on the ground is sufficiently mitigated.''

Google pointed out that an outright ban on operations over people not directly participating in the operation of the UAS or not located under a covered structure would limit beneficial uses for small UAS which involve operations above nonparticipants. Google proposed that operators be able to ''present a safety case'' to the FAA for operations over non-participants.

The National Ski Area Association (NSAA) said the final rule should recognize and accommodate technological innovations, which could be required for use of UAS at ski areas when operating near open-air assemblies of persons. Such technologies include geo-fencing, return-to-home capabilities, pre-programmed waypoint software, land-immediately function, GPS, signal processing, and increasingly reliable navigation systems.

CEA suggested that the FAA allow small UAS to be eligible to obtain airworthiness certifications, and that UAS with such certifications not be subject to the prohibition on operations

[100] *See* Letter to James E. Gardner from Rebecca MacPherson, Assistant Chief Counsel for Regulations (June 18, 2012).

[101] *See, e.g.,* 14 CFR 103.15.

over people. CEA asserted that such an approach ''will create a vibrant market for UAS and encourage manufacturers to seek airworthiness certification.''

Airware pointed out that standards have been developed by ASTM subgroup F38 to ensure higher levels of safety for operations that pose a higher risk like flight over populated areas. In addition to those existing standards, Airware asserted that the combination of the use of fly-away protections like geo-fencing and contingency management, applying design and testing to industry standards, the use of reliable flight control systems, and the use of parachutes to mitigate against the risk of all out failure ''provides an equivalent level of safety for flight in populated areas.'' Airware further asserted that this goes well beyond the requirements imposed in the countries that currently allow for operations over populated areas like France, the Czech Republic, Austria, Denmark, Italy, and Sweden (among others), which ''are currently being conducted with extremely high levels of safety.''

ASTM pointed out that there are multiple approved industry consensus standards under development to support operations over people, in case the FAA decides to require compliance with industry consensus standards for this requirement in the final rule. ASTM also noted that precedent exists for the utilization of industry consensus standards by Federal agencies in the United States. The commenter went on to point out that the National Technology Transfer and Advancement Act (NTTAA) mandates that all Federal agencies use technical standards developed and adopted by voluntary consensus standards bodies, as opposed to using government-unique standards. In addition, ASTM asserted that, consistent with Section 12(d) of the NTTAA, OMB Circular A–119 directs agencies to use voluntary consensus standards in lieu of government-unique standards except where inconsistent with law or otherwise impractical. ASTM further noted that OMB Circular A–119 also provides guidance for agencies participating in voluntary consensus standards bodies and describes procedures for satisfying the reporting requirements of the Act.

The FAA agrees that technology or additional mitigation, such as airworthiness certification, may allow small unmanned aircraft to safely fly over people in certain circumstances. Accordingly, the flight-over-people restriction in this rule will be waivable. In order to obtain a waiver, an applicant will have to demonstrate that he or she has implemented mitigations such that small unmanned aircraft flight over people can safely be conducted under the terms of a certificate of waiver.

The FAA also agrees with CEA that while this rule does not require airworthiness certification, this rule also does not prohibit a small UAS from voluntarily obtaining this certification. The FAA generally agrees that having a small UAS meet an appropriate airworthiness standard could increase safety to the point of permitting a small unmanned aircraft to operate over persons who are not directly involved in the flight operation (*i.e.,* non-participants) and who are not under a covered structure. The FAA may consider airworthiness certification of the small UAS as mitigation to support an application for waiver that would allow a small unmanned aircraft to operate over unprotected non-participants.

With regard to the use of industry consensus-standards, as noted by ASTM, consensus standards for operations such as flight over people are currently in development. As of this writing, those standards have not yet been published. The FAA notes, however, that the level of safety that must be demonstrated in order to obtain a waiver may be demonstrated in a number of different ways. Once consensus standards are published, the FAA may consider whether compliance with the published consensus standards would be one way to demonstrate that the proposed operation can be conducted safely under the terms of a certificate of waiver. The FAA will also consider UAS-specific consensus standards, once they are published, in future UAS rulemakings.

Several commenters said the proposed prohibition should not apply when additional risk mitigating measures are employed. Southern Company said the FAA should allow operations over any person who is located on the property, easement, or right of way of the person or entity for whom the small UAS is operated, and any person who is participating in the activity for which the small UAS is being operated. The commenter said such mitigating restrictions could include a lower operating ceiling, lateral-distance limits, a lower speed restriction, and a prohibition on operations over large gatherings of people. Qualcomm similarly proposed that FAA permit operations over uninvolved persons where risks are mitigated by the use of ''proven means of avoiding harm to individuals via technologies that allow the device to land safely under even extreme circumstances.'' The Rocky Mountain Farmers Union urged the FAA to allow operations over non-participants ''under circumstances when the UAS operator can maintain safe operation of the UAS and either depart the area or safely land the UAS without risk to unrelated persons on the ground.'' The Newspaper Association of America asserted that the FAA should not prohibit news organizations from overhead flight, ''provided that adequate precautionary measures are taken to ensure that [UAS] are operated safely at all times.''

The Mercatus Center at George Mason University said that the FAA did not consider the benefits of allowing UAS operations over persons not involved in the operation, and that the FAA overstates the risks of operation in populated areas. The University asserted that, ''[u]pon loss of positive control, unmanned aircraft can be programmed to safely return to a base, or to simply hover in place.'' Thus, the University continued, the risk to bystanders can be mitigated without a ban on operation over uninvolved persons.

NAMIC recommended that the FAA allow small UAS operations over people not directly involved in the operation, as long as those operations follow enhanced safety protocols, including, for example: (1) That the small unmanned aircraft not loiter over a person or persons for an extended period of time, but transition over them as needed to reach a location where operating is permitted to complete the flight; and (2) that an operator must operate the UAS at a sufficient altitude so that if a power unit fails, an emergency landing can be accomplished without undue hazard to persons or property on the ground. Exelon Corporation said that the final rule should include reasonable accommodations to allow for brief, low-risk exceptions to the ban on flights over non-participating persons (*e.g.,* flying across a road during a survey of damage to power distribution lines in suburban areas), and that ''proper safety precautions as well as signage, education, and protocol can be put in place to mitigate any safety concerns.''

The Property Drone Consortium said that any UAS with ''special safety features'' should be exempt from the ban on flight over non-participants. Furthermore, the Consortium suggested the FAA mitigate any safety concerns by requiring appropriate insurance coverage or creating a suggested list of ''best practices'' for use in the insurance industry. Similarly, the University of Illinois at Urbana-Champaign said the proposed prohibition ''is onerous and overprotective,'' and suggested instead

that insurance and equipment requirements could be employed ''to promote responsible use of the UAS.''

As discussed earlier, the restriction on flight over people in this rule will be waivable. This will allow the FAA to consider, on a case-by-case basis, any additional mitigations that are incorporated into a small UAS operation. The FAA will grant a waiver request allowing small unmanned aircraft flight over people if the applicant establishes that his or her operation can safely be conducted under the terms of a certificate of waiver. In response to comments suggesting an insurance requirement in place of the flight-over-people restriction, the FAA notes that, as discussed in section III.K.1 of this preamble, the FAA lacks jurisdiction to mandate the purchase of liability insurance.

An individual commenter suggested that operations in congested areas be permitted with additional licensure, which the commenter said ''will assist the operator in recognizing potential hazards and risks as well as the ability to assess those risks to ensure that these hazards to the public be minimized.'' Another individual commenter recommended an additional rating for operators to allow them to fly ''in cities and other crowded areas.'' The commenter said the operators could be required to go through a more comprehensive certification process, and the UAS could be required to have annual or semiannual maintenance checks and be equipped with an automatically deployable parachute system.

As discussed earlier, the FAA considered and rejected additional limitations on operations over congested areas because that approach would needlessly limit small UAS operation over congested areas during times when those areas are devoid of people. The FAA also does not agree that additional remote pilot certification should be required to operate over an empty area of operation, even if that area of operation happens to be located in a congested area.

The Stadium Managers Association suggested modifying proposed § 107.39 to mirror the current section 333 exemption language which, in addition to prohibiting flights over people, includes a prohibition against flight over vehicles, vessels, and structures. Vision Services Group similarly recommended prohibiting flight over people in a covered structure.

On the other hand, Edison Electric Institute, NRECA, the American Public Power Association, and Continental Mapping suggested that the exception allowing flight over people located under a covered structure that can provide reasonable protection from a falling small unmanned aircraft should be clarified to indicate that persons under cover in a vehicle ''may qualify as being in a structure providing reasonable protection.''

This rule will allow flight over people located under a covered structure capable of protecting a person from a falling small unmanned aircraft because such a structure mitigates the risk associated with a small unmanned aircraft flying over people. The FAA also agrees with Edison Electric Institute, NRECA, the American Public Power Association, and Continental Mapping that a small unmanned aircraft should be allowed to fly over a person who is inside a stationary covered vehicle that can provide reasonable protection from a falling small unmanned aircraft. The FAA has modified this rule accordingly. This rule will not, however, allow operation of a small unmanned aircraft over a moving vehicle because the moving vehicle operating environment is dynamic (not directly controlled by the remote pilot in command) and the potential impact forces when an unmanned aircraft impacts a moving road vehicle pose unacceptable risks due to head-on closure speeds. Additionally, impact with a small unmanned aircraft may distract the driver of a moving vehicle and result in an accident.

Several commenters sought clarification on the NPRM's use of the phrases ''directly participating in the operation'' (as used in proposed § 107.39(a)) and ''directly involved in the operation'' (as used in the preamble). Associated Equipment Distributors noted that the preamble to the NPRM indicates that direct participation is limited to the operator and the visual observer, but the proposed regulatory language ''does not afford clarity on this point.'' SkySpecs proposed allowing anyone who has permission to be on a construction site and is covered by liability insurance to be covered by the definition.

Edison Electric Institute, NRECA, and the American Public Power Association said the definition of ''directly participating'' ''should be expanded to include personnel engaged in related activities, such as workers at a power plant a small UAS is being used to monitor or an electric utility crew whose work the small UAS is being used to assist.'' The organizations further proposed that such individuals would qualify as ''directly participating in an operation'' if they had received the pre-flight briefing described in proposed § 107.49.

Some commenters, including NBAA, the American Insurance Association, FLIR Systems, the North Carolina Association of Broadcasters, and Skycatch, felt that FAA should permit small UAS operations over individuals not involved in the UAS operations when those individuals consent to, or are made aware of, the operations. Several State farm bureaus and NBAA urged the FAA to allow small UAS operations over people not directly involved in an operation so long as the operator notifies those people of the operation before it starts. The American Farm Bureau Federation and a number of state farm bureau federations said the definition should be expanded to include individuals ''who have been made aware of the presence and approximate flight path of the sUAS in their vicinity.'' The farm bureau federations claimed that the risk of a small UAS endangering a consenting individual working in a field who is not directly involved in, but is aware of, a small UAS operation ''is simply too remote to justify a blanket prohibition.'' [102] AED proposed including consenting individuals, such as employees and contractors at a construction site, in the definition of ''directly participating in the operation.'' The International Association of Amusement Parks and Attractions also suggested that the definition of ''directly participating in the operation'' include persons who have consented to the operation of the UAS overhead.

Associated Builders and Contractors also proposed lifting the restriction on flight over non-participants on a construction site, so long as those people have been notified of the small UAS operations, wear hard hats, and have been provided orientation regarding the equipment prior to entering the work site.

Kapture Digital Media questioned whether people can become ''directly involved'' in an operation if they are notified of the operation by signs posted around the area of operation, or, alternatively, whether people can only become ''directly involved'' in an operation by signing a waiver. Vail Resorts noted that many of the best uses of UAS technology at ski areas would necessarily involve some temporary amount of flight over individuals who

[102] Other commenters who urged FAA to reconsider the proposed prohibition as it applies to agricultural operations include the National Farmers Union, National Corn Growers Association, National Association of Wheat Growers, and the Virginia Agribusiness Council.

are not ''necessary for the safe operation'' of the small UAS, which is how the NPRM defined ''directly involved in the operation.'' Consequently, Vail asserted that a strict ban on operations over people not ''directly involved'' in the operation ''could have the unintended consequence of making many potentially critical ski resort drone operations noncompliant with FAA regulations.'' As such, Vail said FAA should broaden the definition of ''directly involved'' to include ''those people who are aware of and have consented to being involved in the drone operation by, for example, reading particular signage or signing a release.'' Similarly NoFlyZone.org said operations over non-participants should be permitted provided the operator has advised all non-participants to remain clear of the small UAS launch/recovery area, and also advised all non-participants that the small UAS does not comply with Federal safety regulations for standard aircraft.

The National Ski Area Association (NSAA) pointed out that for UAS operations that may involve operations near skiers and snowboarders, or participants and spectators in special events, ski areas could inform participants of the event and associated risks and could obtain consent prior to using a UAS. NSAA suggested further that ski areas ''could be obligated to determine, based on the event or assemblage of persons, acceptable proximity parameters, either laterally or vertically.''

The term ''directly participating'' refers to specific personnel that the remote pilot in command has deemed to be involved with the flight operation of the small unmanned aircraft. These include the remote pilot in command, the person manipulating the controls of the small UAS (if other than the remote pilot in command), and the visual observer. These personnel also include any person who is necessary for the safety of the small UAS flight operation. For example, if a small UAS operation employs a person whose duties are to maintain a perimeter to ensure that other people do not enter the area of operation, that person would be considered a direct participant in the flight operation of the small UAS.

Anyone else would not be considered a direct participant in the small UAS operation. Due to the potential for the small unmanned aircraft to harm persons on the ground, the FAA does not consider consent or the need to do other work in the area of operation to be a sufficient mitigation of risk to allow operations over people. The FAA considers the risks associated with allowing operations over directly participating persons to be a necessary risk associated with the safety of flight because if UAS crewmembers are prohibited from standing near a flying unmanned aircraft, they may be unable to complete their duties. Additionally, some small UAS operations require the aircraft to be hand-launched or retrieved by a person, so it would not be possible to conduct such operations without permitting operations over those people.

Further, the FAA notes that people directly participating in the flight operation of a small unmanned aircraft have situational awareness that provides them with increased ability to avoid a falling unmanned aircraft. Conversely, a non-participant who has consented to allowing operations overhead may not share the same situational awareness and consequently may not be able to avoid being struck by a small unmanned aircraft. For this reason, a remote pilot intending to operate small unmanned aircraft over non- participants must apply for a waiver under this part, which will allow the FAA to evaluate each applicant's operation on a case-by-case basis.

The American Fuel & Petrochemical Manufacturers and Employees, Associated General Contractors of America, Skycatch, Clayco, AECOM, DPR Construction, and the State of Utah Governor's Office of Economic Development said operations over uninvolved persons should be permitted at areas closed to the public (*e.g.,* construction sites, movie sets), as long as the uninvolved persons are aware of and consent to the activity. The National Association of Broadcasters, National Cable & Telecommunications Association, and Radio Television Digital News Association, commenting jointly, pointed out that the FAA has already granted a number of section 333 exemptions for aerial photography and filming which have allowed small UAS flights over consenting production personnel, and thus urged the FAA to define ''directly participating in the operation'' to include persons who have ''implicitly consented to the operation of the sUAS overhead by nature of their presence on a set where sUAS filming is occurring.'' The Motion Picture Association of America similarly asked the FAA to specify that ''all parties on a closed set'' qualify as ''directly participating in the operation,'' thereby ensuring that current practices under the filming exemptions are consistent with § 107.39.

As pointed out by the commenters, the FAA currently allows small unmanned aircraft flight over people in only one type of situation: A closed-set movie set which is a controlled-access environment where the person in charge has extensive control over the positioning of people who are standing near the small unmanned aircraft. The FAA currently considers each movie-set exemption on a case-by-case basis through the section 333 exemption process. The FAA will continue considering flight over people on a movie-set on a case-by-case basis through the waiver process in this rule. The FAA notes that this framework is consistent with the regulatory framework used for motion picture and television filming in manned-aircraft operations, where a waiver is usually required prior to using an aircraft for filming purposes.[103] The FAA also notes that, as discussed in section II.C of this preamble, current section 333 exemption holders who are allowed to fly over people when filming a movie will be permitted to continue operating under their section 333 exemption until they are able to obtain a waiver under part 107.

With regard to flight over people in other controlled-access environments, such as construction sites, the FAA will consider that issue on a case-by-case basis through the waiver process. This process will allow the FAA to consider the specific nature of the controlled-access environment to determine how that environment would mitigate the risk associated with flight over people.

The Association of American Railroads said operations over railroad personnel during a railroad incident investigation or routine railroad inspections should be permitted. The Association noted that the risks associated with such operations can be mitigated by giving those personnel a small UAS operations and safety briefing before flight is commenced.

The FAA disagrees. While this rule will allow flight over direct participants in a small UAS operation after they receive important safety information, the information does not, by itself, completely mitigate the risk posed by flight over people. As discussed earlier, the reason this rule allows flight over direct participants in a small UAS flight operation is because without this exception, those people may be unable to complete their duties to ensure the safety of the small UAS flight operation. People who are not directly participating in the small UAS flight operation are not needed to ensure the safety of that operation, and as such, this rule will not allow flight over those people without a waiver.

[103] *See* FAA Order 8900.1, vol. 3, ch. 8, sec. 1.

The Property Drone Consortium said homeowners inside their homes while an inspection operation is conducted overhead, or homeowners who are in their back yards while an inspection operation is conducted in their front yards, should be considered ''protected'' for purposes of the ban on flight over non-participants.

A homeowner who is inside his or her home would be under a covered structure and flight over him or her would be permitted if the home can provide reasonable protection from a falling small unmanned aircraft. However, a person who is inside his or her backyard would presumably not be under a covered structure and could be injured by a falling small unmanned aircraft. Accordingly, a person who is in his or her backyard would not be considered protected if that backyard is not covered.

The Institute of Makers of Explosives asked the FAA to expand or clarify the proposed prohibition on operation of a small UAS over ''most persons'' to clearly define the persons over whom UAS operations may not be conducted. IME specifically recommended that a UAS not be allowed to operate over any person conducting operations with explosives under the jurisdiction of the Bureau of Alcohol, Tobacco, Firearms, and Explosives, and that the restriction apply to unauthorized, unrelated operators.

As discussed earlier, this rule will prohibit operations over people who are not directly participating in the flight operation of a small UAS and who are not under a covered structure or in a stationary covered vehicle that could reasonably protect them from a falling small unmanned aircraft. This prohibition applies regardless of what the person who is not directly participating in the small UAS flight operation is doing.

A number of commenters sought clarification as to what the FAA considers to be an operation ''over a human being.'' Southern Company asserted that, as written, the proposed provision could either be read strictly, to prohibit operations directly overhead, or it could be read more broadly, to prohibit operations directly overhead and within a short lateral distance of the person. Kansas University UAS Program similarly said the FAA needs to clarify whether by ''over a human being'' means directly overhead or ''within an area that the aircraft could come down on the person.''

Similarly, NAMIC asked the FAA to provide further guidance as to whether the small UAS operation is prohibited directly above persons or ''within a proximate area over persons.'' NAMIC acknowledged that it does not have the FAA's understanding of aeronautics or physics, but nevertheless stated its belief that a terminated UAS at 500 feet and 100 mph seems unlikely to fall directly onto a person standing directly under the UAS at the time of the termination. An individual commenter asserted that a small UAS flying towards a person, even if not directly above that person, could still pose a threat. By way of example, the commenter stated that a multi-rotor helicopter flying at a ground speed of 30 mph at 400 feet AGL that experiences a catastrophic failure ''will transcribe a parabolic arc that will extend horizontally several hundred feet in the direction of travel.''

Matternet also stated that the proposed restriction ''appears to be based on the faulty premise that aircraft only fall straight down when they malfunction or when pilots err'' when, in fact, an aircraft in flight will typically follow its original trajectory, subject to aerodynamic forces and gravity. Thus, the company asserted, an operation that passes directly over a person is not significantly more dangerous than an operation that passes several linear feet, or even tens of linear feet, away from that person on the ground.

The term ''over'' refers to the flight of the small unmanned aircraft directly over any part of a person. For example, a small UAS that hovers directly over a person's head, shoulders, or extended arms or legs would be an operation over people. Similarly, if a person is lying down, for example at a beach, an operation over that person's torso or toes would also constitute an operation over people. An operation during which a small UAS flies over any part of any person, regardless of the dwell time, if any, over the person, would be an operation over people.

The remote pilot needs to take into account the small unmanned aircraft's course, speed, and trajectory, including the possibility of a catastrophic failure, to determine if the small unmanned aircraft would go over or strike a person not directly involved in the flight operation (non-participant). In addition, the remote pilot must take steps using a safety risk-based approach to ensure that: (1) The small unmanned aircraft does not operate over non-participants who are not under a covered structure or in a stationary covered vehicle; (2) the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason (§ 107.19); and (3) the small UAS is not operated in a careless or reckless manner so as to endanger the life or property of another (§ 107.23). If the remote pilot cannot comply with these requirements, then the flight must not take place or the flight must be immediately and safely terminated.

Several commenters recommended that the FAA include specific vertical *and* horizontal minimum-distance requirements. Continental Mapping and MAPPS recommended that no operations be permitted ''within 50 meters vertically or horizontally from people, animals, buildings, structures, or vehicles, with a particular emphasis on takeoff and landing.'' MAPPS pointed out that its testing has shown this is a safe distance to perform emergency landings should something go wrong, particularly with rotary wing platforms. NAMIC recommended that FAA prohibit persons from ''intentionally operat[ing] a small UAS over or within 100 feet'' from a human being who is not directly participating in its operation or not located under a covered structure.

State Farm suggested that FAA remove the word ''over'' from proposed § 107.39, and instead prohibit persons from ''intentionally operat[ing] a small UAS within 100 feet'' from a human being who is not directly participating in the operation or not located under a covered structure. Aviation Management similarly suggested that the FAA provide protection to humans on the ground ''in close proximity to'' small UAS operations by requiring that a small UAS remain a minimum of 100 feet from the nearest human who is not directly participating in the operation (a requirement the commenter pointed out is imposed by Canada and Australia). Stating that an aircraft ''needs a fall radius that contemplates kinetic energy, max speed, max altitude,'' an individual commenter suggested that small UAS flight be restricted to a vertical cylinder with a radius of 200 feet, centered over an animal or persons not directly involved in the operation.

Several other commenters made suggestions as to how the FAA can more precisely define the requisite separation between a small UAS and persons not involved in an operation. The Civil Aviation Authority of the Czech Republic said the proposed prohibition ''should be extended to a safety horizontal barrier, not only directly above people, but also not in an unsafe proximity (for multicopters this should be twice the actual height AGL).'' NOAA and Southern Company said proposed § 107.39 should be revised to include specific lateral distances. Colorado Ski Country USA said the final rule should include a definition of ''Operations Over a Human Being'' that

sets out ''the proximity in which UAS operations would be prohibited.'' The New Hampshire Department of Transportation suggested that the final rule include a ''specified three-dimensional space that a small UAS is prohibited from when operating over any person not directly involved with the operation.'' The Hillsborough County Aviation Authority suggested that the lateral separation from people or structures be revisited to consider a safety area around the UAS ''with regards to momentum, wind drift, malfunction, etc. that would affect people or structures nearby.''

The National Association of Flight Instructors (NAFI) advocated for a larger separation between small UAS and non-participants, and recommended that proposed § 107.39 be revised to prohibit operation of a small UAS ''closer than 400 feet'' to persons not directly participating in the operation or not located under a covered structure or to ''any vessel, vehicle, or structure not controlled by the operator or for which written permission by the owner or licensee of that vessel, vehicle or structure has not been obtained.'' NAFI went on to assert that there is no reliable or sufficient database from which to project accident or injury rates, and to urge FAA to ''proceed cautiously and relatively slowly in significantly reducing the protection currently afforded to persons and property on the surface from the hazards of small unmanned aircraft systems.

Green Vegans asserted that under Public Law 112–95, Congress directed the FAA to implement restrictions for small UAS operations which ''include maintaining a distance of 500 feet from persons.''

The FAA considered requiring minimum stand-off distances in this rule, but ultimately determined that, due to the wide range of possible small unmanned aircraft and small UAS operations, a prescriptive numerical stand-off distance requirement would be more burdensome than necessary for some operations while not being stringent enough for other operations. For example, a 5-pound unmanned rotorcraft flying at a speed of 15 mph in a remote area with natural barriers to stop a fly-away scenario would likely not need a stand-off distance as large as a 54-pound fixed-wing aircraft traveling at a speed of 100 mph in an urban area with no barriers.

Thus, instead of imposing a prescriptive stand-off distance requirement, this rule will include a performance standard requiring that: (1) The small unmanned aircraft does not operate over a person who is not directly involved in the flight operation unless that person is under the appropriate covered structure or vehicle; and (2) the remote pilot ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason (§ 107.19(c)). This performance-based approach is preferable, as it will allow a remote pilot in command to determine what specific stand-off distance (if any) is appropriate to the specific small unmanned aircraft and small UAS operation that he or she is conducting. In response to Green Vegans, the FAA notes that Public Law 112–95 does not direct the FAA to promulgate a small UAS rule that includes a requirement for a small unmanned aircraft to maintain a distance of 500 feet from persons.

Some commenters proposed specific vertical distances that they claimed could permit safe operations of a small UAS over persons not directly involved in its operation. Asserting that flights ''well above'' a person's head pose minimal additional safety risks, the News Media Coalition recommended that the FAA permit overhead flight so long as the UAS remains at least 50 feet vertically from any person not involved in the operation of the UAS. Cherokee National Technologies and an individual commenter recommended that operations be permitted above people not directly involved in an operation, so long as those operations are not conducted less than 100 feet above those people.

These commenters did not provide data that the FAA could use to evaluate this assertion. The FAA notes, however, that a small unmanned aircraft falling from a higher altitude may actually pose a higher risk because the higher altitude would provide the small unmanned aircraft with more time to accelerate during its fall (until it reaches terminal velocity). This may result in the small unmanned aircraft impacting a person on the ground at a higher speed and with more force than if the small unmanned aircraft had fallen from a lower altitude.

The National Association of Broadcasters, the National Cable & Telecommunications Association, and the Radio Television Digital News Association, commenting jointly, said the proposed rule would limit the potential of unmanned aircraft to serve the public interest, particularly with respect to newsgathering. The associations recommended a few changes to ''increase the utility of sUAS for newsgathering and video programming production purposes.'' First, the associations said the FAA ''should clarify that only flights directly over non-participating people are barred''—*i.e.,* the ''FAA should specify that the rule would still permit sUAS with a camera that is capable of filming—at an angle—an area where people are present.'' Second, because ''the proposed rule raises the question of what level of knowledge a reasonable operator can be expected to have,'' the associations said the FAA ''should clarify that the operator must have a good faith belief that sUAS will not be flying over people.'' Third, the associations said ''the FAA should consider relaxing or removing this requirement for sparsely populated areas,'' which ''would give newsgatherers and video programming producers the freedom to cover events and film entertainment programming with sUAS in areas where the risk to human beings on the surface is extremely low.''

NSAA and several individual commenters recommended that the final rule make clear that the prohibition does not extend to incidental or momentary operation of a UAS over persons on the ground. The Organization of Fish and Wildlife Information Managers requested that exemptions for ''unintentional flyovers'' be included in the final rule. The Organization noted that, while conducting fish and wildlife surveys in remote areas, UAS may inadvertently be flown over hunters, anglers, hikers, campers, and other individuals participating in recreational activities. The Organization went on to say that ''[i]n areas where a UAS may be flown over a person, either intentionally or unintentionally, public notice of the planned survey activity could be issued in advance of the survey.''

In response, the FAA clarifies that this rule allows filming of non-participants at an angle as long as the small unmanned aircraft does not fly over those non-participants.

With regard to sparsely populated areas, as discussed earlier, the restriction on flight over people is focused on protecting the person standing under the small unmanned aircraft, which may occur in a sparsely populated area. The FAA notes, however, that because sparsely populated areas have significantly fewer people whose presence may restrict a small UAS operation, a newsgathering organization will likely have significant flexibility to conduct small UAS operations in those areas.

With regard to the remote pilot's good-faith belief and momentary operation of a small unmanned aircraft

over a person on the ground, the FAA notes that the remote pilot in command is responsible for ensuring that the small UAS does not fly over any non-participant who is not under a covered structure or vehicle. This may require creating contingency plans or even terminating the small UAS operation if a non-participant unexpectedly enters the area of operation. The FAA declines to amend this requirement because, as discussed earlier, this requirement creates a performance-based standard for a stand-off distance that the remote pilot in command must use to ensure that his or her small unmanned aircraft does not fly over a person.

The National Association of Realtors suggested that more guidance is needed to clarify the operator's obligations for communicating with bystanders that a UAS flight will occur in the area. Specifically, the commenter wondered: (1) How much notice is required to clear an area of bystanders before the flight takes place; (2) how the notice should be given; (3) for how long an area should be required to be cleared of bystanders; and (4) within what distance bystanders should be provided notice.

This rule will not require that notice be given to non-participants prior to the operation of a small unmanned aircraft. Likewise, the rule will not prohibit the remote pilot from employing whatever means necessary to ensure that the small unmanned aircraft does not endanger the safety of bystanders, such as providing prior notice of operations. Providing notice to bystanders is simply one method that a remote pilot in command can utilize to clear the operating area (assuming that non-participants comply with the notice). However, providing such notice will not relieve the remote pilot in command of his or her duty to ensure the safety of non-participants.

An individual commenter asserted that, taken literally, the proposed prohibition ''would require a UA operator to know at all times, the exact location of all people on the ground who are within VLOS of his or her UA.''

As stated earlier, this rule imposes a performance-based requirement concerning flight over people. It is up to the remote pilot in command to choose the specific means by which he or she will satisfy this requirement. The guidance issued concurrently with this rule provides some examples of means that a remote pilot in command could utilize to satisfy the prohibition against flight over non-participants in part 107.

NAMIC sought guidance with respect to when the presence of a third party ''can prevent or interrupt UAS use.'' Specifically, NAMIC questioned whether, if an insurance review of a private building requires some limited flight over a public street, the street needs to be closed or, alternatively, if the flight can simply take place when there are no pedestrians on the street. An individual commenter similarly questioned what happens when a person enters the operational area once the operation has commenced and the UAS is airborne—*i.e.,* whether the UAS may loiter until the person clears the area or whether the operation must be terminated.

Liberty Mutual Insurance Company said that, given the fact that almost any operation of a small UAS over urban areas will necessarily result in flight over human beings, ''the final rule should include a reasonableness standard whereby, through a safety assessment such as currently permitted in section 333 exemptions, an operator may determine that a flight over a particular area does not pose a reasonable threat to persons who are not covered by a structure.'' If such a reasonable determination is made, Liberty Mutual said, the flight should be allowed. Liberty Mutual noted that this change ''would be particularly important for assessing disaster situations or performing surveys over areas larger than a single structure.''

As discussed earlier, this rule prohibits any small unmanned aircraft from flying over a person who is not a direct participant in the small UAS flight operation and is not under a covered structure or vehicle. This is a performance standard: It is up to the remote pilot in command to choose the best way to structure his or her small UAS operation to ensure that prohibited flight over a person does not occur and that the small unmanned aircraft will not impact a person if it should fall during flight. The FAA anticipates that the remote pilot in command will need to determine an appropriate stand-off distance from nearby persons in order to comply with this requirement. With regard to the specific examples provided by the commenters, the FAA notes that the remote pilot in command is not required to cease small UAS flight if he or she can continue operating in a manner that ensures that the small unmanned aircraft will not fly over an unprotected non-participant.

Several individual commenters suggested proposed § 107.39 be expanded to prohibit operation over any personal property without the permission of the property owner.

Property rights are beyond the scope of this rule. However, the FAA notes that, depending on the specific nature of the small UAS operation, the remote pilot in command may need to comply with State and local trespassing laws.

NAMIC questioned whether a UAS operation over private property is prohibited if the owner wants to watch, ''even if the owners agree that they may be in danger.''

Southern Company suggested that FAA allow operations over any person who is located on the property, easement, or right of way of the person or entity for whom the small UAS is operated, and any person who is participating in the activity for which the small UAS is being operated. This commenter said such mitigating restrictions could include a lower operating ceiling, lateral-distance limits, a lower speed restriction, and a prohibition on operations over large gatherings of people.

The flight-over-people restriction is intended to address the risk of a small unmanned aircraft falling on and injuring a person. Being the owner or easement-holder of the area of operation does not reduce a person's risk of being hit by the small unmanned aircraft. Accordingly, this rule will not impose a different safety standard based on the ownership status of the person over whom the small unmanned aircraft is operating. With regard to additional operational mitigations, the FAA will consider those on a case-by-case basis through the waiver process.

The Wisconsin Department of Transportation (WisDOT) expressed ''concern that this (107.39) restriction may severely limit the ability of public sector agencies to incorporate UAS'' into certain activities, such as bridge inspections, traffic and incident management activities on public highways, and search and rescue operations.

NSAA also said operations over the public should be permitted ''in non-normal or emergency operations where life, limb, and property are at risk.'' UAS Venture Partners similarly sought an exemption from the proposed prohibition on operations over persons not directly involved in the operation for Civic Municipal Rescue Service agencies and the trained rescue first responders who will be operating the UAS devices. Vail also said the final rule should include specific exemptions from the ''directly involved'' requirement ''for temporary flight over uninvolved persons for emergency and safety uses.''

As discussed in section III.C.3 of this preamble, this rule applies only to civil small UAS operations. It does not apply to public UAS operations which may include governmental functions such as

public road and bridge inspections, traffic control and incident management on public highways, and search and rescue operations. To that end, a public UAS operator such as WisDOT may apply for a COA to use its UAS for specific governmental functions instead of operating and complying with the provisions of part 107.

With regard to emergency and search-and-rescue operations, it should be noted that those operations are typically conducted by local, State, or Federal government agencies (such as fire departments or police) as public aircraft operations. Public aircraft operations will be granted operational authority by way of a COA and will not be subject to part 107. With regard to civil small UAS operations, the FAA emphasizes that the remote pilot in command's ability to deviate from the requirements of part 107 to address an emergency (discussed in section III.E.1.d of this preamble) is limited to emergency situations that affect the safety of flight. For emergency situations that do not affect the safety of flight, the remote pilot in command should contact the appropriate authorities who are trained to respond to emergency situations.

The Professional Helicopter Pilots Association suggested that the FAA provide a means by which individuals or companies can limit or eliminate the overhead or adjacent operation of UAS by anyone other than properly certified public service/public safety operators.

Though a governmental entity may choose to operate a small UAS under the civil regulatory structure of part 107, the FAA does not agree that operational distinctions should be made within part 107 regarding the specific entity that is conducting a civil operation. To that end, under part 107 all civil small unmanned aircraft operations are prohibited from operating over a person not directly participating in the operation of the small unmanned aircraft and not under a covered structure or in a covered vehicle and not directly participating in the flight operation of the small unmanned aircraft.

The International Association of Amusement Parks and Attractions (IAAPA) stated safety and privacy concerns are implicated by third-party small UAS operations. IAAPA stated that the operation of UAS over amusement parks and attractions by third parties is also implicated by proposed section 107.39. IAAPA asserted that the facility operator can carefully control the use of UAS over a person who is not directly participating in its operation if the UAS is operated by the facility or its designee, but this degree of control is impossible when hobbyists or other third-parties who do not have the facility owner's permission operate UAS near or over the perimeter or interior of amusement parks and attractions. IAAPA stated that amusement parks and attractions generally contain large numbers of people, and that the safety risks posed to employees and to visitors enjoying rides potentially traveling 100 miles per hour, watching shows, or walking through amusement parks and attractions are considerable and outside the control of facility operators.

The restriction on flight over people applies regardless of the location in which that flight occurs. Thus, a remote pilot in command may not operate a small unmanned aircraft over a non-participant in an amusement park who is not under a covered structure or in a vehicle. Additionally, the remote pilot in command must ensure that the small unmanned aircraft does not pose an undue hazard to a person in the event of a loss of control for any reason. The FAA also notes that hobbyists or other third parties who do not have the facility owner's permission to operate UAS near or over the perimeter or interior of amusement parks and attractions may be violating State or local trespassing laws.

Aerial Services, the National Society of Professional Surveyors, Continental Mapping, MAPPS, and 12 members of the Wisconsin Legislature said the ban on flights ''over populated areas'' needs to be removed or modified, because the definition of ''populated area'' is inadequate and seems to mean ''any single person within the area of operation that is not inside a structure.'' In response, the FAA notes that this rule does not ban flights over a ''populated area.'' This rule only restricts flights over a person who is not directly participating in the flight operation and who is not inside a covered structure or vehicle.

v. Preflight Briefing

The NPRM proposed to require that, prior to flight, the remote pilot in command must ensure that all persons directly involved in the small UAS operation receive a briefing that includes operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards. The FAA proposed this requirement because, as discussed in the previous section, this rule will allow a small unmanned aircraft to fly over people who are directly participating in the small UAS operation. A preflight familiarization briefing would help ensure that these people have greater situational awareness and are better able to avoid the flight path of the small unmanned aircraft if the remote pilot in command were to lose positive control of the aircraft or if the aircraft were to experience a mechanical failure.

The Travelers Companies said the FAA should modify proposed § 107.49 to eliminate the ''briefing'' requirement for operations conducted without a visual observer or other crew members.

If the remote pilot in command is conducting a small UAS operation entirely by him or herself, there is no one else that he or she can brief. Additional regulatory text is not necessary to explain this concept. However, upon reviewing the regulatory text of § 107.49(a)(2), the FAA noted that the proposed briefing requirement would apply to people who are ''involved'' in the small UAS operation, while the exception to the flight-over-people restriction discussed earlier will apply to people who are ''directly participating'' in the small UAS operation. Because the briefing requirement is supposed to apply to people who may have a small unmanned aircraft fly over them, the FAA has amended § 107.49(a)(2) to reference people who are directly participating in the small UAS operation.

The FAA also noted that the proposed requirement to convey important information in the form of a briefing was needlessly prescriptive. Thus, the FAA has amended § 107.49(a)(2) in the final rule to simply require that the remote pilot in command ensure that persons directly participating in the small UAS operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards. This information could be conveyed through a briefing or through some other means that would reasonably be expected to inform the recipient.

vi. Preflight Assessment of the Operating Area and Ensuring That the Aircraft Poses No Undue Hazard

Within the above constraints, the NPRM proposed a two-part performance-based standard for mitigating loss-of-positive control risk. The first part consisted of a preflight assessment of the operating environment. The second part consisted of a requirement to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of positive control of the aircraft for any reason.

1. Preflight Assessment of the Operating Environment

The NPRM proposed to require that, prior to flight, the operator must become familiar with the confined area of operation by assessing the operating environment and assessing risks to persons and property in the immediate vicinity both on the surface and in the air. As part of this operating environment assessment, the operator would need to consider conditions that could pose a hazard to the operation of the small UAS as well as conditions in which the operation of the small UAS could pose a hazard to other aircraft or persons or property on the ground. Accordingly, the operating environment assessment proposed in the NPRM would include the consideration of: (1) Local weather conditions; (2) local airspace and any flight restrictions; (3) the location of persons and property on the ground; and (4) any other ground hazards.

For the reasons discussed below, this rule will finalize the operating environment assessment as part of the preflight familiarization provision as proposed in the NPRM, but will change the reference from ''operator'' to ''remote pilot in command'' to reflect the change in the crewmember framework discussed in section III.E.1 of this preamble.

Boeing asserted that the proposed rule imposes a requirement to assess risk, but provides no criteria against which to measure that risk. The commenter therefore recommended the FAA revise the proposed provision to include criteria to measure risk (*e.g.,* reference the Structural Repair Manual (SRM) or similar criteria). The commenter also noted that there is no requirement to determine if the risk is acceptable, and recommended the FAA clarify this issue to ensure appropriate compliance with, and consistent interpretation of, the regulation.

As discussed in the next section of this preamble, this rule will require the remote pilot in command to ensure that the small UAS will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason. Section 107.49 is intended to help the remote pilot in command satisfy this requirement by having the remote pilot in command assess the operating environment so that he or she can design the operation, as well as any mitigation, to ensure that the small unmanned aircraft does not create an undue hazard if positive control is lost.

As a performance-based requirement, it is not the intent of this section to be prescriptive with regard to how remote pilots conduct an assessment of their operating environment. Because there is a diverse range of aircraft and operating environments that could exist for part 107 operations, a prescriptive preflight-assessment standard may be more burdensome than necessary in some instances. For example, a remote pilot in command operating a small UAS in an empty rural area would not need to look at the same things to assure the safety of the operation as a remote pilot in command operating a small UAS in a crowded urban environment. The guidance material which the FAA has issued concurrently with this rule provides examples and best practices for how to conduct the preflight assessment of the operating area and assess risks that may affect the small UAS operation. The FAA will also consider publishing industry best practices in future small UAS guidance that will assist remote pilots in assessing risk.

The Professional Helicopter Pilots Association said that, prior to flight, the remote pilot should be required to obtain a briefing, similar to a manned-aircraft pilot's briefing, which would include weather, NOTAMs, and any other pertinent information for the area in which they intend to operate.

As discussed in sections III.E.2 and III.E.5 of this preamble, this rule includes requirements for assessing the operating environment with regard to weather and NOTAMs. The remote pilot in command is responsible for satisfying those requirements. The remote pilot may choose to use the means suggested by the commenter to help satisfy his or her regulatory obligations, or he or she may choose some other method of obtaining the pertinent information. As long as the pertinent regulatory requirements are fulfilled, the means by which the remote pilot in command accomplishes this goal is within his or her discretion.

API encouraged the FAA to consider all provisions of the Helicopter Safety Advisory Conference's Unmanned Aerial Systems Guidelines, including provisions related to pre-flight briefings, as the rule is finalized. The FAA concurs with the API's recommendation to consider the provisions of the Helicopter Safety Advisory Conference Recommended Practices 15–1 Unmanned Aerial Systems Guidelines document (HSAC RP UASRP 15–1) published in February 2015. After reviewing the HSAC RP UASRP 15–1 guidelines, the FAA finds that the recommended practices address all of the requirements found in § 107.49.

The Kansas State University UAS Program also recommended that the assessment consider potential issues with link integrity to the aircraft from obstacles between the ground antennas and the aircraft (*e.g.,* trees) or electromagnetic interference from nearby RF sources such as radio towers and radars. In response, the FAA notes that this concern is addressed in § 107.49(a)(3). Section 107.49(a)(3) requires that the remote pilot ensure that all control links between ground station and the small unmanned aircraft are working properly. The remote pilot in command may not commence a small UAS operation if a control link is working improperly (whether as a result of radio interference or for some other reason). The FAA also expects that the remote pilot in command will develop a contingency plan for ensuring that the small unmanned aircraft does not pose an undue hazard to other aircraft, people, or property if positive control of the small unmanned aircraft is lost through a disruption in the data control link.

2. Undue Hazard If There Is a Loss of Control

The NPRM proposed that, after becoming familiar with the confined area of operation and conducting an operating environment assessment, the operator must ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of positive control of the aircraft for any reason. The FAA proposed this performance-based requirement instead of a more prescriptive standard because it would provide the operator with significant flexibility to choose how to mitigate the hazards associated with loss of aircraft control.

In a joint submission, PlaneSense and Cobalt Air stated that the language in proposed § 107.19(b) sets a different standard from that in § 107.23 (hazardous operation). They noted that while § 107.19(b) requires that small UAS operations ''pose no undue hazard to other aircraft, people or property[,]'' § 107.23(b) prohibits persons from operating a small UAS in a ''careless or reckless manner so as to endanger the life or property of another[.]'' The commenters argued that these two standards are not consistent, because § 107.23 does not include other aircraft within the scope of the third parties who must be protected. The commenters went on to say that these discrepancies create inconsistencies which result in incomplete guidance for the operators of small UAS, and may result in an increase in danger to the public. The commenters suggested that the appropriate standard is to be found

in § 107.19(b), and that § 107.23 should be changed to match it. Finally, the commenters asked the FAA to clarify whether ''other aircraft'' includes other unmanned aircraft.

Part 107 prohibits a small UAS operation from endangering life or property, and prohibits a remote pilot from operating a small UAS in a careless or reckless manner. Property includes other aircraft, including other unmanned aircraft. These two requirements complement, rather than contradict, one another, and provide the remote pilot with the flexibility to adjust his or her operation according to the environment in which he or she is operating. For example, if the operation takes place in a residential area, the remote pilot in command could ask everyone in the area of operation to remain inside their homes while the operation is conducted. If the operation takes place in an area where other air traffic could pose a hazard, the remote pilot could advise local air traffic control as to the location of his or her area of operation and add extra visual observers to the operation so that they can notify the remote pilot if other aircraft are approaching the area of operation. These precautions would be one way to ensure that the operation will not pose an undue hazard to other aircraft, people or property in the event of a loss of control of the aircraft. Additionally, during the operation of the small unmanned aircraft, the remote pilot in command is prohibited from operating the aircraft in a careless and reckless manner, further ensuring that the operation does not pose an undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft.

The NextGen Air Transportation Program, NC State University commented that § 107.19(b) is ''not realistic.'' The commenter stated that the remote pilot can do everything possible to minimize the risk and harm possible in the event of loss of positive control, but asserted that requiring that no damage be caused without requiring fly-away prevention or other risk management mechanisms does not align with the general NPRM objectives.

Similarly, ALPA stated that many small unmanned aircraft, particularly those with multiple propulsion units, may become highly unstable when they enter a state of ''lost link'' or ''loss of positive control.'' This commenter also asserted its strong belief that if lost link occurs, mitigations to safely perform auto-hover, auto-land, and return-to-home maneuvers, and geo-fencing protection, must be incorporated into the navigation and control systems for a small UAS to safely land without harm to persons or property.

The undue hazard standard in this rule is a performance-based standard, which the remote pilot in command may satisfy through operational or equipage/technological mitigations. In section III.E.3.b.vi of this preamble, the FAA describes equipment that remote pilots may incorporate into their small unmanned aircraft systems as one means of complying with this requirement. Due to the diversity and rapidly evolving nature of small UAS operations, this rule allows individual remote pilots to determine what equipage methods, if any, mitigate risk sufficiently to meet the performance-based requirements of this rule, such as the prohibition on creating an undue hazard if there is a loss of aircraft control. This provides the greatest amount of regulatory flexibility while maintaining the appropriate level of safety commensurate with part 107 operations.

The methods suggested by the commenters are some, but not all of the possible mitigations available for remote pilots of UAS. The FAA recognizes that it is impossible to prevent every hazard in the event of a loss of control of the small unmanned aircraft; however, as several commenters stated, this rule requires remote pilots to do everything possible to minimize risk and harm in the event of loss of positive control.

NOAA commented that § 107.19(b) should be revised to include ''protected wildlife'' in the class of entities to be protected from undue hazard in the case of loss of positive control. NOAA states that this change would acknowledge the importance of other Federal statutes already in place to protect, conserve, and recover vulnerable wildlife populations and ensure the FAA-regulated community is aware of them and that the final rule does not contradict them.

The FAA notes that other Federal statutes already in place establish laws on the protection of wildlife. Independent of this rule, the remote pilot in command is responsible for complying with any other Federal, State, or local laws that apply to his or her small UAS operation.

vii. Automation

Several commenters addressed the issue of autonomous operations of small UAS. An autonomous operation is generally considered an operation in which the remote pilot inputs a flight plan into the control station which sends it to the autopilot onboard the small unmanned aircraft. During automated flight, flight control inputs are made by components onboard the aircraft, not from a control station. Thus, the remote pilot in command could lose the control link to the small unmanned aircraft and the aircraft would still continue to fly the programmed mission or return home to land. During automated flight, the remote pilot in command also must have the ability to change routing/altitude or command the aircraft to land immediately. The ability to direct the small unmanned aircraft may be through manual manipulation of the flight controls or through commands using automation.

For the reasons discussed below, this rule will allow autonomous small UAS operations. However, the remote pilot in command must retain the ability to direct the small unmanned aircraft to ensure compliance with the requirements of part 107.

ALPA, the U.S. Hang Gliding & Paragliding Association, and the Permanent Editorial Board of the Aviators Model Code of Conduct Initiative asserted that the NPRM says autonomous operations would be permitted for small UAS, but then fails to discuss such operations further. ALPA generally opposed allowing autonomous operations for small UAS. The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative said the NPRM's mention of autonomous operations ''requires explanation and context.'' The U.S. Hang Gliding & Paragliding Association said it would be opposed to such operations ''unless the operator has the ability to take positive control immediately and redirect the sUAS.''

The Air Medical Operators Association raised concerns about the safety of ''automated UAS,'' saying that such aircraft do not have the capability to maintain the necessary separation from manned aircraft. The association acknowledged, as noted in the NPRM, that the many advancements in anti-collision avoidance systems have been very effective in reducing the rate of mid-air collisions, but went on to say that the evidence of the effectiveness of such technology in preventing collisions between UAS and manned aircraft ''would have to be overwhelming in order to alleviate the safety concerns of the low-altitude flying public.''

Other commenters supported allowing autonomous operations for small UAS. Yale University recommended the final rule clarify that small UAS operators ''may rely on autonomous or pre-programmed flight systems.'' Streamline Designs also stated that autonomous operations should be permitted, adding that some commercial uses ''may depend heavily on

automatic, stabilized flight.'' A number of individual commenters also supported autonomous operations. One such individual noted that there are situations where manual operations are more dangerous than automated operations, because computer controlled flight ''can provide much greater control and safety by making corrective inputs on the order of hundreds of inputs per second.''

The Property Drone Consortium recommended the final rule clarify what types of autonomous flights are permitted. The organization further recommended that autonomous flight be permitted without a need for the pilot/operator to intervene, although the pilot/operator ''would always have the ability to intervene.''

Several commenters suggested that autonomous operations be permitted in certain circumstances. LifeDrone, LLC sought a final rule that would specifically permit the autonomous operation of an emergency small UAS ''that is initiated by an emergency signal along prearranged, low flight risk corridors at an altitude of 150 feet.'' Prioria Robotics suggested that autonomous operations should be permitted ''with the simultaneous usage of first person video (FPV) flight equipment.'' AOPA recommended that the FAA consider an autopilot requirement for operations in controlled airspace, which the association said would provide ''a layer of safety for operations in airspace that contains a concentration of manned aircraft.''

The New England Chapter of AUVSI and Devens, IOP, commenting jointly, noted that ''[t]he future will bring more reliable UAS technology that can be fully autonomous.'' The Competitive Enterprise Institute similarly noted that ''[a] number of developers have expressed confidence that their sense-and-avoid technologies will soon permit safe automated operations.''

Autonomous operations have numerous practical applications, including agricultural operations, aerial photography, and search and rescue. The FAA agrees with the commenters who pointed out that the ability for a small unmanned aircraft to fly autonomously could add significant utility to a small UAS operation and would further encourage innovation in the industry. Accordingly, this rule will allow the autonomous flight of small unmanned aircraft.

While sense-and-avoid equipment may one day be integrated into an autonomous aircraft to aid the pilot in avoiding hazards, as discussed in section III.E.2.a of this preamble, there is insufficient data to establish that UAS equipage is able to, at this time, detect other nearby aircraft in a manner that is sufficient to provide a substitute for the human pilot's ability to see and avoid those aircraft. Thus, a small unmanned aircraft may be unable to, without human input, yield the right of way to another user of the NAS that may enter the area of operation. Accordingly, this rule will require that the remote pilot in command have the ability to direct the small unmanned aircraft to ensure compliance with the provisions of part 107. In particular, the FAA emphasizes the requirements of §§ 107.37 and 107.39, which require the small unmanned aircraft to yield the right of way to all other users of the NAS and to avoid flying over a human being who is not directly participating in the small UAS operation and not under a covered structure.

There are a number of different methods that a remote pilot in command may utilize to direct the small unmanned aircraft to ensure compliance with part 107. For example, the remote pilot may transmit a command for the autonomous aircraft to climb, descend, land now, proceed to a new waypoint, enter an orbit pattern, or return to home. Any of these methods may be used to satisfactorily avoid a hazard or give right of way.

The FAA also emphasizes that, as discussed in section III.E.3.b.ii of this preamble, a person cannot act as a remote pilot in command in the operation of more than one small unmanned aircraft. Thus, this rule does not allow a person to use automation to simultaneously operate more than one small unmanned aircraft.

NetMoby recommended that FAA consider UAS that are pre-programmed to fly a mission to one or more waypoints as being ''under positive control.'' The company recommended that, for local line-of-sight and multi-waypoint missions, ''an active, live wireless link to the UAS be present and that loss of such a link below the link's reliable signal receive threshold for a period of greater than 15 seconds be defined as an instance of loss of positive control,'' thus triggering a return-to-home command.

As discussed earlier, this rule will allow a small unmanned aircraft to conduct preprogrammed flight through a waypoint as long as the remote pilot has the means to direct the aircraft to ensure compliance with part 107. With regard to when a return-to-home command should be triggered, the FAA declines to add this level of prescriptiveness to the rule. Instead, as discussed in section III.E.3.b.vi.2 of this preamble, the remote pilot in command must ensure that the small unmanned aircraft remains within visual line of sight and does not pose an undue hazard in the event of loss of positive control. The remote pilot in command may do this in the manner suggested by NetMoby or in another manner that satisfies the regulatory requirement.

viii. Other Equipage

In the NPRM, the FAA considered technological approaches, such as a flight termination system, to address a failure of the control link between the aircraft and the operator's control station. However, because small UAS operations subject to the proposed rule would pose a lower level of risk, the FAA proposed operational alternatives to mitigate their risk to an acceptable level without imposing an FAA requirement for technological equipage. Accordingly, the proposed rule did not mandate the use of a flight termination system or the equipage of any other navigational aid technology. The FAA invited comments on whether a flight termination system or any other technological equipage should be required and how it would be integrated into the aircraft for small UAS that would be subject to the proposed rule. The FAA also invited comments, with supporting documentation, as to the costs and benefits of requiring a flight termination system or other technological equipage.

1. Geo-fencing

A geo-fence is a virtual barrier which may prevent the small unmanned aircraft from either entering or exiting a geographically defined area. The area may be defined by a property owner or aircraft operator utilizing a combination of mapping programs and technology such as global positioning system (GPS) or radio frequency identification (RFID). Such technology could restrict the small unmanned aircraft from flying in locations where a flight may be restricted for security, safety, or other reasons.

The proposed rule did not establish geo-fencing equipment requirements for small UAS operating in the NAS. Instead, the NPRM proposed operational limitations such as requiring small UAS operators or visual observers to maintain visual line of sight in order to mitigate the risk of failure of the control link resulting in loss of positive control. After careful consideration of the comments, the FAA has decided not to add any geo-fencing equipment requirements in the final rule.

The Small UAV Coalition and Predesa supported the FAA's proposal to not require geo-fencing equipment under

proposed part 107. However, these commenters noted the increased safety benefit provided by these systems in applications beyond visual-line-of-sight operations. Airware provided detailed information on its flight control system that offers geo-fencing and contingency management functionality. However, Airware noted that ''[d]etailed airworthiness requirements [are] not needed for the very low risk environment proposed by this NPRM.''

Conversely, some commenters disagreed with the FAA's proposal, and advocated for requiring geo-fencing technology on small UAS. Commenters including TTD, ALPA, AOPA, and the Electronic Privacy Information Center (EPIC) generally requested that the FAA require geo-fencing technology to be equipped on small UAS.

TTD, ALPA, the Air Medical Operators Association, and an individual supported geo-fencing technology standards that provide functional performance and reliability to ensure safe operation of small UAS in the event of loss of positive control or flying near restricted, unauthorized, or controlled airspace. ALPA urged the FAA ''to consider means, other than the operator's skill and intention, to ensure the aircraft cannot be operated outside the confined area required to mitigate the collision risk.'' The Air Medical Operators Association requested that the FAA ''test the effectiveness of these technologies and consider requiring them onboard UAS.'' AOPA stated that the FAA ''should consider requiring small commercial UAS to use geo-fencing technology to ensure safety and reliability of their operations.'' The International Brotherhood of Teamsters stated that it supports ''geo-fencing and other technologies which would directly inhibit the movement of an unauthorized UAS into secure areas.''

MAPPS stated that ''[a]ll UAS must be constructed with firmware that incorporates a database of restricted flight areas.'' MAPPS provided information on its concept of geo-fencing using cellular technology and requiring flight plans to be uploaded to the small UAS flight management system before each flight. MAPPS explained that this geo-fencing technology requires access to a ''Master Restricted Flight Area Database (MRFAD)'' including ''any and all restricted flight areas'' to prevent the operator from flying the small UAS into these restricted areas. An individual stated that the FAA should require ''autonomous vehicles flying in, or within range of, airspace where UAS operations are prohibited'' to have an updated database of that airspace.

Requiring the installation of a geo-fencing system capable of keeping small unmanned aircraft out of restricted and prohibited airspace would present a number of technical hurdles. Specifically, there are currently no design or performance standards for geo-fencing equipment to ensure safe and reliable integration into the NAS. Without appropriate geo-fencing design and performance standards, the industry and the FAA lack the data necessary to assess the accuracy and reliability of geo-fencing equipment and therefore, the FAA cannot promulgate geo-fencing equipment design requirements (*i.e.,* airworthiness certification).

Also, geo-fencing equipment integrated on small UAS would require an evolving database of terrain and obstacle updates, restricted and special use airspace, Notices to Airmen (NOTAMs), and Temporary Flight Restrictions (TFRs). The FAA is unaware of a database that provides this full capability and therefore cannot accurately determine the effort to develop and maintain it for remote pilots. The FAA also does not have information on how frequently updates to the onboard small UAS geo-fence database would be required to maintain safe and reliable operation in the NAS.

In addition, any geo-fencing equipment required under part 107 would also need to include an override feature to allow the remote pilot to enter the airspace if he or she receives permission from Air Traffic Control or an appropriate controlling agency. Additionally, as discussed in section III.E.1.d of this preamble, this rule will allow the remote pilot to deviate from the operational restrictions of part 107 if doing so is necessary to respond to an emergency situation. Thus, an override feature may also be necessary to allow a remote pilot to respond to emergencies. A geo-fencing system without an override function that prevents the human pilot from exercising this deviation authority may impair the pilot's ability to safely respond to an emergency situation.

If these technical obstacles are overcome, a mandatory geo-fencing system may provide a marginal increase to safety by forcibly keeping small unmanned aircraft out of certain airspace in which the aircraft may pose a higher risk to manned-aircraft operations. However, under Executive Order 12866, the FAA can adopt a regulation ''only upon a reasoned determination that the benefits of the intended regulation justify its costs.'' [104] Here, the FAA has no data that would allow it to quantify the benefits of a possible safety increase associated with a mandatory geo-fencing system. Conversely, a mandatory geo-fencing requirement would substantially increase the costs of this rule. If mandated, there would be a cost for developing the minimum performance standards for this equipment. Once the standards are developed, the cost to owners for retrofitting previously purchased small UAS would be realized. If it is not possible to retrofit a small UAS to include geo-fencing, a replacement cost would be incurred. Additionally, an incremental per unit cost to small UAS manufacturers for installing mandated geo-fencing on newly built small UAS would be incurred.

Once geo-fencing is installed, the on-board avionics would rely upon a database of restricted airspace, NOTAMs, TFRs, obstacles, and terrain upon which to remain current. Maintaining these databases would incur additional costs, based on the frequency of database updates and the value of the time for the individual performing the task. Finally, small UAS owners would have recurring costs for subscribing to the database supplier or app developer for updates to regulatory airspace. To sum up, mandating geo-fencing equipage would result in substantial costs and, at this time, the FAA does not have sufficient data to determine, consistent with its obligations under Executive Order 12866 and 13563, whether the benefits associated with such a mandate would justify those costs.

The FAA appreciates the commenters' information and support for geo-fencing technology, and the agency will use this information in follow-on UAS-related activities. However, based on the considerations outlined above, the FAA has decided not to add any geo-fencing equipment requirements in this rule.

Commenters including the Association of American Universities, Association of Public Land-grant Universities, and NAMIC generally stated that geo-fencing technologies should be considered to allow small UAS operation beyond visual line of sight. The Association of American Universities and Association of Public and Land-grant Universities stated that this final rule should require ''performance-based standards for the capabilities of a UAS authorized to conduct [beyond-visual-line-of-sight] operations'' and noting ''dual auto pilot modes, anti-collision systems employing SONAR, LIDAR,'' and ''geo-fencing capabilities'' as possible means of compliance. NAMIC cited benefits of

[104] Executive Order 12866, § 1(b)(6).

beyond-line-of-sight UAS operations following a catastrophic disaster. The Colorado Cattlemen's Association and the Rocky Mountain Farmers Union supported rules that ''allow for the use of such technologies to expand the permissible operating area for UAS in appropriate circumstances'' and ''permit the use of these technologies.'' The Interstate Natural Gas Association of America suggested geo-fencing technology, ''programmed into a UAS that establishes defined controlled zone such as a pipeline corridor, combined with location, altitude and forward looking camera'' to provide an equivalent level of safety to the proposed line of sight requirement.

The National Ski Areas Association acknowledged that collision detection and avoidance systems are in development; however, the commenter stated that FAA ''needs to recognize and accommodate these technological innovations, especially when the risk to manned aircraft and public safety is so minimal, as it is at ski areas.''

An individual asserted that multi-rotor helicopter small UAS have equipment providing ''geo-fencing to prevent loss of control link—or even to prevent airspace incursions and accidental 'fly-aways'.'' Another individual stated that ''[s]everal technologies have been available for the last four years that enable pre-programmed GPS guided flight paths using latitude and longitude coordinates.'' Qualcomm added that geo-fencing ''can ensure small UAS remain well outside of airspace that is off limits to UAS.''

As discussed in other parts of this preamble, the two operational restrictions of interest to these commenters (the requirement to remain within visual line of sight and the restriction on flying over people) are both waivable upon demonstration that the proposed operation can safely be conducted under the terms of a certificate of waiver. Waiver applicants may use geo-fencing and other technological equipage to help demonstrate, in support of a waiver application, that the proposed operation can be conducted safely. Alternatively, applicants may be able to demonstrate the safety of their proposed operation through non-technological means, such as mitigations present in the area of operation. The FAA will evaluate the technological and non-technological means employed by a waiver applicant to mitigate the risk of a small UAS operation and will issue a waiver if the applicant demonstrates that his or her specific means establishes the requisite level of safety.

2. Flight Termination System

The FAA initially considered requiring a flight termination system (FTS), which is a system that terminates the flight of a small UAS in the event that all other contingencies have been exhausted and further flight of the aircraft cannot be safely achieved, or other potential hazards exist that require immediate discontinuation of flight. However, the FAA determined that there are other viable alternatives that can achieve this goal without requiring an FTS.

The NPRM invited comments as to the costs and benefits of requiring an FTS. After reviewing comments, the FAA has decided against requiring small UAS to include an FTS.

Several commenters, including the Small UAV Coalition, the University of Arkansas Division of Agriculture, and Northrop Grumman, agreed with the NPRM that use of an FTS should not be mandatory. Southern Company stated that alternative operational measures would adequately mitigate loss of control risk. Two individuals argued that flight termination systems are too heavy for small UAS. The Oklahoma Governor's Unmanned Aerial Systems Council commented that automatic termination of flight could have significant unintended consequences for the safety of people and property on the ground. NetMoby agreed that flight termination systems are not necessary, but encouraged the FAA to require return-to-home capabilities in UAS. Predesa also agreed that flight termination systems should not be required for small UAS, but asserted that GPS-based flight termination systems could mitigate risk. Planehook Aviation argued that the use of flight termination systems should be the operator's decision.

On the other hand, some commenters, including ALPA and EAA, among others, said the FAA should require small UAS to have flight termination systems. Texas A&M University-Corpus Christi/LSUASC and TTD said that a UAS without a flight termination system is dangerous to other users of the NAS if positive control is lost. The Professional Helicopter Pilots Association commented that this technology is already being included in most devices above the hobby level. NAAA said most of these technologies are software-based and utilize GPS systems already onboard the UAS and thus have no effect on the weight of the aircraft. Modovolate Aviation said the FAA should encourage small UAS stakeholders to develop performance standards for flight termination systems and require manufacturers to certify they have designed and manufactured their vehicles in accordance with these standards.

The Aviation Division of the Washington State Department of Transportation, the Nez Perce Tribe and UPS generally felt that an FTS could be optional equipage but stopped short of supporting a mandate. One individual stated ''. . . that if loss of control does occur, it can be easily mitigated by GPS based 'return to home' systems which take control of the craft and automatically fly it back to its launch point. The most widely available consumer quadcopter, the DJI Phantom 2, comes standard with this capability out of the box, and many hobbyists and commercial operators who build their own craft also install similar systems, which can be obtained for less than $100.''

The NPRM mitigated the potential risk associated with UAS flight primarily through operational restrictions rather than airworthiness certification and equipage requirements, such as the installation of an FTS. If installed, an FTS may mitigate the risk associated with loss of positive control by having the unmanned aircraft execute intentional flight into terrain if the link between the remote pilot and the unmanned aircraft is severed. However, mandating equipage such as FTS would increase the costs of complying with this rule to address a safety risk that may be mitigated through low-cost operational parameters.

Instead of requiring an FTS, the NPRM proposed to mitigate the risk associated with loss of positive control using the concept of a confined area of operation. Under the NPRM, the remote pilot would, prior to flight, be required to become familiar with the area of operation and to create contingency plans in that operations area to mitigate the risk associated with possible loss of positive control to people on the ground or other aircraft.

The NPRM proposal is a less costly method to address loss-of-positive-control risk because it does not require equipage (such as FTS, ''return home,'' or geo-fencing systems) or airworthiness certification. If FTS were to be required, that would be an equipage requirement that would likely increase the costs of this rule. In addition, an FTS equipage requirement would likely have to be accompanied by some type of airworthiness certification requirement to ensure that the FTS works reliably. This also would increase the costs of this rule.

Conversely, it is unclear whether an FTS would provide a safety increase justifying the increase in costs for two reasons. First, the operational restrictions of this rule would significantly confine the area of operation of a small UAS, thus mitigating the loss-of-positive control risk through operational parameters. Second, an FTS could be potentially unsafe because using it would immediately terminate the flight with the possibility of placing people below in harm's way, especially if the FTS is programmed to automatically activate sometime after the control link is lost and cannot be re-established. For these reasons, the FAA will not require FTS on small unmanned aircraft in this rule.

3. Other Technological Equipage

A number of commenters suggested additional equipage requirements for small UAS operations. However, because small UAS operations subject to this rule pose a lower level of risk, there are operational alternatives available to mitigate their risk to an acceptable level without imposing an FAA requirement for technological equipage. Additionally, the FAA recognizes that the use of new and advanced technology applications on UAS has not been tested and there is not enough data to support regulatory requirements of technological equipage. Therefore, this rule will not mandate the use of any kind of technological equipage or device.

Modovolate Aviation recommended a general process for developing and integrating equipage requirements for small UAS. The commenter said it is important that the FAA ''avoid anything resembling airworthiness and type certification for manned aircraft,'' and instead ''adapt the consensus standard approach used in the early days of occupational health and safety regulation and combine it with the performance standards approach used by the Federal Communications Commission for unlicensed wireless devices.'' Modovolate Aviation explained that the FAA should encourage small UAS organizations to articulate performance standards for control technologies, and then manufacturers would certify that they have designed and manufactured their UAS in accordance with these consensus standards. The operating rules would require operators to confirm, as part of their pre-flight inspection, that these basic features are present and operating properly, and any manufacturers that falsely certify compliance with the standards would be subject to civil penalties and criminal prosecution for mail or wire fraud.

As discussed in section III.J.3 of this preamble, the FAA has determined that airworthiness certification for small UAS operating within the limits set by part 107 is unnecessary. However, as noted by the commenter, the FAA encourages industry organizations to set voluntary standards for small UAS to further develop the industry. Such standards, however, would not relieve the remote pilot in command of his or her pre-flight responsibilities to determine that the system is in a condition for safe operation under §§ 107.15 and 107.49. That is because the remote pilot in command must ensure that the small UAS is in a condition for safe operation for each flight, which requires greater diligence as the small UAS ages.

A number of commenters addressed the NPRM's statement that ''existing technology does not appear to provide a way to resolve the 'see and avoid' problem with small UAS operations without maintaining human visual contact with the small unmanned aircraft during flight.'' CropLife America and Responsible Industry for a Sound Environment, commenting jointly, and the Professional Helicopter Pilots Association agreed with FAA that no see-and-avoid technology currently exists, but nevertheless said such technology should be required once it does become available. The United States Ultralight Association said UAS equipment should be designed with software or firmware that prevents the UAS from being flown further than one mile from the operator. The association asserted that ''[d]epth perception fails well before that distance and one mile should be seen as the outside limit for safety.''

The FAA recognizes that the use of software or firmware that prevents the UAS from being flown further than one mile could potentially help to prevent the small unmanned aircraft from flying out of the area of operation. This type of software and firmware could also potentially help to prevent injury or damage to those on the ground. However, as discussed in section III.E.1.d of this preamble, the remote pilot in command may need to deviate from the regulations of part 107 to respond to an emergency. A technological limitation on the small unmanned aircraft traveling more than one mile from the remote pilot could limit the remote pilot's ability to respond to an emergency situation that requires quickly moving the small unmanned aircraft farther away from the remote pilot.

Several commenters addressed the issue of compliance with the proposed maximum altitude and speed restrictions. PlaneSense and Cobolt Air, commenting jointly, wondered why manned aircraft are required to be equipped with an altimeter or an altitude limiting program or device, but unmanned aircraft are not.

The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative noted that, absent altimetry technology (such as altimeters or GPS), altitude would need to be estimated from the ground, and ground-based estimates are generally inaccurate and may cause significant noncompliance and safety challenges. As such, the organization recommended the final rule either require the use of a ''practical and effective technique'' for small UAS operators to estimate altitude ''with sufficient accuracy,'' or require the use of altimetric technology. The U.S. Hang Gliding and Paragliding Association said a ''simple barometric system set at launch would likely suffice'' to keep small UAS in compliance with maximum altitude restrictions. An individual also said UAS should be equipped with ''devices that provide the operator with telemetry data such as (but not limited to) height, speed, distance, bearing and battery level.''

Virginia Commonwealth University Honors Students asserted that GPS systems could be used to ensure compliance with both altitude and speed restrictions for small UAS equipped with minimum equipment, such as an altimeter and magnetic direction indicator, to ensure the UAS remains below a specific altitude and within a certain radius from the operator's location, in compliance with ATC instructions. Several individuals said that FAA should require UAS to be equipped with technology that limits operations to below a certain altitude or within a certain airspace. Another individual suggested the requirement of technology to enable automated communication between a UAS and an FAA computer that can authorize flight in a particular area at a specific time.

As discussed in section III.E.3.a.ii of this preamble, while 400 feet AGL is generally the maximum altitude for a small unmanned aircraft, there is an exception to that requirement. Specifically, this rule allows a small unmanned aircraft flying within 400 feet of a building to fly higher than 400 feet AGL. As such, a technological component limiting aircraft altitude to 400 feet AGL would disallow some small UAS operations that are permitted by part 107. In addition, a categorical technological limitation on altitude would limit the remote pilot's ability to respond to an emergency. With regard to

estimating altitude, section III.E.3.a.ii provides examples of other methods that a remote pilot in command can use to estimate the altitude of a small unmanned aircraft.

The NJIT Working Group recommended the use of ''a heads up display of flight information such as airspeed, vertical speed, attitude, heading and power'' to help the remote pilot fly according to actual flight parameters instead by sight.

The FAA supports the NJIT Working Group's efforts to provide remote pilots with an optimized method of displaying telemetry data of the aircraft. However, a regulatory requirement for a heads up display is unnecessary in this rule due to the limited nature of small UAS operations, and for many aircraft, the lack of telemetry data to display to the remote pilot.

A number of commenters addressed a requirement for return-to-home capabilities. Virginia Commonwealth University Honors Students said the FAA should require UAS to be equipped with a GPS system that automatically returns the UAS to home in adverse weather conditions. Those students and NetMoby also said UAS should be equipped with technology that returns the UAS to home when battery life is low.

NetMoby also recommended UAS be equipped with return-to-home capability ''which, when automatically activated, as a result of loss of positive UAS control, puts the aircraft on a course to a waypoint that is mandated to be programmed into the UAS circuit board Random Access Memory (''RAM'') prior to departure from the ground.'' The company further recommended the following to mitigate the risk associate with loss of positive control of a UAS: (1) UAS be equipped with GPS capable of position refresh rates of 5 seconds or better; and (2) GPS be accompanied with WAAS differential for greater position accuracy.

The Small UAV Coalition asserted that technological capabilities such as return-to-base and geo-fencing programming are currently being used by small UAS operators in other countries, and that such technologies ''achieve and surpass the level of safety attained by a pilot's control of aircraft.''

Airware acknowledged that detailed airworthiness requirements are not needed ''for the very low risk environment proposed by this NPRM,'' but that ''minimal protections'' should nevertheless be required. One such requirement cited by the company is a flight control system that allows for certain contingency events to be monitored (*e.g.,* lost RC link, lost data link, low voltage), and for an appropriate response to be executed should any such events occur (*e.g.,* land now, return to home and land, return to home, loiter and land). Airware said such programmable contingency actions ''are critical, as flight systems which just simply execute a return home and land procedure for example, may send the aircraft on a course that intersects with a structure or other obstacle.''

Section 107.19 requires the remote pilot in command to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of positive control of the aircraft for any reason. In consideration of the numerous ways that a remote pilot may mitigate the risk associated with a contingency event, the FAA considers it unnecessary to enact a prescriptive requirement such as a return-to-home function, as many other methods may exist now and in the future to ensure no undue hazard due to a loss of control. For example, non-equipage mitigations for loss of control may include utilizing physical barriers such as trees or netting, utilizing security/safety personnel to control non-participant entry into the operating area, or ensuring non-participants are under/in a protected covering.

The AIT Austrian Institute of Technology GmbH said that a data link requirement is essential for safe operations, and that ''adequate Frequencies and Standards should be put in place to support the growing market potentials.'' The Institute went on to recommend specific data link spectrum requirements for both visual-line-of-sight and beyond-line-of-sight operations.

Frequency spectrum requirements are outside the scope of this rule. The comment has been forwarded to the FAA Spectrum Engineering service unit for future consideration.

Several individuals said small UAS should be equipped with flight data recording systems or ''black boxes'' so that operators can be held accountable for infractions. One individual said that, for those aircraft that can record flight log data, there should be a requirement to preserve that data in the event of an operation that causes injury or property damage. The commenter further suggested that, in case of airspace violations, the FAA consider requiring all such flight logs be kept for some predetermined period of time.

Due to the mitigations provided by part 107 that reduce the likelihood of a small UAS flight resulting in significant injury or property damage, a requirement to equip small unmanned aircraft with flight data recorders would be unnecessarily burdensome.

Transport Canada questioned whether, ''[g]iven the potential interference caused by radios, cell phones, electronic devices, etc.,'' the FAA has considered a prohibition against using personal electronic devices at, or in the vicinity of, a control station.

Prior to flight, the remote pilot in command must, pursuant to § 107.49(c), ensure that all control links between the ground control station and the small unmanned aircraft are functioning properly. If an electronic device is being used nearby and that electronic device affects the control link such that it is not functioning properly, the remote pilot in command may not commence the operation until the problem with the control link has been resolved. The FAA expects that the remote pilot will resolve this problem by either: (1) Terminating the use of any electronic devices that are known to the remote pilot to cause interference with operation of the UAS; or (2) delaying the operation until use of the interfering electronic device has ceased. It would not be practical to enact a prohibition on the use of personal electronic devices because such devices are routinely used to control or monitor small UAS.

The City of Phoenix Aviation Department said the FAA should require ''7460 applications'' from small UAS because ''there are unknown impacts of UAS remote frequency system[s] interacting with commercial airport operations.''

The FAA disagrees. FAA Form 7460, *Notice of Proposed Construction or Alteration,* applies to persons constructing structures greater than 200 feet AGL, or within a specific distance of an existing airport or heliport. Because the form does not apply to aircraft operations, there is no requirement for small UAS remote pilots to submit a 7460 application.

4. External Load and Dropping Objects

In the NPRM, the FAA proposed to not allow external load and towing operations under part 107. The FAA also proposed to prohibit objects from being dropped from an aircraft in flight if doing so would endanger the life or property of another. For the reasons discussed below, this rule will allow external load and towing operations as long as the object that is attached to or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft. This rule will also maintain the prohibition on dropping objects from a small

unmanned aircraft if doing so would create a hazard to persons or property, but will rephrase the regulatory text of § 107.23(b) to make it similar to the ''undue hazard'' standard used in § 107.19(b). Additionally, as discussed in section III.C.1 of this preamble, this rule will also allow the intrastate transportation of property for compensation or hire.

a. External Load and Towing

In the NPRM, the FAA noted that external load and towing operations ''involve greater levels of public risk due to the dynamic nature of external-load configurations and inherent risks associated with the flight characteristics of a load that is carried or extends outside of the aircraft fuselage and may be jettisonable.'' [105] The FAA added that these types of operations may ''also involve evaluation of the aircraft frame for safety performance impacts, which may require airworthiness certification.'' [106] Accordingly, the NPRM would not have permitted external load or towing operations to be conducted under part 107. However, the FAA invited comment on whether external-load and towing UAS operations should be permitted, whether they should require airworthiness certification, whether they should require higher levels of airman certification, whether they should require additional operational limitations, and on other relevant issues.

Several commenters, including Cherokee Nation Technologies, NAAA, and ALPA, generally supported the proposed prohibition on conducting external load and towing operations. Cherokee Nation Technologies contended that the risks associated with external loads and towing are beyond the scope of this rulemaking effort. NAAA argued that additional data is needed to safely allow external load small UAS operations in the NAS. ALPA asserted that external load and towing operations require a level of piloting skill that is higher than the one envisioned by part 107.

Approximately 30 other commenters opposed a blanket prohibition on conducting external load and towing operations. Modovolate Aviation stated that the NPRM does not explain sufficiently why external load and banner-towing operations should be excluded. DJI asserted that external load and towing operations could be conducted safely within the other operating parameters proposed in the NPRM. DJI specifically noted that the 55-pound limit on the total weight of the small unmanned aircraft would significantly reduce the risk of cargo-carriage operations by limiting the weight of the cargo that could be carried or towed by the unmanned aircraft.

Yale University, the Information Technology and Innovation Foundation, American Farm Bureau Federation, and Google stated that the proposed prohibition on external load and towing operations would offer only marginal improvements in safety, if any, at the cost of important research and a wide range of useful applications of small UAS. American Farm Bureau Federation, the Michigan Farm Bureau, and the Missouri Farm Bureau specifically noted that the prohibition is overbroad and impractical as applied to agricultural applications. Short of recommending that the FAA completely eliminate the external load and towing prohibition, the American Farm Bureau Federation and the Michigan Farm Bureau urged the FAA to clarify that this prohibition only applies to actual towing operations or operations that would cause the weight of the UAS to exceed 55 pounds. The Oklahoma Governor's Unmanned Aerial Systems Council said that if a small UAS is specifically designed to safely accommodate external loads and towing operations, then these operations should be allowed as long as they are in compliance with the manufacturers' engineering and operating specifications.

The Mercatus Center at George Mason University stated that the NPRM fails to include a discussion of the benefits of allowing small UAS to conduct external load operations. The commenter asserted that, given that no fatalities have been reported due to ''jettisoned parcels from UASs,'' parcel-for-parcel, it may be safer to transport goods via UAS external load operations than to do so using delivery trucks. The Colorado Cattlemen's Association and Amazon argued that the FAA should take a performance-based approach to allow external load and towing operations. AIA similarly recommended the FAA apply ''risk analysis techniques'' to the specific operations under consideration.

The University of California and the Consumer Electronics Association stated that, instead of a blanket prohibition on external load and towing operations, safety concerns could be mitigated by sensible limits on weight, range, location and altitude, and by technology and a registration procedure that certifies to a higher degree of safety. By way of example, the Consumer Electronics Association pointed out that Amazon has said that a 5-pound package limit would create minimal safety concerns, yet would still permit the delivery of more than 85 percent of the products it sells.

Google and several individual commenters cited numerous examples of small unmanned aircraft missions that would be adversely affected by a prohibition on external loads and towing. These operations include activities such as banner towing, magnetometer missions, towing lines for electric utility industry, and delivery of tools and equipment. A few commenters opposed the prohibition on external load and towing operations in limited contexts. The National Ski Areas Association said the prohibition should be relaxed for safety and emergency operations. The Associated General Contractors of America said that the FAA should invite further comment on whether the prohibition should extend to highly controlled construction jobsites. Aviation Management stated that FAA should be able to effectively assess the risk of towing operations on a class basis or a case-by-case basis. One commenter suggested that external loads of a limited weight should be allowed, and that the weight allowed should be a specified percentage of the weight of the unmanned aircraft.

The FAA agrees with the commenters who objected to the proposed prohibition on external load and towing operations. Under part 107, the combined weight of the small unmanned aircraft and any objects towed or loaded (either externally or internally) must be less than 55 pounds. As a result of this limitation, the risk posed by a small unmanned aircraft conducting external load or towing operations is significantly lower than the risk associated with manned-aircraft external load or towing operations, which can carry 1,000 to 50,000 pounds of cargo.

Further, the majority of risks associated with load (either internal or external) and towing operations are already mitigated by the other provisions of this rule. First, § 107.19(c) requires the remote pilot in command to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason. Second, § 107.49(a) requires the remote pilot in command to conduct a preflight assessment of the operating environment, and consider the potential risks to persons and property in the immediate vicinity. Finally, as discussed below, § 107.23(b) prohibits a person from dropping an object from a small unmanned aircraft in a manner

[105] 80 FR at 9553.

[106] *Id.*

that creates an undue hazard to persons or property.

Because the other provisions of this rule mitigate the risks associated with external load and towing operations, these operations will be permitted under part 107 if they do not adversely affect the flight characteristics and controllability of the small unmanned aircraft. To ensure that this is the case, the FAA has revised § 107.49 to require that, prior to flight, the remote pilot in command and the person manipulating the flight controls of the small UAS must ensure that any object attached to or carried by the small unmanned aircraft (either internally or externally) is secured and does not adversely affect the flight characteristics or controllability of the aircraft.

Flight characteristics refer to the stability of the small UAS, while controllability refers to the maneuverability of the small UAS. To satisfy the above requirement, the remote pilot in command must examine the equipment used for lifting or securing a payload to ensure that it is in good condition, strong enough for the task, and attached in a manner such that there is no unintended shifting or detaching of the payload. For example, if a single cable is used to secure and lift a payload, the cable must be inspected to determine that it is securely attached at both ends and that the cable and attach points are in good condition so that the payload will not inadvertently detach. If netting is used, the netting and the attach points must be in good condition so that the netting does not inadvertently become detached. The payload must also be securely fastened so that it does not slip out of the netting during flight.

A payload will likely adversely affect the flight characteristics of the small unmanned aircraft if that payload shifts in a manner that causes the small unmanned aircraft to deviate from its intended flight path or become uncontrollable. In other words, if a payload becomes partially detached or if the presence of the payload creates an imbalanced small unmanned aircraft, then the flight characteristics of the small unmanned aircraft have been adversely affected. Additionally, if a payload shifts during flight or weighs down a small unmanned aircraft such that the aircraft is unable to properly respond to a remote pilot's controls, then the controllability of the small unmanned aircraft has been adversely affected.

A joint submission from the State of Nevada, the Nevada Institute for Autonomous Systems, and the Nevada FAA-designated UAS Test Site, and a comment from an individual claimed that external load and towing operations involve a greater level of complexity and safety risk and that the FAA should develop appropriate standards and certification criteria for these operations. Conversely, Yale University said that a prohibition on all external-load operations or requiring an airworthiness certificate for such operations would impede ability to rapidly prototype aircraft. The Oklahoma Governor's Unmanned Aerial Systems Council recommended airworthiness certification only for larger UAS platforms conducting external load operations.

Planehook Aviation said that the FAA should create a special category of common carrier certification for conducting external load operations. The commenter recommended that FAA create a UAS-specific advisory circular to mirror manned aviation guidance in AC 133–1A, Rotorcraft External Load Operations in accordance with 14 CFR part 133.

Separate airworthiness or other certification analogous to manned-aircraft operations is not necessary for external load and towing operations that will be conducted under part 107. As discussed earlier, a small unmanned aircraft weighing less than 55 pounds (including the weight of any payload) does not pose the same safety risk as a 1,000 to 50,000-pound manned aircraft. Thus, it is not necessary for a small unmanned aircraft to be subject to the same regulatory provisions as a manned aircraft that conducts external-load operations.

Consequently, this rule will not require small unmanned aircraft operating under part 107 to comply with either the provisions of part 133 (which normally applies to rotorcraft external load operations) or current guidance associated with airplane external load operations. However, because larger UAS than the ones governed by this rule may pose additional safety risk, future rulemakings may impose additional mitigations, such as those required by part 133, on larger UAS operations. While the FAA does not plan to issue guidance on external load operations with larger UAS in conjunction with this rulemaking, it may do so in the future.

DJI recommended that instead of banning towing operations, the FAA use existing language from § 91.15, which prohibits dropping objects from aircraft in flight ''that creates a hazard to persons or property.'' One individual commenter said the FAA should consider a restriction on the size of a towed banner, and that the device should meet requirements similar to the requirement for 14 CFR part 101 (balloons). Another individual commenter said towing operations should be permitted as long as the power-to-weight/drag ratio is appropriate for safe flight. In response, the FAA notes that, as discussed earlier, this rule will allow external load and towing operations (including banner towing) as long as the object is securely attached to the small unmanned aircraft and does not pose adverse flight characteristics.

Several commenters, including the Small UAV Coalition, the North Carolina Association of Broadcasters, and Modovolate Aviation stated the FAA needs to clarify whether a gimbal, camera, or sensor affixed to a UAS is considered an external load. The News Media Coalition stated that the final rule should make clear that an interchangeable camera that is affixed to or carried by a small UAS to be used by that UAS is permissible. SkyBridge Holdings said that any item that is clearly, mechanically fastened to the aircraft (*e.g.,* using screws or bolts) should not be considered an external load.

The FAA acknowledges the concerns raised by the commenters, but as discussed earlier, this rule will remove the proposed prohibition on external-load operations. Consequently, part 107 will not have any external-load-specific regulatory provisions and, as such, a UAS-specific definition of external load is unnecessary in this rule. The FAA also emphasizes the requirements (discussed earlier) that any object attached to or carried on or in the small unmanned aircraft must be secured and may not pose adverse flight characteristics. These requirements apply regardless of whether the object is carried inside or outside of the aircraft.

Southern Company sought clarification as to whether the proposed external-load and towing prohibition would apply to tethered operations (*e.g.,* the stringing of a conductor, the rigging of climbing protection, or the carriage of any line or cable that is tied to the ground or held by a person). If tethered operations are permitted, the commenter asked whether the weight of the tether counts toward the small UAS weight limitation. Southern Company stated that a tether provides sufficient risk mitigation such that it should not be considered part of the aircraft for the purpose of determining weight.

As discussed in section III.D.4 of this preamble, the weight of the small unmanned aircraft includes everything that is on board or otherwise attached to the aircraft and may be lifted. Thus, if

a cable is attached to an unmanned aircraft, then the weight of the entire cable must be added to the weight of the unmanned aircraft to determine whether the total weight is under the 55-pound limit imposed on small unmanned aircraft. The FAA acknowledges that a portion of the attached cable may rest on the ground during the small UAS operation, but the small unmanned aircraft may end up lifting the entire cable if positive control is lost during the operation. If the unmanned aircraft is tethered by the cable in such a way that the cable, securely attached to an immoveable object, prevents the unmanned aircraft from flying away in the event of loss of positive control, only the portion of the cable which may be lifted aloft by the small unmanned aircraft must be added to the weight of the unmanned aircraft when determining total weight.

Transport Canada asked whether the FAA has considered prohibiting certain payloads (*e.g.,* explosives, corrosives, bio-hazards, lasers, weapons). Transport Canada added that the FAA might consider a prohibition on equipping small UAS with an emergency locator transmitter (ELT), ''and the potential response of search and rescue assets as a result of an ELT activation.''

As discussed in section III.C.1 of this preamble, this rule will not allow the carriage of hazardous materials. With regard to ELTs, an ELT is generally required to be installed in manned aircraft under 14 CFR 91.207 for the purpose of locating a downed aircraft and aiding in the rescue of survivors. Because a small unmanned aircraft will not carry any people onboard, the installation of an ELT would not result in significant safety benefits and will not be required by this rule. Further, due to the cost and weight of ELT devices, we do not anticipate small UAS owners voluntarily equipping their aircraft with ELTs.

b. Dropping Objects

In § 107.23(b) of the proposed rule, the FAA proposed to prohibit an object from being dropped from a small unmanned aircraft if such action endangers the life or property of another. The FAA received approximately 15 comments in response to this proposed provision.

CAPA and one individual commenter expressed concern about the proliferation of small UAS and their accessibility to persons with limited or no aviation experience. Both commenters asserted that it requires great skill to drop an object safely from an aircraft. CAPA also expressed concerns about the potential security risks of permitting objects to be dropped from small unmanned aircraft. Similarly, two individual commenters worried that small unmanned aircraft equipped for package delivery could be used to carry out terrorist activities, such as dropping canisters of poisonous gases into populated areas such as shopping malls.

The FAA disagrees with the commenters that airmen operating under part 107 will lack the skill necessary to safely drop an object from a small UAS. As discussed in section III.E.1 of this preamble, all small UAS operations must be conducted either by a certificated remote pilot or under the direct supervision of a certificated remote pilot in command. In order to obtain a remote pilot certificate under part 107, an applicant will be required to demonstrate his or her knowledge of how to safely operate a small UAS under part 107.[107] Thus, operations under part 107 will be conducted and overseen by certificated airmen who will have the knowledge necessary to safely conduct various part 107 operations, including safely dropping objects from a small UAS.

With regard to dropping dangerous objects, the FAA notes that, as discussed in section III.C.1 of this preamble, this rule will prohibit the carriage of hazardous material by small unmanned aircraft. With regard to terrorism and criminal activities more broadly, as discussed in section III.J.2 of this preamble, there already exist criminal statutes that prohibit criminal and terrorist activities.

Five commenters suggested that the language in the final rule regarding the dropping of objects should mirror the language in 14 CFR 91.15. These commenters suggested that while proposed § 107.23(b) does not necessarily differ in substance from § 91.15, it should be made explicit that the rule does not prohibit the dropping of any object if reasonable precautions are taken to avoid injury or damage to persons or property. DJI suggested that the FAA adopt the ''hazard to persons or property'' standard used in § 91.15 for external load and towing operations.

Section 91.15 prohibits an object from being dropped from an aircraft in flight in a manner that creates a hazard to persons or property. Section 107.19(b) of this rule uses a similar standard of ''undue hazard'' with regard to loss of positive control of a small unmanned aircraft. In order to promote regulatory consistency throughout part 107, the FAA has rephrased the regulatory text of § 107.23(b) to use the ''undue hazard'' standard specified in § 107.19(b). The revised § 107.23(b) will prohibit dropping objects from a small unmanned aircraft in a manner that creates an undue hazard to persons or property.

DJI noted that the term ''hazard'' is inherently subjective. DJI acknowledged that ''it may be impossible to adopt a non-subjective standard,'' and requested that the FAA provide guidance on the types of operations that the FAA would consider to be hazardous.

As discussed earlier, § 107.23(b) will prohibit dropping an object from a small unmanned aircraft in a manner that creates an undue hazard to persons or property. For purposes of this rule, a falling object creates an undue hazard to persons or property if it poses a risk of injury to a person or a risk of damage to property. This standard will be applied on a fact-specific basis. For example, a small unmanned aircraft that drops a heavy or sharp object capable of injuring a person in an area where there are people who could be hit by that object would likely create an undue hazard to persons. The remote pilot in command of the operation could take reasonable precautions prior to flight by moving people away from the drop site to a distance where they would not be hit by a falling object if something goes wrong with the operation. Guidance associated with the enactment of part 107 will provide additional examples to help remote pilots comply with § 107.23(b).

5. Limitations on Operations in Certain Airspace

In the NPRM, the FAA proposed limiting the exposure of small unmanned aircraft to other users of the NAS by restricting small UAS operations in controlled airspace. In addition, the NPRM proposed prohibiting small UAS operations in prohibited and restricted areas without permission from the using or controlling agency. The proposed rule also prohibited operation of small UAS in airspace restricted by NOTAMs unless authorized by ATC or a certificate of waiver or authorization.

For the reasons discussed below, this rule will adopt the provisions for operating in Class B through E airspace and in prohibited or restricted areas as proposed in the NPRM, but with the option to request a waiver from the provisions for operating in Class B through E airspace. This rule will not adopt the provisions for compliance with NOTAMs as proposed, but will

[107] Depending on whether the applicant holds a part 61 pilot certificate other than student pilot, that demonstration will take the form of either an aeronautical knowledge test or online training.

instead require compliance with §§ 91.137 through 91.145 and § 99.7, as applicable. This rule will also not adopt the proposed prohibition on operations in Class A airspace because the other operational restrictions of this rule will keep a small unmanned aircraft from reaching Class A airspace. Lastly, this rule will add a prohibition against small unmanned aircraft operations that interfere with operations and traffic patterns at any airport, heliport or seaplane base.

a. Operations in Class B, C, D, and Lateral Boundaries of the Surface Area of Class E Airspace Designated for an Airport

The NPRM proposed to require prior permission from Air Traffic Control (ATC) to operate in Class B, C, or D airspace, or within the lateral boundaries of the surface area of Class E airspace designated for an airport. The NPRM did not propose equipment requirements for small UAS operating in controlled airspace, nor did it propose to require small UAS to demonstrate strict compliance with part 91 in order to operate in controlled airspace.

Several commenters including AOPA, EAA, and the Small UAV Coalition, supported the FAA's proposal that remote pilots obtain ATC approval prior to operating small UAS in Class B, C, or D airspace, or within the lateral boundaries of the surface area of Class E airspace designated for an airport. Some commenters added that they would like clarification that ATC approval does not mean the FAA issuance of a COA. The International Air Transport Association supported the proposal and stated this requirement should not be allowed to impede ATC's primary responsibility to manage traffic. Transport Canada requested clarification on the process for requesting ATC approval. Foxtrot Consulting and JAM Aviation expressed concern about inconsistent application of the regulation by ATC facilities.

Some of these commenters requested that the FAA provide guidance to ATC facilities regarding the handling of requests to operate small UAS in controlled airspace. Modovolate Aviation agreed with the proposed framework, but suggested that the FAA should provide guidance on how ATC permission would be obtained. The Small UAV Coalition asked the FAA to provide contact information for each ATC facility, and to agree to provide timely decisions on whether to authorize operations in controlled airspace. NBAA suggested prohibiting use of ATC frequencies to obtain the required permission.

In response to comments, the FAA will establish two methods by which a remote pilot in command may request FAA authorization for a small unmanned aircraft to operate in Class B, C, D, and the lateral boundaries of the surface area of Class E airspace designated for an airport. The first method is the same as what was proposed in the NPRM: A remote pilot in command may seek approval from the ATC facility with jurisdiction over the airspace in which the remote pilot would like to conduct operations. The second method allows a remote pilot to request a waiver from this provision in order to operate in Class B through E airspace. As stated in the NPRM, the appropriate ATC facility has the best understanding of local airspace, its usage, and traffic patterns and is in the best position to ascertain whether the proposed small UAS operation would pose a hazard to other users or the efficiency of the airspace, and procedures to implement to mitigate such hazards. The ATC facility has the authority to approve or deny aircraft operations based on traffic density, controller workload, communications issues, or any other type of operational issues that could potentially impact the safe and efficient flow of air traffic in that airspace. If necessary to approve a small UAS operation, ATC may require mitigations such as altitude constraints and direct communication. ATC may deny requests that pose an unacceptable risk to the NAS and cannot be mitigated.

The ATC facility does not have the authority to approve or deny small UAS operations on the basis of equipage that exceeds the part 107 requirements. Because additional equipage and technologies such as geo-fencing have not been certificated by the FAA, they therefore need to be examined on a case-by-case basis in order for the FAA to determine their reliability and functionality. Additionally, requiring ATC to review equipage would place a burden on ATC and detract from other duties. Instead, a remote pilot who wishes to operate in controlled airspace because he or she can demonstrate mitigations through equipage may do so by applying for a waiver.

Requests for authorization to operate a UAS in one of the above areas should be made by writing or an electronic method as determined by the Administrator and publicized on the FAA's Web site. Requests for such authorization via air traffic control radio communication frequencies will not be accepted because they may interfere with the separation of aircraft.

The FAA is not committing to a timeline for approval after ATC permission has been requested because determining the level of review required for approval is dependent on the management at the individual facilities. The FAA also notes that the time required for approval will vary based on the resources available at the ATC facility and the complexity and safety issues raised by each specific request. The FAA encourages remote pilots who know that they will need to operate in Class B, C, D, or E airspace to contact the appropriate ATC facility as soon as possible prior to the operation.

While some UAS activity will still utilize a COA, operating under part 107 regulations will not require a COA where ATC permission is specified. The FAA is working concurrently on several other documents, including an advisory circular, and training and direction to ATC facilities that will provide guidance to users and ATC personnel as to procedures and responsibilities. This guidance will ensure consistent application of ATC permission and processes, to the extent practicable. The FAA notes that some discrepancies may arise due to the unique nature of different airspace.

Several commenters, including ALPA, TTD, and the University of North Dakota John D. Odegard School of Aerospace Sciences, opposed allowing operations in class B, C, D, or E airspace. The University of North Dakota John D. Odegard School of Aerospace Sciences argued that this provision would place an undue burden on ATC, and that the well-established COA process would be a better mechanism than ATC permission. TTD suggested that the FAA adopt design provisions that ensure small UAS remain in the intended airspace when operating optimally, as well as risk mitigation technology when command controls are lost, and that operations in controlled airspace be banned in the absence of such provisions. ALPA stated that it does not believe there is sufficient information on which to base a sound safety case for allowing small UAS into controlled airspace at this time. Several commenters including SWAPA, Airport Council International-North America and the County of Los Angeles Department of Public Works, thought a real-time two-way communication requirement should be included. The Property Drone Consortium opposed the requirement to notify ATC, while adding that it believed this requirement imposed burdens on UAS operators that are different from those imposed on manned operations.

The FAA does not believe that prescriptive design provisions are

necessary in this rule. The FAA acknowledges the concerns raised by the commenters but notes that, as of this writing, safety-relevant equipage such as transponders has not been certificated for use on a small UAS. Additionally, there could be small UAS operations with operational parameters that would make those UAS not a danger to manned aircraft even if positive control is lost. For example, a small unmanned aircraft flying at low altitude and surrounded by natural barriers that would stop the aircraft from flying away would not pose a danger to other aircraft, even in the absence of equipage mitigations. Thus, this rule will retain the framework allowing the FAA to evaluate operations seeking to be conducted in controlled airspace on a case-by-case basis, and will not impose generally applicable design or equipage provisions on all small UAS operations. The FAA will continue to monitor the development of small UAS technology and may revisit this issue once the pertinent technology becomes more mature and additional safety data is available.

This framework is similar to the regulatory construct underlying controlled-airspace access under part 91. Specifically, while part 91 imposes minimum equipage requirements on aircraft seeking to operate in controlled airspace, part 91 also gives ATC the power to authorize aircraft that do not have the required equipage to access the airspace.[108] Part 107 provides ATC with a similar power to evaluate whether an individual small UAS operation may safely be conducted in controlled airspace even though the unmanned aircraft lacks equipage typically used to mitigate safety concerns in that airspace.

Additionally, the FAA does not agree that the current COA process would be a better mechanism for operating in controlled airspace. Currently, when a small UAS operator applies for a COA, the Flight Standards Service in the FAA first addresses the equipage exemptions, and then if a favorable outcome is reached, the operator is allowed to operate in Class G airspace up to 200 feet AGL. If an operator wishes to operate in controlled airspace, under the previous COA framework, the request is sent to the air traffic service center. The service center then works with the appropriate ATC facility to respond to the request. This rule will streamline the process, such that equipage no longer needs to be reviewed by the FAA if the part 107 requirements are met. Therefore, the only outstanding step in the COA process would be resolving requests to operate in controlled airspace. This rule incorporates that step within the ATC-permission framework, making the COA process unnecessary for part 107 operations.

Embry-Riddle Aeronautical University supported the proposed rule and proposed adding a filed flight plan option in lieu of explicit ATC approval. The City and County of Denver, Colorado, insisted that permission should be granted only for essential commercial, non-recreational purposes. Airport Council International–North America and the American Association of Airport Executives stated that ATC should only grant permission when there is a specific need to do so. The Center for Robot-Assisted Search and Rescue asked that public safety operators be exempt from the requirement to obtain ATC approval prior to operating in controlled airspace.

The FAA does not agree with Embry-Riddle's proposal to add a flight plan option in lieu of ATC approval. Filing a flight plan would not alert ATC in advance as to the nature of the operation, nor would it give them an opportunity to apply mitigations in a timely manner. The FAA also notes that the flight plan system is set up for point-to-point flights. Adapting it for small UAS operations would be a technology hurdle and would introduce unnecessary delay into the rule. Therefore, a flight plan is not a viable substitute for obtaining ATC permission.

Additionally, ATC should not be placed in the position of validating the need of any specific operation. Any decision on allowing an operation within the appropriate ATC facility's jurisdiction will take into account the workload of the controller. If it is anticipated the volume of traffic could change, the facility might require a means to terminate a small UAS operation in real-time, such as two-way radio or cell phone communication.

The FAA also notes that this rulemaking does not apply to recreational small UAS operations that are conducted in accordance with section 336 of Public Law 112–95. Further, the FAA does not agree that public safety operators should be exempt from the requirement to obtain ATC approval prior to operating in controlled airspace. Although public safety operators may have time-critical aspects to their operations, the risks associated with flying in controlled airspace remain the same regardless of the type of operation. The requirement for ATC approval gives ATC the opportunity to prescribe mitigations to address any risks associated with operating in controlled airspace. The FAA notes that while a public entity has the option to operate under a public COA, it may gain an operational advantage by operating under part 107. However, in electing to operate under part 107, a public entity is required to operate wholly under the part, and its operation would therefore be considered a civil operation.

Some commenters, including TTD and NAFI, expressed concern that the testing required by the proposed rule would not adequately prepare UAS operators to effectively communicate with ATC. The American Association of Airport Executives and the Associated General Contractors of America suggested that the FAA develop a protocol or guidance for UAS operators when communicating with ATC. NBAA asserted that if ATC requires two-way radio capability in their approval, the remote pilot should be required to hold at least a sport pilot airman certificate to ensure familiarity with ATC phraseology.

Transport Canada asked whether FAA considered mandating that the UAS operator develop and adhere to procedures for loss of positive control that include communications with air traffic control. Similarly, CAPA said that the FAA should require procedures for operators of small UAS to notify the appropriate ATC agency when the UAS operator has lost positive control.

This rule does not mandate a specific method of communication with ATC. In its evaluation of a request to fly in controlled airspace, an ATC facility may request two-way radio communications as a condition of approval for that request. ATC's evaluation may include assessing the experience and ability of the remote pilot in using proper phraseology. Imposing a general sport pilot certificate requirement would not ensure the appropriate knowledge and skills because sport pilots are not permitted to operate in class B, C, or D airspace without an additional endorsement, and would not necessarily have the radio training or experience by virtue of holding a sport pilot certificate. Additionally, there are several means outside of an airman certificate that may provide proper ATC communication experience, such as airport ground personnel or air traffic controller training.

The FAA has not mandated specific coordination with ATC for manned or unmanned aircraft during a loss-of-control event. As described in the

[108] *See, e.g.,* 14 CFR 91.215(b) (allowing ATC to authorize access to Class A, B, or C airspace for aircraft that do not have a transponder) and § 91.225(b) (allowing ATC to authorize access to Class B or C airspace for aircraft that do not have ADS–B).

introduction to the FAA Safety Team (FAAST) course ALC–40,[109] a common rubric used by pilots is aviate, navigate, communicate. In other words, during an emergency, a pilot should maintain control of the aircraft, know where he or she is and where he or she intends to go, and let someone know his or her plans. To require a communication task during an emergency may distract a pilot from these priorities and possibly create additional risk. Proper flight planning by a remote pilot in command includes an assessment of the risk of violating regulatory airspace, and incorporation of mitigations and contingencies commensurate with that risk.

Prioria Robotics said the FAA should consider blanket access to airspace below 500 feet for small and micro class unmanned vehicles of less than 15 pounds, with exceptions for within one mile of airports. Prioria Robotics also recommended that only vehicles larger than 15 pounds be subject to airspace restriction. One individual stated that operations below 100 feet and farther than 3 miles from an airport in class B and C airspace should be allowed without ATC involvement. Similarly, the National Association of Broadcasters, the National Cable & Telecommunications Association, and the Radio Television Digital News Association, commenting jointly, suggested a sliding scale for operations that would require lower altitudes when closer to an airport for operations without ATC approval. DJI suggested that in lieu of restrictions in certain classes of airspace, the FAA should consider adopting an approach akin to the one that the agency has adopted in 14 CFR part 77, in which maximum altitude increases as distance to an airport increases.

The FAA disagrees with the assumption that the weight of an unmanned aircraft is the sole safety concern when operating in controlled airspace. The FAA designates the various classes of controlled airspace to allow ATC to provide separation services to instrument flight rules (IFR) and, in the case of class B and C airspace, VFR traffic. Controlled airspace surface areas have a high number of arriving and departing aircraft at altitudes below 500 feet and rely on ATC to assess and mitigate the associated risk.

Trying to create a sliding scale that would require lower altitudes closer to an airport for operations without ATC approval would be complex because the slope would not be uniform. Instead, the slope would be shallower in the path of approach or departures, and steeper away from traffic flows. Each airspace has unique characteristics, and individual small UAS operations are different, making it impossible to establish a uniform standard. Allowing the local ATC facility to determine the feasibility of a small UAS operation is an efficient means to mitigate the risks involved in operating in controlled airspace.

The Colorado Agricultural Aviation Association, the City of Phoenix Aviation Department, and PlaneSense and Cobalt Air, commenting jointly, suggested that a NOTAM be issued when small UAS are flying in class B, C, D, and E airspace.

The FAA disagrees with this suggestion because, in many instances, a NOTAM would not provide any additional level of safety. For example, neither a very low altitude operation (*e.g.,* below 50 feet), nor a flight that is shielded by a taller structure that would preclude manned aircraft from operating in that area, would benefit from a NOTAM. In both instances there is a low probability that manned aircraft will be present in those areas. The FAA has a responsibility to keep NOTAMs relevant to pilots, and NOTAMs that do not provide an additional level of safety may create information ''clutter'' during a preflight briefing. A facility may issue a NOTAM for the impacted timeframe after giving permission to a remote pilot to operate in controlled airspace, if appropriate.

NOAA requested more details about requirements for civil UAS operated in the Mode C veil. In response, the FAA notes that operations conducted under part 107 do not need to comply with part 91 unless explicitly directed by part 107. The transponder requirement in the mode C veil (14 CFR part 91.215(b)(2)) is not required of part 107 operations.

NAFI asked what radio station license a small UAS operator would use on the aviation radio spectrum. In response, the FAA notes that licensing of radio stations is outside of its jurisdiction. The pertinent FCC guidance can be found in form 605 Schedule C (*https://transition.fcc.gov/Forms/Form605/605c.pdf*).

Several commenters, including the American Association of Airport Executives, the Hillsborough County Aviation Authority, and the Metropolitan Airports Commission, suggested that the FAA require remote pilots wishing to operate in class B, C, D, or E airspace to also notify the appropriate airport operator. The City and County of Denver, Colorado, and the City of Phoenix Aviation Department added that UAS operators should be required to seek authorization from both ATC and the airport operator at least two full business days prior to small UAS operations in controlled airspace.

An airport operator does not have responsibility for air traffic or activities outside airport property. The FAA has been tasked with integrating UAS operations into the NAS, and notes that manned aircraft do not have a corresponding requirement to notify airport management. The ATC facility is the proper focal point for approval and notification for small UAS operations in controlled airspace under this rule.

The FAA does not agree that remote pilots must seek permission from an ATC facility at least two full business days prior to the small UAS operations. As discussed previously, the timeframe for ATC to process permission requests will vary based on the ATC facility, the airspace, and the small UAS operation. In some instances it may take less than two full business days to process a permission request and, as such, a requirement to submit the permission request two days in advance would be unnecessarily burdensome.

The Professional Helicopter Pilots Association said operations in class B airspace should not be allowed without a transponder for operation above at least 200 feet AGL.

Because part 107 operations are constrained to visual line of sight, they are confined to a limited area known to ATC. Requiring a transponder in class B airspace for all operations over a certain altitude would place a burden on the small UAS operation that might not provide any additional safety because all manned traffic (except under certain SFRA procedures)[110] is required to be in radio communication and under the direct control of ATC. ATC would deny a small UAS flight operating under part 107 if lack of a transponder created an unacceptable risk for that operation.

The Human Factors and Ergonomics Society expressed concern that UAS might inadvertently enter class B airspace. ALPA was concerned about the ability of a small UAS pilot/operator to correctly identify specific airspace areas and make the correct determination of whether operations are permitted or must be coordinated with ATC.

This risk remains unchanged regardless of the restrictions imposed on

[109] FAA Safety Team Course ALC–40: Aviate—Navigate—Communicate.

[110] As it pertains to this discussion, Special Flight Rules Areas are areas of tightly constrained altitude and path where VFR aircraft can traverse Class B airspace without receiving a clearance or talking to ATC.

operating in class B airspace. Other than the inner surface areas, there are very few instances where the floor of class B airspace is less than 1,000 feet above ground level, and therefore a vertical intrusion would be rare. The lateral boundaries of Class B airspace can be easily ascertained and avoided with proper planning of the operation. Airspace configuration is a knowledge area that will be tested for remote pilot certification, and a remote pilot should be aware of proximity of the unmanned aircraft to more restrictive airspace. Remote pilot certificate holders will also be regularly tested on their knowledge of airspace configuration, either as part of their flight review (for part 61 pilot certificate holders) or when they take the recurrent knowledge test (for non-part-61 certificate holders). In addition, applicants for a remote pilot certificate who do not hold a part 61 pilot certificate will be required to pass an initial aeronautical knowledge test that includes knowledge of airspace, airspace operating requirements, and the use of aeronautical charts. Pilots who hold a part 61 pilot certificate with an aircraft category and class rating will not have to take the initial aeronautical knowledge test, but they will have acquired the pertinent knowledge in order to obtain their part 61 pilot certificate.

b. Operations in Class A Airspace

The NPRM proposed prohibiting small UAS operations in Class A airspace. Class A airspace starts at 18,000 feet mean sea level and extends up to 60,000 feet.[111] This rule will not adopt the proposed prohibition because a small unmanned aircraft will be unable to access Class A airspace without violating the other operational restrictions of part 107.

The Mid-Atlantic Aviation Partnership, Crew Systems, and three individual commenters questioned the need for specifically prohibiting operations in Class A airspace. One of the individual commenters did not have an objection to the proposed restriction, but stated that the other operational restrictions in the NPRM would make it impossible to operate in Class A airspace. Another individual commenter pointed out that the only location where an operation could meet all of the operational restrictions proposed in the NPRM and still be in Class A airspace is near the summit of Mt. McKinley. This commenter suggested that an explicit restriction on Class A airspace operations was unnecessary, as no one would bother to carry a small UAS up a mountain in order to fly it.

The FAA agrees with the commenter who stated that other operational restrictions in the NPRM would make it impossible to operate in Class A airspace. Title 14 CFR 71.33(b) designating Class A airspace in Alaska specifically excludes the airspace less than 1,500 feet above the surface of the earth. This eliminates the possibility of a small UAS operating under part 107 from reaching Class A airspace given the altitude limitations of the rule. Consequently, this rule will not adopt the proposed Class A airspace restriction.

c. Prohibited or Restricted Areas

The NPRM proposed prohibiting small UAS operations in prohibited and restricted areas without permission from the using or controlling agency, as applicable. Prohibited and restricted areas are designated in 14 CFR part 73. The proposed provision concerning prohibited and restricted areas was similar to the part 91 restriction on operations in these areas, and did not include any new UAS-specific prohibited or restricted areas.[112] After careful consideration of the comments, the FAA will adopt the provisions as proposed.

The FAA establishes prohibited and restricted areas when necessary to prohibit flight over an area on the surface in the interest of national security or welfare. As discussed in section III.J.2 of this preamble, several commenters requested that the FAA establish prohibited or restricted airspace over energy infrastructure facilities, citing national security concerns as the basis for their comments. However, four commenters also cited safety concerns when suggesting that the FAA establish such restrictions.

Southern Company and Edison Electric Institute, individually and jointly with NRECA and APPA, explicitly cited safety reasons for restricting operations near energy infrastructure facilities. Edison Electric Institute raised concerns regarding UAS operations over critical energy infrastructure, including electric transmission and distribution facilities, power generation facilities, transmission lines, and substations. The commenter noted that the FAA currently has a TFR for manned aircraft over generation facilities, which the commenter said should be extended to cover UAS. The commenter argued that the FAA should extend the TFR to small UAS because of ''the obvious safety factor involved with any activity near high voltage equipment and the attendant economic loss that comes from the possible loss of electric distribution.'' EEI also submitted a separate, joint comment with NRECA and the APPA, which reiterated the same concerns.

Southern Company proposed that the FAA prohibit small UAS operations over power generation and transmission facilities, except by the utility or third parties acting on behalf of the utility. The commenter stated that the current NOTAM advising pilots to avoid overflight of power-generation facilities, including nuclear power plants, does not adequately address the potential risk small UAS pose. The commenter argued that, ''[b]ecause of the small size, low-cost, great availability, and unmanned nature of small UAS, little deters small-UAS operators, as opposed to their manned aircraft counterparts, from operating over power generation and transmission facilities.'' The commenter further argued that, although small UAS are capable of safe operation in close proximity to most structures, operation next to power generation and transmission facilities may be subject to invisible hazards, such as fire hazards caused by light and heat produced from an electric arc, that may be unfamiliar to non-utility operators.

Consumers Energy Company and the American Fuel & Petrochemical Manufacturers also addressed the safety of energy infrastructure. Consumers Energy Company said the FAA should consider expressly identifying a zone of no small UAS operation within a specified distance from electrical facilities (substations, power lines, and utility poles), except for small UAS operations by the facilities' owners. The commenter said that such a rule would reduce the likelihood of small UAS operations negatively affecting electrical facilities and continue to ensure the safety of the United States electric grid.

The American Fuel & Petrochemical Manufacturers complained that the NPRM does not identify—much less address—issues of safety and security arising from certain scenarios that are a serious issue for its members, including an accidental crash into a facility, such as a refinery. The commenter expressed concern that the airspace and geographic limitations in the proposed rule are not sufficient to ensure the safety and security of critical infrastructure facilities, and therefore requested that the final rule prohibit the unauthorized use, or unauthorized operation, of a small UAS over all oil and gas production, handling, transport, and processing facilities.

[111] 14 CFR 71.33.

[112] *See* 14 CFR 91.133.

EEI expressed concern that FDC NOTAM 4/0811 advising pilots to avoid the airspace over, or in proximity to, power plants would prevent electric utility companies from conducting small UAS flights around their own facilities.

Restricted airspace is designated when the FAA determines it is necessary to confine or segregate activities hazardous to nonparticipating aircraft. The FAA does not create special use airspace applicable to only one particular airframe or aircraft type. The public's right of free transit through the airspace includes the users of unmanned aircraft. Accordingly, the FAA declines commenters' suggestions to create UAS-specific restricted airspace around certain facilities. However, the FAA acknowledges commenters' concerns. In response to these concerns, the FAA emphasizes FDC NOTAM 4/0811, which states that ''. . . to the extent practicable, pilots are strongly advised to avoid the airspace above, or in proximity to such sites as power plants (nuclear, hydro-electric, or coal), dams, refineries, industrial complexes, military facilities and other similar facilities. Pilots should not circle as to loiter in the vicinity over these types of facilities.'' [113] This NOTAM applies with equal force to pilots of manned and unmanned aircraft. In response to EEI's concern, the FAA notes that FDC NOTAM 4/0811 is advisory and thus, does not constitute a regulatory prohibition.

d. Areas Designated by Notice to Airmen

The NPRM proposed to prohibit operation of small UAS in airspace restricted by NOTAMs, including NOTAMs issued to designate a TFR, unless authorized by ATC or a certificate of waiver or authorization. After reviewing comments on this issue, the FAA will change the method by which remote pilots may gain permission to operate in airspace restricted by NOTAMs. The final rule will require that small UAS operators comply with the provisions of §§ 91.137 through 91.145, and § 99.7, as applicable.

Southern Company commented that electric utility companies should be excepted from TFRs under §§ 91.137(a)(2) and (a)(3) to be able to expeditiously restore power during natural disasters. The Washington State Department of Transportation, Aviation Division, recommended that small UAS be allowed to operate in airspace restricted by NOTAMs, including TFRs, if the aircraft is equipped with position-reporting transmission capability, if two-way communication can be maintained between the operator and ATC, and if the appropriate level of permission to enter the airspace has been obtained.

TFRs are implemented for a number of reasons, from protecting aircraft from hazards on the ground or other sight-seeing aircraft, to providing a safe environment for the operation of disaster relief aircraft. The Washington State Department of Transportation, Aviation Division, did not describe how a UAS equipped with position-reporting transmission capability and two-way radio communication would allow for safe operation in a TFR. NOTAMs contain time-critical aeronautical information that is either temporary in nature or not sufficiently known in advance to permit publication on aeronautical charts or other publications.[114] NOTAMs are available to the public on the FAA's Web site.[115] In response to Southern Company's comment, the FAA notes that NOTAMs exist to address hazards in the restricted airspace, and allowing an aircraft to enter TFRs based only on its mission does not address the hazard that warranted the airspace restriction.

However, these comments raise the question of whether the proposed rule needlessly conflicted with the NOTAM provisions in part 91. Part 91 contains various types of NOTAMs, and the requirements to gain permission differ accordingly. For example, § 91.137(b) requires an aircraft to be participating in hazard relief activities under the direction of the official in charge of on-scene emergency response activities in order to operate within an area for which the specified NOTAM has been issued.[116] Section 91.137(c) contains a number of conditions, at least one of which must be met in order to operate within an area for which the specified NOTAM has been issued.[117] Conditions under § 91.137(c) include that the aircraft be carrying law enforcement or media personnel, or the aircraft is operating under an ATC-approved IFR flight plan.[118] Conversely, a § 91.141 TFR in the proximity of Presidential and other parties has no exceptions other than those stated in the NOTAM.[119]

These provisions conflict with the proposed language in the NPRM that would allow operations in airspace restricted by NOTAM with ATC or COA permission. In considering this issue, the FAA has identified no UAS-specific concerns that would require treating small UAS differently, for TFR purposes, than aircraft operating under part 91. Thus, the FAA has amended the language of § 107.47 to require compliance with §§ 91.137 through 91.145 or § 99.7.

Additionally, the FAA notes that part 91 subpart J lists the provisions under part 91 that are waivable, and describes the process to request a waiver.[120] Because small UAS remote pilots will be subject to the part 91 provisions described above, the waiver provisions and process described in part 91 subpart J will also apply should a remote pilot wish to seek a waiver from the applicable part 91 provisions.

The Department of Defense (DOD) through its Policy Board on Federal Aviation (PBFA) submitted a comment on protecting certain military and Federal law enforcement facilities, recommending that ''[t]he FAA Administrator classifies the airspace below 500 feet Above Ground Level (AGL) or within 2000 horizontal feet of a military installation (as defined in 10 U.S.C. 2801(c)(4)), or any buildings, grounds or property owned, occupied or secured in whole or in part by any Federal law enforcement or national security agency, as 'National Defense Airspace Area' in accordance with 49 U.S.C. 40103(b)(3).'' [121] In their comments, the PBFA also requested that for small UAS operations within a military training route (MTR) or military operations area (MOA), that small UAS operators publish a NOTAM and notify the MTR/MOA scheduler at least 24 hours in advance.

The FAA implements the National Defense Airspace mentioned above as prohibited and restricted areas. These areas are created by rulemaking actions and charted on VFR and IFR charts. A prohibited area would prevent flight of all aircraft, manned and unmanned, including aircraft operated by the agency occupying the facility. In addition, a prohibited area is only established by the FAA over those areas demonstrating a need to prohibit all flight generally due only to national security concerns, a standard that is currently met by only eight areas in the United States. PBFA's requested

[113] FDC 4/0811, June 18, 2007, at 2106.

[114] *See* FAA Aeronautical Information Manual, para. 5–1–3.

[115] *See, e.g., https://www.notams.faa.gov/dinsQueryWeb/* and *http://www.faa.gov/pilots/flt_plan/notams/.*

[116] 14 CFR 91.137(b).

[117] 14 CFR 91.137(c).

[118] 14 CFR 91.137(c)(2), (3), (5).

[119] 14 CFR 91.141.

[120] *See* 14 CFR 91.903, 91.905.

[121] DOD Policy Board on Federal Aviation comment at 5.

language would have the effect of expanding the number of areas 100-fold.

A restricted area is also not appropriate because FAA Order 7400.2 defines the purpose of a restricted area as ''. . . necessary to confine or segregate activities considered hazardous to nonparticipating aircraft.'' [122] Examples of hazardous activities in this context are live weapons fire, non-eye-safe lasers, and explosive demolition. The PBFA comment does not claim these facilities meet these criteria.

The FAA also declines to impose additional NOTAM requirements on small UAS operations. The NOTAM system is used to alert pilots of conditions or situations in the NAS that could present a hazard to aircraft. Historically, the FAA has used a NOTAM requirement in the COAs it issued for UAS operations. This was appropriate because small UAS operations were outside the regulatory structure that was then in place, and, while not inherently hazardous, small UAS flights required exemption or waiver from a number of FAA regulations. Because these operations deviated from existing FAA regulations, a NOTAM was an acceptable means to notify pilots of the activity. However, with part 107, the FAA is bringing a subset of UAS operations within the FAA regulatory structure. Civil, public, and military pilots are expected to be familiar with regulations affecting their flight, including the possibility of encountering UAS activity below 400 feet. Therefore, requiring a NOTAM would not be appropriate.

UAS remote pilots must be aware of their location and operating environment in relation to MTRs and MOAs. As part of their see and avoid responsibilities, remote pilots must use extreme caution when operating through an MTR or MOA. Because of the high speed of some military aircraft, the necessary reaction time will be substantially less in an MTR or MOA. Checking the NOTAM system and/or the responsible Flight Service Station for activity in these areas will provide information to a remote pilot that will help ensure a safe flight.

e. Operations in Class G Airspace

The FAA did not include any discussion of airports in Class G airspace in the NPRM and it did not propose any regulatory text to restrict small UAS operations in the vicinity of airports in class G airspace. Class G airspace is considered uncontrolled and ATC does not have authority or responsibility for separation of traffic. For operations in the vicinity of non-towered airports located in class E surface areas, the remote pilot in command must obtain prior permission from Air Traffic Control. After further review, the FAA will include a provision in the final rule that prohibits any small unmanned aircraft operations that interfere with operations and traffic patterns at any airport, heliport, or seaplane base.

Several commenters, including Trimble Navigation and NAMIC, supported allowing operations in class G airspace, without additional comment regarding operations in the vicinity of airports in class G.

AOPA and GAMA recommended prohibiting small UAS operations within a minimal accepted horizontal distance from airports in Class G airspace, but they did not recommend a specific distance. NBAA suggested that FAA restrict operations within a 3-mile radius of airports in class G airspace. The Airline Pilots Association and Hillsborough County Aviation Authority recommended restricting operations within a 5-mile radius of airports. Several individual commenters also recommended a prohibition of small UAS in the vicinity of airports.

The FAA agrees with commenters that supported the integration of small UAS operations with existing aeronautical operations in uncontrolled class G airspace because part 107 has specific risk mitigation and hazard reduction provisions that facilitate integration. First, small UAS pilots will be required to pass initial aeronautical knowledge testing before receiving a part 107 airman certificate. This knowledge testing will include operations in class G airspace. With issuance of the remote pilot certificate, the pilot will have the authority and responsibility of a remote pilot in command. The remote pilot in command will also be directly responsible for, and will be the final authority as to the operation of the small unmanned aircraft system. Finally, the remote pilot in command will be required to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason.

The FAA acknowledges, however, that there is a risk associated with close operations between manned and unmanned aircraft. Therefore, this rule will include a performance-based approach to integrating small unmanned aircraft near airports, heliports, and seaplane bases. Because the NPRM did not contemplate prohibiting operations within the vicinity of an airport in class G airspace, the FAA will not restrict small UAS operations within a specified distance from an airport. Rather, in response to concerns regarding the integration of small UAS and manned aircraft, this rule will prohibit remote pilots from operating their small unmanned aircraft in a manner that interferes with operations and traffic patterns at airports, heliports, and seaplane bases.

While a small unmanned aircraft must always yield right of way to a manned aircraft, a manned aircraft may alter its flight path or delay its landing or take off in order to avoid a small UAS that may present a potential conflict or otherwise affect the safe outcome of the flight. For example, an unmanned aircraft hovering 200 feet above a runway may cause a manned aircraft holding short of the runway to delay take off, or a manned aircraft on the downwind leg of the pattern to delay landing. While the unmanned aircraft in this scenario would not pose an immediate traffic conflict to the aircraft on the downwind leg of the traffic pattern or to the aircraft intending to takeoff, nor would it violate the right-of-way provision of § 107.37(a), the small unmanned aircraft would have interfered with operations and traffic patterns at an airport.

In order to avoid interfering with operations in a traffic pattern, remote pilots should avoid operating in the traffic pattern or published approach corridors used by manned aircraft.[123] When operational necessity requires the remote pilot to operate at an airport in uncontrolled airspace, the remote pilot should operate the small unmanned aircraft in such a way that the manned-aircraft pilot does not need to alter his or her flight path in the traffic pattern or on a published instrument approach in order to avoid a potential collision. Because remote pilots have an obligation to yield right of way to all other aircraft and avoid interfering in traffic pattern operations, the FAA expects that most remote pilots will avoid operating in the vicinity of airports because their aircraft generally do not require airport infrastructure, and the concentration of other aircraft increases in the vicinity of airports.

The FAA adds this performance-based approach requirement in response to concerns that small UAS operations

[122] FAA Order 7400.2.

[123] The official source regarding airport traffic patterns is the Airport/Facility Directory (A/FD). Instrument Approach Procedures are published by the FAA and can be found in U.S. Terminal Procedures Publications (TPPs), online from the FAA at *https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/dtpp/,* or in numerous third-party sources.

may present a hazard to manned aircraft operating at low altitudes in the vicinity of airports in both controlled and uncontrolled airspace. Due to the requirements for remote pilots to not operate in a careless or reckless manner and to yield the right of way to all other aircraft, the FAA does not consider it necessary to prohibit small UAS operations in the vicinity of an airport in uncontrolled airspace. Like ballooning, skydiving, banner towing, and other non-traditional aeronautical activities, the FAA expects that remote pilots will work with airport operators to identify ways to safely integrate small UAS operations into the flow of other operations at the airport.

Experimental Aircraft Association, National Association of State Aviation Officials, Minneapolis-Saint Paul Metropolitan Airports Commission, US Hang Gliding & Paragliding Association, the Permanent Editorial Board of the Aviators Model Code of Conduct initiative, and several individual commenters said that FAA should require operators intending to fly small UAS within 5 statute miles of airports in Class G airspace to notify airport authorities in advance of the operations. These commenters said that such notification would allow airport authorities, in turn, to notify aircraft in proximity of the airport of the small UAS activity. City and County of Denver, Colorado and County of Los Angeles said that Airport Operators should be permitted to limit small UAS operations on and around airports.

Airport operators have the proprietary right to operate their airport in a safe and efficient manner. Under 49 U.S.C. 40103, the FAA has the sole authority to regulate airspace, including airspace overlying an airport. While airport operators have the ability to manage operations on the surface of the airport, airport operators may not regulate the use of airspace above and near the airport. In an effort to safely integrate small unmanned aircraft and manned aircraft at an airport, airport operators may recommend certain areas where small UAS operate, in order to avoid conflicts with manned aircraft. The FAA does not consider the notification of airport operators to significantly enhance the safety of integration with existing operations. The requirement for notification creates a burden on the airport operator with little benefit to users of the airport, because the airport operator would have no requirement to disseminate knowledge of small UAS operations to other airport users.

Instead, remote pilots should adhere to operational recommendations and discontinue operations if the potential for interference arises. If the concentration of air traffic at an airport results in the likelihood of a small UAS interfering with operations, the remote pilot should avoid operating at that airport. Remote pilots who do not hold a part 61 pilot certificate will be required to pass initial and recurrent aeronautical knowledge tests that include specific knowledge of airport operations. Part 61 pilot certificate holders acquired this knowledge when they obtained their part 61 pilot certificate.

6. Inspection, Maintenance, and Airworthiness Directives

This section discusses the maintenance and inspection requirements applicable to a small UAS operation. Those requirements will consist of: (1) Conducting a preflight check prior to each flight to ensure that the small UAS is in a condition for safe operation; and (2) discontinuing flight if the small UAS ceases being in a condition for safe operation. Additionally, to mitigate risks associated with possible loss of positive control, this rule will also require the remote pilot in command to, as part of the preflight inspection, ensure that all control links between the control station and the small unmanned aircraft are working properly. Finally, this section will explain why this rule will not include airworthiness-directive requirements in part 107.

a. Inspections and Maintenance

As discussed in section III.J.3 of this preamble, pursuant to section 333(b)(2) of Public Law 112–95, the FAA has determined that a small UAS will not be required to obtain airworthiness certification if satisfying the provisions of part 107. However, without an airworthiness certification process, the FAA still needs to provide criteria for small UAS to meet that support safe operations. In considering how to address this issue, the FAA notes that existing regulations applicable to manned civil aircraft require particular U.S. airworthiness certificated aircraft to be inspected every 12 months.[124] Maintenance that might be necessary as a result is governed primarily by the provisions of 14 CFR part 43. Part 43 requires that the inspection examine every system and component of the aircraft in detail to identify present conditions that may render the aircraft as unairworthy.[125] If the inspection reveals any hazardous characteristics that would render the aircraft as unairworthy, then maintenance, conducted pursuant to the regulations of part 43, must be performed in order to approve the return of an aircraft to an airworthy condition.

In place of the requirements of part 43, the NPRM proposed to create a maintenance and inspection framework that corresponds with the significantly reduced risk posed by small UAS operations conducted under part 107. First, the NPRM proposed to require, in § 107.21, that the operator must maintain the small UAS in a condition for safe operation and inspect the small UAS prior to each flight to determine it is in a condition for safe operation. Second, the NPRM proposed to prohibit a person from operating a small UAS unless that UAS is in a condition for safe operation. Third, the NPRM proposed to require the operator to discontinue the flight of the small unmanned aircraft when he or she knows or has reason to know that continuing the flight would pose a hazard to other aircraft, people, or property. Finally, to reduce the possibility of a malfunctioning control link, the NPRM proposed to require that, prior to flight, the operator must ensure that all links between the control station and the small unmanned aircraft are functioning properly.

For the reasons discussed below, this rule will require the remote pilot in command to check the small UAS to determine whether it is in a condition for safe operation. The remote pilot will be prohibited from commencing flight if the small UAS is not in a condition for safe operation. Additionally, the remote pilot in command will be required to discontinue the flight of the small unmanned aircraft if he or she knows or has reason to know that the small UAS is no longer in a condition for safe operation. This rule will also finalize as proposed the requirement that the remote pilot in command ensure, prior to flight, that all control links between the control station and the small unmanned aircraft are functioning properly.

i. Preflight Check and Maintenance Requirements

Most commenters, including Google, AOPA, the Property Drone Coalition and others, supported the proposed preflight inspection requirement. However, several commenters proposed

[124] *See* 14 CFR 91.409.

[125] *See* 14 CFR part 43, Appendix D (scope and detail of items as applicable to the particular aircraft) to be included in Annual and 100 hour inspections. Note: These items listed constitute inspection of the complete aircraft only and does not include interrelated system components and equipment.

changes to the requirement or requested clarification regarding what the inspection should entail. Two individual commenters expressed opposition to the preflight inspection requirement and suggested that the requirement is burdensome or unnecessary. One individual commented that it would be impractical to perform a meaningful inspection before every flight, since many UAS flights last only a few minutes each, and there is a need to minimize delay between flights. That commenter proposed instead that the FAA require only one thorough pre-flight inspection prior to the first flight of the day, and that the first flight of the day should be a test flight. Another individual commenter said a preflight inspection before every flight ''could become a hassle and may be unnecessary,'' and that a monthly inspection would be more suitable.

This rule will require the remote pilot in command to conduct a preflight check prior to each flight to determine if the small UAS is in a condition for safe operation. An integral ground functional check as part of the preflight inspection will include a check of the associated data link equipment for proper operation. This is a check of the control link functionality between the ground control station and the small unmanned aircraft. If the preflight check reveals that the small UAS is not in a condition for safe operation or that the control link is not functioning properly, the remote pilot in command will be prohibited from commencing the flight operation until the small UAS is in a condition for safe operation and any and all control link deficiencies have been corrected.

To satisfy preflight check requirements, the remote pilot in command must check the entire unmanned aircraft and associated system components and equipment for visible defects such as broken or damaged parts, loose fasteners or wires, leaking fluids, and general wear and tear.[126] The remote pilot in command is responsible for making a condition for safe operation determination of the small UAS. A complete inspection of the aircraft and associated system equipment will include a functional ground check as a test to verify all control link systems are properly responding to control inputs and are otherwise functioning properly. The systems and equipment that could be checked in this manner could, depending on the complexity of the small UAS, include the engine, flight controls, landing gear, internal/external payload, link checks, ground control station, signal flow, auxiliary equipment rack, video dissemination, power requirements, and software configuration management. It is highly recommended that the remote pilot in command augment a complete small UAS preflight check by following manufacturer-suggested inspections and checks prior to conducting flight operations. The FAA will also issue guidance providing additional examples and best practices for how to properly conduct a preflight check to ensure that the small UAS is in a condition for safe operation.

The FAA notes commenters' concern that a mandatory check conducted prior to flight could be burdensome. However, the FAA anticipates that through repetition, the efficiency of the preflight check sequence will increase resulting in no more than a few minutes to complete the preflight check if the pertinent systems are functioning properly. As such, the FAA declines to remove the preflight-check requirement, as this check will serve to detect and mitigate the risks imposed by defects such as inoperative or deteriorating small UAS systems and components that may render adverse flight characteristics. Additionally, recurring checks will serve to identify equipment deficiencies that have occurred since the previous preflight inspection.

An individual commenter suggested that a test-flight is necessary because certain components and systems, such as avionics and control systems, cannot be tested on the ground. In response, the FAA notes that many of the systems that are tested through a test-flight cannot currently be tested without introducing additional risk into the operation. For example, flight termination (*e.g.* ''return to home'') and fail-safe systems are designed to trigger when the control link between the small unmanned aircraft and the control station is lost. In order to do a flight test of these systems, the remote pilot in command may need to deliberately sever the control link between the small unmanned aircraft and the control station during a test flight to see how the unmanned aircraft responds. A deliberate loss of positive control may introduce unnecessary risk to safe flight operation in the NAS. In addition, requiring flight testing prior to each flight would also impose an additional burden on the remote pilot in command in the form of time and power consumption. Accordingly, this rule will not impose a flight testing requirement.

DronSystems stated that a preflight inspection is unnecessary, asserting that a remote pilot could safely forego a preflight inspection by instead using ''sophisticated asset management tools'' or ''UAS self-diagnostic'' equipment.

The FAA is aware of no data showing that technology currently exists that could result in an equivalent level of safety to that attained by a visual and operational inspection conducted by the remote pilot in command. Visual and operational checks prior to each flight will serve as a vital safety practice essential for ensuring that the aircraft, control station, unmanned aircraft, and related integral systems are in a condition that will enable safe operation.

A number of commenters expressed concern that the proposed maintenance and inspection requirements were not stringent enough. ALPA and several individual commenters asserted that a preflight inspection conducted by the remote pilot is insufficient to ensure safe operation, as it would be conducted in the absence of defined criteria on which the owner/operator can base a decision about airworthiness. ALPA further stated that in the absence of airworthiness certification requirements combined with tamper-proof equipage that limits the vertical and lateral movement of unmanned aircraft, there is no way to ensure that a small UAS is safe and reliable.

Several commenters suggested that more formal maintenance and inspection requirements should be imposed on manufacturers and operators. The NextGen Air Transportation Program at NC State University said ''some statement of airworthiness from the manufacturer, a certified inspector, or system provider with a date evaluation should be a minimum requirement.'' The commenter also said that the aircraft should be tested for airworthiness every 2 years. The State of Nevada, the Nevada Institute for Autonomous System, and the Nevada FAA-designated UAS Test Site, commenting jointly, asserted that a preflight inspection ''clearly does not infer than an aircraft is airworthy,'' and said minimal standards should include lost link procedures and altitude determination. Other commenters similarly said small UAS should be required to have specific safety systems and protections. An individual commenter, who said self-certification establishes an unsafe precedent, said that UAS should be required to have redundant backup systems in place. That commenter said a standard airworthiness certificate may be

[126] The examples used in this preamble section are not intended to be exhaustive.

unnecessary for small UAS, and instead recommended an experimental-type certification, which would ensure an airworthiness review and reduce the excessive burden on manufacturers.

An individual commenter said that allowing the operator to conduct a preflight inspection to certify airworthiness ''is a mistake.'' The commenter pointed out that for manned aircraft almost all of the equipment has to be periodically certified by an approved testing lab to ensure that it is still at manufacturer-issued standards. Without a similar requirement for small UAS, the commenter continued, the aircraft could have a modified airframe or propulsion system, the electric motors or batteries could be deteriorating, and the payload carrying capacity could be altered, among other concerns. Another individual commenter opposed allowing operators with no presumed specialized knowledge to make key safety determinations, and recommended the FAA conduct further cost-benefit analysis, ''with a specific focus on the magnitude of potential damage that might be inflicted by errantly operated small UAVs.''

The FAA notes commenters' concern with regard to airworthiness but disagrees with the position that the maintenance and inspection requirements proposed in the NPRM need to be made more prescriptive in this rule. The proposed requirements are appropriate to the type of risk posed by small UAS operating under part 107. Specifically, as discussed throughout this preamble, small unmanned aircraft operating under part 107 will: (1) Weigh less than 55 pounds; (2) not carry any people onboard; and (3) operate within visual line of sight and other operational parameters that mitigate risk to other aircraft operating in the NAS, people, and property on the ground. Thus, a small unmanned aircraft operating under part 107 has been determined to pose a significantly lower risk than a manned aircraft that weighs hundreds or thousands of pounds and carries one or more people onboard that may be injured in the event of a mishap. Consequently, imposing a more prescriptive level of maintenance and inspection requirements on small UAS operating under part 107 is not justified in this rule.

Completion of a preflight inspection of the small UAS prior to each flight will serve to mitigate risk in a manner appropriate for the risk posed by the small UAS operation. While this rule will not require small UAS to comply with part 43, the FAA encourages the use of certificated maintenance providers, which may include repair stations, holders of mechanic and repairman certificates, and persons working under the supervision of these mechanics and repairmen. Recommendation for the use of certificated maintenance providers is predicated on their heightened maintenance and inspection capabilities that may lend support to sustained conditions for safe operation of small UAS. Additionally, as discussed earlier, the FAA will publish guidance providing additional examples and best practices for how to ensure that a small UAS remains in a condition for safe operation.

Several commenters, including NAAA, Reabe Spraying Service, and the University of North Dakota's John D. Odegard School of Aerospace Sciences urged the FAA to include a requirement that remote pilots keep maintenance records. NAAA stated that it disagrees ''with the agency's approach to abandon the aviation industry's longstanding requirement of proper recordkeeping and inspections in favor of accommodation for a new NAS entrant.'' The University of North Dakota's John D. Odegard School of Aerospace Sciences asserted that a review of the aircraft's maintenance history is necessary for a remote pilot to determine that the aircraft is in a safe condition for flight and that all manufacturer-suggested inspections, if any, are complied with. The commenter specifically recommended that, at a minimum, remote pilots be required to keep a permanent record of: (1) Component changes or replacements caused by inflight abnormalities; (2) command and control link frequency changes; (3) ground control station and aircraft software changes; and (4) airframe configuration changes which may affect the handling and performance characteristics of the aircraft.

The Kansas State University UAS Program said the lack of required maintenance documentation will cause significant challenges in determining the causal factors associated with small UAS accidents that are investigated by the FAA and NTSB. The commenter recommended that the records requirement in § 43.9 be applied to small UAS, with any necessary alterations ''to ensure the traceability of maintenance and approval of the aircraft for return to service.''

The Washington State Department of Transportation, Aviation Division said documentation of maintenance should be required for small UAS operated over large assemblies of people, such as professional sporting events, large concerts, and ''similar environments where a safe landing area is likely unavailable.'' NetMoby suggested that operators should be required to log the results of each preflight inspection for inspection by the FAA if needed.

Under Executive Order 12866, the FAA may ''adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.'' Imposing maintenance or preflight-check recordkeeping requirements, such as the ones suggested by the commenters, would likely result in a significant cost because the remote pilot in command would have to create new paperwork every time that he or she conducts a preflight check, or every time that any type of maintenance is conducted on the small UAS. At this time, the FAA does not have data to determine whether the safety benefits of additional documentation would be sufficient to justify this burden, especially in light of the significant safety mitigations already provided by the other provisions of part 107. Accordingly, at this time, the FAA declines to impose the suggested documentation requirements on small UAS operated under this rule.

Boeing asked the FAA to provide a definition for the phrase ''safe operation.'' In the context of preflight check and maintenance requirements, the FAA has concluded that ''safe operation'' pertains to mechanical reliability, and is predicated on overall condition of the entire unmanned aircraft and integral system equipment relative to wear and deterioration. Determinations made of the overall condition of the small UAS includes an evaluation based on the make, model, age, type and completeness of continued maintenance and inspections of the aircraft and associated system equipment making up the entire UAS. Some examples of characteristics that may render a small UAS not in a condition for safe operation are: (1) Unsecure, damaged airframe structures affecting flight characteristics; (2) damaged primary flight control surfaces affecting flight control characteristics; (3) inoperative, intermittent propulsion system components; (4) inoperative, intermittent flight controls; (5) data link equipment failures, *e.g.,* control outputs from ground control station not matching control inputs to aircraft flight controls; and (6) damaged or distorted propeller blades.

The Permanent Editorial Board of the Aviators Model Code of Conduct Initiative stated that the rule should be expanded to require certain operational checks, such as hover-checks for multirotors and rotorcraft, arguing that

such checks serve an important safety purpose.

There is a wide variety of small UAS and many of them use different systems that are constructed and function in different ways. As such, the specific tasks necessary to check whether safety-relevant components are functioning properly will vary between different small UAS. This rule will require the remote pilot in command to check at a minimum the control link and available power to complete the intended flight.[127] However, beyond control link there may be many other systems and equipment, depending on the complexity of the small UAS, that may be necessary for safety of flight. The remote pilot in command will have to check those systems to ensure that they are functioning properly, but the specific tasks necessary to conduct these checks will be determined by the remote pilot so long as the tasks enable him or her to reasonably ascertain whether the pertinent systems are functioning properly.

Several commenters, including Transport Canada, Skycatch, the Kansas State University UAS Program, and Prioria Robotics, stated that the FAA should require that remote pilots employ OEM-provided checklists and manuals when carrying out preflight inspections. The Small UAV Coalition suggested the FAA consider adopting its standard phrase from its section 333 exemptions that the remote pilot ''must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.'' The Professional Helicopter Pilots Association suggested that UAS manufacturers be required to provide ''airworthiness'' checklists. PHPA added that in the absence of a list of requirements, the criteria for a preflight inspection become subjective. ALPA also recommended that manufacturers be required to define parameters for maintenance and inspection. Similarly, Transport Canada asked whether consideration has been given to requiring the UAS operator to either adhere to the manufacturer's maintenance instructions and schedule or, in the alternative, develop and adhere to his or her own maintenance schedule.

DJI noted that it already provides its clients with significant information on how to inspect and maintain DJI's small UAS. Several other commenters addressed the use of manufacturer-developed minimum maintenance standards. NAAA noted that the FAA has not set standards for what manufacturer's instructions for UAS are to contain, and recommended that manufacturers make a manual available for approval by the FAA. A few individual commenters also said manufacturers should provide an operational manual, which they said should also contain a maintenance schedule.

The FAA agrees with commenters that manufacturer-developed manuals, checklists, and instructions can provide excellent guidance about how to maintain a small UAS in a condition for safe operation. As such, the FAA recommends that the remote pilot in command familiarize him or herself with this material and strongly consider using the approach specified in the manufacturer's materials. However, the manufacturer-recommended approach may not be the only way to keep a small UAS in a condition for safe operation. As such, this rule will simply require that the small UAS must be in a condition for safe operation. The specific method by which the small UAS achieves this state will be determined by its owner and the remote pilot in command; this could be the method recommended by the manufacturer or in accordance with a developed maintenance and inspection program that may encompass and exceed the manufacturer's program. The remote pilot in command and/or small UAS owner may also follow the best practices outlined in the guidance provided by the FAA.

The FAA acknowledges the concern raised by commenters that some manufacturer manuals may not provide sufficient guidance for the remote pilot in command to properly inspect the small UAS. However, this rule will not require the remote pilot in command to comply with the manufacturer's manual as part of the preflight check. If the manufacturer's manual provides sufficient guidance and the remote pilot in command determines that this guidance is the best way to conduct the preflight check, the remote pilot can conduct the check according to the manufacturer's instructions. If the manual is deficient or the remote pilot in command determines that a different method of conducting the preflight check is more appropriate, the remote pilot in command will assume the responsibility of making that decision as well.

The FAA notes that, as discussed in section III.F.2.j of this preamble, in order to obtain a remote pilot certificate, an applicant will have to demonstrate that, among other things, he or she has acquired knowledge about how to maintain and inspect a small UAS. Thus, the remote pilot in command will have the knowledge needed to select the best method by which to conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation and the control link is functioning properly.

Several commenters suggested that the FAA should develop—or encourage the development of—universal inspection and maintenance criteria to be used by remote pilots when conducting preflight inspections, or maintaining their aircraft. For example, the Nevada Institute for Autonomous Systems suggested that a preflight inspection would be insufficient to ensure safety in the absence of ''minimum maintenance standards.'' Predesa stated that the FAA should consider publishing its own general guidelines on preflight inspections, including recordkeeping guidelines to track ''major modular replacements of small UAS equipment.'' The Associated General Contractors of America asked the FAA to provide more guidance on ''the scope and nature'' of the required preflight inspections. Specifically, the commenter questioned: (1) Whether the time and effort the agency expects an operator to devote to preflight assessments depends on the size or nature of the aircraft, or the scope, complexity or other specifics of the operation; (2) to what extent the agency will defer to an operator's exercise of his or her judgment; (3) if an operator performs a manufacturer-recommended preflight inspection, whether the FAA will defer to those recommendations; and (4) whether the FAA will defer to any more specific industry standards and whether the agency will go so far as to encourage the development of such standards.

The State of Nevada, the Nevada Institute for Autonomous Systems, and the Nevada FAA-designated UAS Test Site, commenting jointly, recommended that minimum maintenance standards be developed with the help of the future FAA UAS Center of Excellence and the UAS Test Sites. ASTM International pointed out that it has developed approved standards for Maintenance and Continued Airworthiness of Small Unmanned Aircraft Systems (F2909). Predesa said that remote pilots should consider applying the Academy of Model Aeronautics National Model Aircraft Safety Code's ''good general safety practices'' pre-flight checks. Similarly, an individual commenter suggested that the small UAS should be maintained using standards developed

[127] The sufficient-power requirements of this rule are discussed in section III.E.7.c of this preamble.

and approved by a recognized standards development organization.

The FAA agrees that guidelines concerning the preflight check would assist the remote pilot in command with complying with this requirement. As discussed earlier, the FAA plans to issue guidance containing best practices for determining whether a small UAS is in a condition for safe operation. Separately from FAA guidance, other supporting industry guidance also exists that could be utilized by the remote pilot in command. The FAA notes the availability of ASTM standards such as practices for maintenance and continued airworthiness of small UAS, as well as AMA's standards, as additional guidance that may be utilized by the remote pilot in command. The FAA also encourages interested stakeholders to develop additional guidance if they feel that it may provide further assistance to the remote pilot in command.

With regard to the time and effort needed to conduct the preflight check, the FAA notes that this will vary depending on the size and complexity of the aircraft and the types of components used in the small UAS. Larger and complex UAS that have more components will likely take longer to check than simple micro UAS with few components. However, as discussed earlier, the FAA does not anticipate that an experienced remote pilot in command will need more than a few minutes to conduct the preflight check (assuming the preflight check does not reveal any adverse characteristics that render the small UAS not in a condition for safe operation). Repetition of the preflight inspection and checks will enhance the remote pilot's skill and efficiency in completing this requirement.

An individual commenter said the FAA should delete proposed § 107.21(a), which requires an operator to maintain the small UAS in a condition for safe operation, because aircraft maintenance should be the responsibility of the registered owner, and not all operators are the registered owners of the vehicles they operate.

Proposed § 107.21(a) would have required that the small UAS must be maintained in a condition for safe operation while § 107.15(a) would have prohibited the operation of a small UAS unless it is in a condition for safe operation. The FAA agrees that proposed § 107.21(a) is duplicative with § 107.15(a) and as such, § 107.21(a) has been removed from this rule. For ease of readability the FAA has also moved the regulatory text of proposed § 107.21(b), which requires a preflight check to determine whether the small UAS was in a condition for safe operation, into § 107.15(a).

ii. Discontinuing Flight

A small UAS that appears to be in a condition for safe operation during the preflight check may become unsafe for operation during flight. For example, the small unmanned aircraft could sustain damage or partial loss of propulsion during flight rendering that aircraft unsafe for continuing the flight. As such, the NPRM proposed to require the operator to discontinue the flight of the small unmanned aircraft when he or she knows or has reason to know that continuing the flight would pose a hazard to other aircraft, people, or property. For the reasons discussed below, this rule will revise the proposed provision to require the remote pilot in command to discontinue flight if he or she knows or has reason to know that the small UAS is no longer in a condition for safe operation.

Several organizations, including DJI, Predesa, State Farm and the Small UAV Coalition, supported the provision as proposed. On the other hand, the University of North Dakota's John D. Odegard School of Aerospace Sciences and an individual commenter suggested that the term ''hazard'' in this context should be qualified as it is in § 107.19(b), which uses the phrase ''undue hazard.'' These commenters suggested that § 107.15(b) should be amended for consistency, in part, to read ''. . . pose an *undue* hazard to other aircraft, people, or property.'' (Emphasis added).

The FAA agrees with the University of North Dakota and the individual commenter that the term ''hazard'' in proposed § 107.15(b) is inconsistent with the standard of ''undue hazard'' in § 107.19. In considering how to address this issue, the FAA noted that § 107.15(b) is intended to address instances in which a small UAS that is in a condition for safe operation during the preflight check ceases being in a condition for safe operation after flight commences. Accordingly, the FAA has amended § 107.15(b) to reflect the fact that the pertinent standard is ''condition for safe operation'' and not ''hazard.''

AIA suggested that the FAA should define the timing of the discontinuation of flight if the small UAS ceases being in a condition for safe operation. AIA suggested that the requirement should be to terminate flight ''as soon as practicable.'' In response, the FAA notes that, if a small UAS should cease being in a condition for safe operation during flight, the remote pilot in command must immediately discontinue the flight by landing the small unmanned aircraft at the first available location where the landing can be conducted safely.

iii. Control Link Check

Several commenters specifically addressed the proposed requirement to ensure that all links between the control station and the small unmanned aircraft are working properly. DJI and Qualcomm supported the proposed requirement, without further comment. ALPA also supported the proposed requirement, but then recommended an additional requirement to verify the usable range of the transmitter in the control station before a flight. Transport Canada questioned whether the FAA has considered requiring the UAS operator to check for radio interference during the preflight inspection. The NextGen Air Transportation Program at NC State University argued that the proposed requirement should include ''something about spectrum management/approvals.''

This rule will require the remote pilot in command to ensure that all links between the control station and the small unmanned aircraft are working properly. This can be done simply by inputting specific commands into the control station and seeing whether the small unmanned aircraft carries out the pertinent command. The FAA acknowledges the concerns raised by ALPA but the suggested requirements would not be appropriate for all small UAS operations. Specifically, in order to verify the usable range of the control-station transmitter, the remote pilot in command would likely need to fly the small unmanned aircraft to the limits of the radio signal to determine the point at which the signal begins to degrade. Flying a small unmanned aircraft to the point that the control link begins to degrade may pose a heightened risk of loss of positive control, and as such, the FAA will not require the remote pilot in command to conduct this type of testing in this rule.

With regard to radio interference and spectrum management, the FAA notes that the requirement for a preflight control link check is performance-based and already addresses radio interference and spectrum issues. Specifically, under § 107.49(c), a small unmanned aircraft may not be operated in the NAS if the control link between the ground control station and the small unmanned aircraft is not working properly. If radio interference or a spectrum issue results in a control link working improperly, the small UAS operation will be prohibited from commencing until the issue has been resolved and the control link is once again working properly.

b. Airworthiness Directives

The NPRM also proposed to require that small UAS comply with all applicable airworthiness directives. For the reasons discussed below, the FAA will not finalize this proposed requirement in the final rule.

A number of commenters objected to the proposed airworthiness-directives requirement. Aviation Management and two individual commenters stated that the proposed requirement should be removed because part 107 does not contain any airworthiness certification standards. Similarly, Boeing asked for clarification as to what an operator would be required to comply with, since there are no specific airworthiness requirements.

The FAA agrees with commenters that an airworthiness-directive framework may, at this time, not be suitable for part 107 small UAS because of the lack of airworthiness certification requirements in part 107. Accordingly, this rule will not finalize the proposed airworthiness-directive requirement. However, the FAA notes that it is not precluded from taking appropriate action to address unsafe conditions that may be identified in small UAS subject to part 107. Any such actions would be conducted in accordance with the Administrative Procedure Act.

7. Additional Operating Provisions

a. Careless or Reckless Operation

Current FAA regulations (codified in 14 CFR 91.13(a)) prohibit a person from operating an aircraft in a careless or reckless manner so as to endanger the life or property of another. The NPRM proposed to apply similar regulations in § 107.23 to ensure that a small UAS is not operated in a hazardous manner. For the reasons discussed below, the FAA will finalize this provision as proposed in the NPRM.

One commenter stated that § 107.23 must have the same force and effect as 14 CFR 91.13. Two commenters said that ''careless and reckless'' is a vague and subjective standard, with one stating that it is unenforceable unless the FAA describes concretely what constitutes careless or reckless behavior.

Section 107.23(a) will prohibit a person from operating a small UAS in a careless or reckless manner so as to endanger the life or property of another. This provision is derived from a similar prohibition on careless/reckless conduct that currently exists for manned aircraft in § 91.13(a), and as such, the FAA expects that these two provisions will have similar effects.

The determination of whether conduct is careless or reckless is made on a case-by-case basis through NTSB caselaw. The FAA has issued guidance (FAA Order 8900.1, vol. 14, ch. 3, sec. 5) summarizing the pertinent caselaw, which provides illustrative examples of conduct that is considered to be careless or reckless.

One commenter suggested that the FAA should permit local law enforcement authorities to enforce the prohibition against careless or reckless operations. In response, the FAA notes that, as discussed in section III.I of this preamble, the FAA cannot delegate its formal enforcement functions.

One commenter asked the FAA to clarify what evidence would be used to prove that a remote pilot operated in a careless or reckless manner. Another commenter suggested that a flight data recorder be required to facilitate the enforcement of the prohibition against careless or reckless operations.

A flight data recorder requirement would add cost, complexity, and weight to small unmanned aircraft without a corresponding incremental safety benefit. The FAA notes that enforcement of violations will be similar to enforcement conducted for part 91 operations: In addition to conducting routine surveillance of part 107 operations, the FAA will act on reports of violations to conduct further investigations. The FAA relies on many sources to further investigate complaints, such as accounts from witnesses, video, and reports from Federal, State, and local law enforcement agencies.

b. Drug and Alcohol Prohibition

As proposed in the NPRM, this rule will require the remote pilot in command, the person manipulating the flight controls of a small UAS, and the visual observer to comply with the drug and alcohol provisions of 14 CFR 91.17 and § 91.19. Section 91.19 prohibits knowingly carrying narcotic drugs, marijuana, and depressant or stimulant drugs or substances in civil aircraft unless authorized to do so by a Federal or State statute or government agency. Additionally, § 91.17 prohibits a person from acting as a crewmember of a civil aircraft: (1) Within 8 hours after the consumption of any alcoholic beverage; (2) while under the influence of alcohol or any drug that affects the person's faculties in any way contrary to safety; or (3) while having an alcohol concentration of 0.04 or greater in a blood or breath specimen. Under § 91.17, a remote pilot in command, the person manipulating the flight controls of a small UAS (if that person is not the remote pilot in command), and the visual observer must submit to testing to determine alcohol concentration in the blood if there is a suspected violation of law or § 91.17. These tests must be submitted to the FAA if the FAA has a reasonable basis to believe that the person violated § 91.17.

The Small UAV Coalition, the Aviation Division of Washington State Department of Transportation, and three individuals generally supported the provisions related to drugs and alcohol. One commenter asserted that the FAA proposed no requirement about the condition of the operator, such as illness or impairment by drugs or alcohol, and that small UAS remote pilots should be required to self-certify that they are in a condition that enables them to safely operate a small UAS.

The FAA clarifies that this rule does not allow operation of a small UAS if the remote pilot in command, visual observer, or the person manipulating the flight controls of a small UAS is unable to safely operate the small UAS due to drug or alcohol impairment. As discussed previously, this rule will, among other things, require these people to comply with the provisions of § 91.17.

With regard to non-drug or alcohol impairment, such as an illness, the FAA notes that, as discussed in section III.F.2.c of this preamble, a person may not act as a remote pilot in command or visual observer or manipulate the flight controls of a small UAS if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of a small UAS. It is also not necessary to require a self-certification statement prior to every small UAS flight because this requirement is not imposed on manned-aircraft operations by the drug and alcohol provisions of §§ 91.17 and 91.19.

Cherokee Nation Technologies commented that over-the-counter medications could impair the ability to safely operate a small UAS. The FAA agrees with this comment and notes that over-the-counter medications are addressed by the provisions of this rule. Specifically, § 91.17(a)(3) prohibits the use of any drug that affects the person's faculties in any way contrary to safety.

The University of North Dakota's John D. Odegard School of Aerospace Sciences commented that the contents of §§ 91.17 and 91.19, which are cross-referenced in proposed part 107, should be included in their entirety in proposed part 107 to enable ease of reading and understanding the regulations. However, duplicating the entire regulatory text of §§ 91.17 and 91.19 in part 107 is unnecessary in this case. FAA regulations, such as §§ 91.17

and 91.19, may be changed by future rulemakings or statutory changes, and cross-referencing regulatory sections in part 107 will minimize inconsistencies between part 107 and any subsequent amendments made to §§ 91.17 or 91.19. Additionally, cross-referencing regulatory sections allows the FAA to avoid duplicative regulatory text in its regulations.

Two commenters expressed concerns about the potential use of small UAS for drug-smuggling and other illicit acts. The Institute of Makers of Explosives asked that the FAA specify penalties for the use of small UAS in committing illicit acts, including those involving drugs and alcohol. One commenter stated that any remote pilot should lose his or her privileges under part 107 if found to be operating while in a condition that does not permit safe operation of the small UAS. Another commenter suggested that remote pilot certificates should be denied, suspended or revoked for committing an act prohibited by 14 CFR 91.17 or § 91.19.

The FAA emphasizes that, in addition to the requirements of § 91.17 discussed above, this rule will also require compliance with § 91.19, which prohibits the knowing transportation of illegal drugs unless authorized by a Federal or State statute or government agency. If a person violates § 91.17 or § 91.19, the FAA can take enforcement action, which can result in the imposition of civil penalties or suspension or revocation of that person's airman certificate. People who engage in illegal conduct involving drugs may also be subject to criminal prosecution under Federal or State law.

c. Sufficient Power for the Small UAS

For the reasons discussed below, this rule will amend the proposed requirement that, prior to flight, the remote pilot must ensure that the small UAS has sufficient power to operate for its intended operational time and an additional five minutes. After further consideration, the FAA retains the requirement that the small UAS has enough power to operate for its intended operational time, but has eliminated the additional five-minute requirement.

Several commenters, including DJI, ALPA, and Qualcomm, supported the FAA's proposal. On the other hand, the Kansas State University UAS Program, Center for Robot-Assisted Search and Rescue, Consumers Energy Company and an individual generally noted that some UAS have very short battery lives. One commenter asserted that some small UAS have only five minutes of total available flight time. Commenters suggested that a small UAS should simply be required to have enough available power to operate for its intended time and then land safely, which could require significantly less than five minutes of total power.

The FAA concurs with commenters who suggested that a small UAS should be required to have enough available power to operate for its intended operational time and then land safely. As discussed in section III.E.3.a of this preamble, small UAS operations conducted under this rule will operate in a confined area of operation. As a result of this confined area, the prohibition of operations over people, and due to the defined weight of the small unmanned aircraft, small UAS operations conducted under part 107 will generally pose a low risk as compared to manned aircraft. As such, a requirement for an additional five minutes of power is unnecessary. The FAA acknowledges that some small unmanned aircraft flights may be conducted for very short durations at very low altitudes, and the need for a larger battery to provide an additional five-minute power reserve may significantly limit those operations without a corresponding safety benefit.

Several commenters suggested different approaches other than the requirement for five minutes of additional power. Embry-Riddle and several individual commenters generally noted that different small UAS have differing amounts of power and flight time available. These commenters suggested that a requirement that is based on a 10% reserve of power would better accommodate small UAS of differing design, equipment, and performance standards. The Center for Robot-Assisted Search and Rescue suggested that the reserve power requirement be based on the distance needed for the aircraft to return to the remote pilot. An individual commenter noted that gas powered aircraft may need a longer fuel reserve, such as 10 to 15 minutes, to allow for extended emergency flights.

The FAA notes that remote pilots are required under this section to ensure that the small UAS has enough power to operate for its intended operational time. The intended operational time includes all power requirements for the entire flight, including take off and a controlled landing. While the final rule does not prescribe a specific amount of reserve power, the FAA notes that a remote pilot must take into consideration the type of operation being conducted. The remote pilot must ensure that sufficient power is available to complete the intended flight, or terminate the flight early if the remote pilot has reason to believe that the power remaining is insufficient to continue flight. A remote pilot who fails to properly plan for sufficient power may also be in violation of §§ 107.15, 107.23, and 107.49, particularly if insufficient power results in loss of positive control of the small unmanned aircraft.

The reserve power requirement does not need to be based on the distance needed for the small unmanned aircraft to return to the remote pilot because small unmanned aircraft flight can be terminated through a controlled safe landing; the aircraft does not necessarily need to return to its point of origin. A percentage-of-power requirement would also be unduly burdensome, as it would require UAS with greater total power capacity to hold a larger power reserve than a UAS with a lesser power capacity.

DJI, ALPA and QUALCOMM suggested that the FAA require equipment that would accurately display how much battery life remains to the remote pilot. In response, the FAA emphasizes that this rule does not prohibit remote pilots from using the type of equipment suggested by the commenters. However, while equipage may be one way to measure battery life, it is not the only way to measure remaining battery life. For example, prior to flight, a remote pilot could determine the total amount of time that a battery can provide power before it needs to be recharged. Then, during flight, the remote pilot could simply use a watch to determine how much energy is left in the battery. Accordingly, mandating specific equipage displaying how much battery life is left in the small UAS is not necessary in this rule.

F. Remote Pilot Certificate

As discussed in section III.E.1 of this preamble, this rule will create a new small-UAS-specific airman certificate called a remote pilot certificate with a small UAS rating. A person will be required to obtain this airman certificate prior to acting as a remote pilot in command. This rule will also require any person manipulating the flight controls of a small UAS to obtain a remote pilot certificate with a small UAS rating unless: (1) That person is under the direct supervision of a remote pilot in command; and (2) the remote pilot in command has the ability to immediately take direct control of the flight of the small unmanned aircraft. For the reasons discussed in section III.E.1 of this preamble, a UAS-specific airman certificate is preferable in this

rule to one of the existing part 61 pilot certificates because the process for obtaining the remote pilot certificate will focus on UAS-specific areas of knowledge that are typically not included in the requirements associated with current part 61 pilot certificates.

1. Use of UAS Experience To Apply for Part 61 Pilot Certificate

In the NPRM, the FAA emphasized its desire to maintain a distinction between a remote pilot certificate and the airman certificates issued under parts 61, 63, and 65. As such, the NPRM proposed § 61.8, which would prohibit UAS activities conducted under this rule from being used to meet part 61 requirements. Under proposed § 61.8, activities would include any training, certification, or flights associated with small UAS under part 107. The FAA did not receive any adverse comments on this aspect of the proposed rule, and as such, this rule will finalize § 61.8 as proposed.

2. Remote Pilot Certificate Eligibility and Issuance

The NPRM proposed establishing eligibility requirements for a part 107 airman certificate and specifying when a certificate would be issued. The NPRM proposed that an applicant must be: (1) At least 17 years of age; (2) able to read, speak, write and understand the English language; and (3) vetted by the Transportation Security Administration. Additionally, the NPRM proposed that the applicant must pass an initial aeronautical knowledge test and self-certify, at the time of application, that he or she does not have a medical condition that could interfere with the safe operation of a small UAS.

As discussed in more detail below, the process for issuance of a remote pilot certificate will be as follows. First, an applicant will have to take and pass an initial aeronautical knowledge test. After taking the knowledge test, the applicant will be provided with an airman knowledge test report showing his or her test results. If the applicant passed the test, the applicant will then fill out an application for a remote pilot certificate using either the FAA's electronic application process (referred to as the Integrated Airman Certification and Rating Application (IACRA) system) or a paper application. The FAA will then forward the applicant's information to the TSA for security vetting to determine whether the applicant poses a security risk. Once TSA notifies the FAA that the applicant does not pose a security risk the FAA will issue an electronic temporary remote pilot certificate to an applicant who applied through the IACRA system.[128] This temporary certificate (valid for 120 days after receipt) will be issued within 10 business days after receipt of an electronic application, and it will allow the applicant to exercise all the privileges of a remote pilot certificate with a small UAS rating. Once all other FAA-internal processing is complete, the FAA will issue the applicant a permanent remote pilot certificate.

Holders of a part 61 pilot certificate other than student pilot who have completed a flight review within the previous 24 months will have the option of a different certification process. These pilot certificate holders will be allowed to substitute completion of an online training course for the small UAS aeronautical knowledge test. Upon completion of the training course, the part 61 pilot certificate holder will then go to one of the following authorized portals: An FAA Flight Standards District Office (FSDO), a designated pilot examiner (DPE), an airman certification representative (ACR) for a pilot school, or a certificated flight instructor (CFI). The certificate holder will provide his or her remote pilot certificate application and supporting documentation to that portal to verify the applicant's identity, fill out the pertinent portion of the application, and then forward the completed application to the FAA Airman Certification Registry. Because a part 61 pilot certificate holder has already been vetted by TSA, he or she will be issued a temporary remote pilot certificate with a small UAS rating, valid for 120 days, immediately upon the FAA's receipt of the completed application via IACRA. Once all other processing is complete, the FAA will issue a permanent remote pilot certificate.

The FAA emphasizes that part 61 pilot certificate holders are not required to use the process discussed in the previous paragraph and can instead apply for a remote pilot certificate by taking the small UAS initial aeronautical knowledge test. Part 61 pilot certificate holders who pass the knowledge test will not be required to submit their application to a FSDO, DPE, ACR, or CFI. Instead these certificate holders may submit their applications via IACRA. Because these certificate holders have already been vetted by TSA, they will be issued a temporary remote pilot certificate, valid for 120 days, upon FAA's receipt of their application via IACRA regardless of the method they use to qualify for the certificate (*i.e.* knowledge test or online training course).

a. Minimum Age

The NPRM proposed that a person must be at least 17 years of age to be eligible for a remote pilot airman certificate with a small UAS rating. This minimum age would be consistent with existing FAA minimum age requirements for the sport pilot, recreational pilot, and private pilot airman certificates with an airplane or rotorcraft rating. The FAA also invited comment on whether to adopt a minimum age of 16 years, which would be consistent with existing FAA minimum age requirements for the sport pilot and private pilot airman certificates with a glider or balloon rating. After review of the comments, the FAA adopts a minimum age of 16 for a person to be eligible for a remote pilot certificate with a small UAS rating.

Fourteen commenters, including the Small UAV Coalition, AUVSI, and NAMIC, all agreed that the proposed minimum age of 17 generally strikes an appropriate balance between safety and operational viability for low risk small UAS operations, ensuring that baseline safety is enhanced without unduly burdening low risk small UAS operators or their operations. These commenters argued that the NPRM's proposal is consistent with the requirements for other pilot certificates and, at this time, there is a lack of data and evidence to support lowering the age to 16. The commenters added that although persons under the age of 17 are already allowed to operate model aircraft, it is unclear if there is a strong need for allowing younger remote pilots to operate non-hobby and non-recreational small UAS.

University of North Dakota's John D. Odegard School of Aerospace Sciences added that 16-year-old student pilots are accompanied or monitored by an instructor, whereas, a small UAS operator would effectively be unmonitored. Federal Airways & Airspace also agreed with limiting the certification age to 17 years old, and pointed out that the National Institute of Mental Health has stated on their Web site that the rate of death by any injury of those aged 15 to 19 years old is six times higher than that for individuals aged 10 to 14 years old. Federal Airways & Airspace also mentioned that studies have shown that the human brain does not reach maturity until the early 20s, and the CDC states that those aged 16 to 19 are almost three times more likely

[128] Because the temporary certificates will be issued electronically, the FAA will be unable to issue them to applicants who did not apply through electronic means.

than 20-year-olds to be in a fatal motor vehicle accident.

Several commenters recommended raising the minimum age above 17. Commenters including the General Aviation Manufacturers Association (GAMA), Textron Systems, and Aerius Flight, recommended an 18-year-old eligibility requirement for small UAS operators, because it aligns with existing airman certification standards for other commercial flight operations. One commenter asserted that 18 is the appropriate age for an operator certificate because it is the age at which an individual is an adult and able to enter into legally binding contracts. The Air Line Pilots Association and Transportation Trades Department, AFL–CIO said small UAS operators should hold a commercial pilot certificate, and should therefore be a minimum of 18 years old. Several commenters recommended the minimum age requirement be raised even higher, to 21 or 25 years old.

Conversely, 36 commenters, including NBAA, AIA, and the Kansas Farm Bureau, argued that the minimum age should be lowered to 16. One commenter asserted that: (1) Flying a manned aircraft is considerably more complex than operating a small UAS; and (2) a small UAS has no people on board who would be injured in the event of an accident. Many other individuals argued that because of all the operating constraints contemplated by the NPRM, a 16-year-old should be able to safely operate a small UAS without exposing anyone to undue risk.

Nine commenters asserted that a minimum age of 16 would also align with current requirements for glider and balloon pilots. One commenter argued that the NPRM does not provide any justification to support why the operator of a small UAS must be older than a sport pilot, recreational pilot, or private pilot airman with a glider rating,[129] or a student pilot of a glider.[130] NBAA stated its belief that a lesser risk exists for small UAS operations conducted within the confines of the rule when compared to glider and balloon operations conducted within controlled airspace.

One of the commenters from the Center for Information & Research on Civic Learning and Engagement (CIRCLE) argued that the minimum age should be dropped to 16. The commenter conducted research that it claimed supports the proposition that 16-year-olds have the same capacity for sophistication as 21-year-olds. Although the research is geared towards younger individuals voting in local elections, not operating aircraft, the commenter believed that it makes a general statement about the intellectual capacity of minors at the age of 16.

Prioria Robotics argued that the FAA should allow an apprenticeship-like certificate to be held by those younger than 18. Others argued that the minimum age for independent operation of a small UAS should be 16. One individual suggested that if the operator is under the age of 16, he or she should be required to be accompanied by a qualified operator who is over the age of 18.

The Washington State Department of Transportation, Aviation Division suggested that, with regard to minimum age, in many cases the maturity level difference of an operator between ages 16 and 18 may be imperceptible. This commenter suggested lowering the minimum age to 16 would rule out the likelihood of willful underage violation and provide a legal path forward for younger operators. The commenter also pointed out that in many states a driver's permit can be obtained at age 15 and driver's license at age 16.

The Kansas Farm Bureau also argued that the added year available for academic use, education, and experience are positives for future UAS operators. DJI similarly noted that a lower age limit could increase academic use of small UAS because more high school age students could be operators. Also, commenters argued that a high age limit would inhibit curiosity and innovation among younger people who are exploring the capabilities of UAS.

The Colorado Cattlemen's Association did not object to the proposed minimum age requirement, but noted potential value in reducing the minimum age to 16 years old. The commenter noted that, while this approach would be a slight deviation from the current age requirement for non-commercial airman certificates, it would be consistent with the recognized lower risk associated with small UAS operations. The commenter also noted it would accommodate UAS operations for those beef producers who run family operations, many of which include older teenagers.

The FAA agrees that a certain level of maturity is required to operate any aircraft responsibly in the NAS. The FAA originally proposed a minimum age of 17 because it is consistent with existing FAA minimum age requirements for the sport pilot, recreational pilot, and private pilot airman certificates with an airplane or rotorcraft rating—the base-level certificates authorizing pilots to operate these two categories of aircraft while not under the supervision of an instructor. However, the FAA does not use a minimum age of 17 for all part 61 pilot certificates. As noted in the NPRM and by the commenters, the proposed minimum age of 17 is not consistent with existing FAA minimum age eligibility requirements for sport and private pilot airman certificates with a glider or balloon rating.

After further consideration, the FAA has determined that the risk posed by a small UAS operation is comparable to the risk posed by a glider or balloon operation. Balloon and glider operations generally take place during daytime visual meteorological conditions and are limited to a relatively confined geographical area. Balloon and glider aircraft also tend to be lighter and slower-moving aircraft, limiting the harm to people and property on the ground in the event of a mishap. Similarly, small UAS operations do not take place at night or in instrument meteorological conditions, and are operated in a limited geographical area as necessary for the remote pilot to maintain visual line of sight. Analysis of safety data for balloon and glider operations suggests that there is no significant difference in accident rates for 16-year-old pilots compared to 17- or 18-year-old pilots. Because the risk of a part 107 small UAS operation is comparable to the risk of a balloon or glider operation and because the minimum age for glider and balloon operations is 16,[131] the FAA will lower the minimum age in this rule to 16 years old.

The FAA also notes that a minimum age of 16 is consistent with its current practice of allowing airmen conducting a small UAS operation under a section 333 exemption to hold a sport or private pilot certificate with a glider or balloon rating. Although the FAA does not track the age of persons operating small unmanned aircraft under section 333 exemption grants, the agency is not aware of any specific safety concerns associated with 16-year-old private pilots or sport pilots operating small UAS. The FAA notes that lowering the minimum age to 16 will also enable additional small UAS agricultural operations, such as those described by the Colorado Cattlemen's Association.

Several commenters, including AIA, the Virginia Commonwealth University Honors Students, and the New Jersey Institute of Technology suggested that the minimum age should be no greater than 16. As noted in AIA comments,

[129] *See* 14 CFR 61.103(a).

[130] *See* 14 CFR 61.83(b).

[131] 14 CFR 61.103(b) and § 61.305(a)(1).

AIA and others believe that a driver's license issued from within the U.S. should be considered as a prerequisite for a remote pilot certificate. The commenters recommended mimicking the process to obtain a driver's license, in which a person first obtains a learner's permit and then, following months of training and test-taking, obtains a license. This would enable 16-year-olds (depending on their State of residence) to obtain a certificate. According to the commenters, maintaining currency of the driver's license would also imply certain motor skills, vision, and a minimal level of medical fitness to operate UAS.

Several individual commenters said the minimum age should be lowered even further to 14 years old. The commenters pointed out that 14-year-olds are capable of having certain after-school jobs, and are allowed to operate a glider or balloon as a student pilot. Event 38 Unmanned Systems said that it sees no logical reason for a minimum age requirement, and that anyone who can pass the operator test should be allowed to fly a UAS. Two other commenters also said there should be no minimum age requirement.

The FAA disagrees with commenters who suggest that the minimum age be less than 16 because age 16 is the youngest age at which a person can be certificated to operate an aircraft independently in the NAS. Because a remote pilot certificate allows people to operate their small UAS independently, it is critical that those people possess the maturity necessary to operate in a safe manner. The FAA also disagrees with commenters who provided the example of a driver's license and a learner's permit as a justification for lowering the minimum age below 16. In most states, the driving privileges of people under the age of 16 are significantly limited compared to the privileges granted at age 18. According to the Governors Highway Safety Association, most states do not permit full driving privileges until 17 or 18 years of age. These privileges include high-risk situations such as the ability to drive unsupervised at night or with a certain number of passengers.[132]

The FAA also notes that driving a car does not use the same skills as operating a small UAS. For example, in order to successfully drive a car, drivers have to learn skills, such as parallel parking and making three-point turns, which have no applicability to small UAS operations. Requiring a U.S. driver's license as a prerequisite to obtaining a remote pilot certificate would impose the cost of acquiring those skills on people who do not currently possess a driver's license without a corresponding safety benefit. Accordingly, this rule will not require remote pilot certificate applicants to hold a driver's license.

In response to commenters who recommended a lower minimum age to enable academic uses, or the suggestion for an apprenticeship-like certificate for those under 18 years of age, the FAA notes that this is unnecessary because this rule allows an uncertificated person to manipulate the controls of a small UAS, provided that: (1) They are under the direct supervision of a certificated remote pilot in command; and (2) the remote pilot in command is capable of taking over controls at any time during the flight. The FAA also notes that, depending on the purpose of the operation, small UAS operations conducted by community groups and non-profit organizations may be considered recreation or hobby operations, which are not regulated under part 107 if conducted in accordance with Public Law 112–95, section 336.[133]

The Agricultural Technology Alliance, Illinois Farm Bureau, and GROWMARK suggested that the FAA treat age eligibility to operate a small UAS in the same manner as the operation of farm equipment—*i.e.,* allowing individual State labor laws to control. Though it did not explicitly advocate for the use of State labor laws to determine eligibility, Predesa pointed out that child labor laws would apply to minors participating in commercial operations. The commenter recommended the FAA consider mandating an adult visual observer to assist a minor with an operator certificate when operating a small UAS for commercial purposes. The commenter also recommended that the FAA consider mandating an adult visual observer to assist a minor with an operator certificate when operating a small UAS for education in a private program for fee, in a university setting, or in a public school system.

The FAA does not agree with the recommendation to adopt State labor laws to set the minimum age requirement. State laws are not uniform, and this could result in a patchwork of regulations that would apply uneven requirements depending on one's State of residence. The FAA also notes that not all operations conducted under part 107 will be commercial. For example, as discussed in section III.C.4 of this preamble, recreational small UAS operations that do not meet all of the criteria specified in Public Law 112–95, section 336 will be conducted under part 107.

The FAA disagrees with Predessa's suggestion that an adult visual observer should be mandated in order to assist a minor with a remote pilot certificate (*i.e.* someone between 16 and 18 years of age) when operating a small UAS. As discussed previously, the FAA currently allows 16-year-old pilots to operate, without supervision, glider and balloon manned aircraft and small UAS (under a section 333 exemption). The FAA has not observed an adverse effect on safety as a result of the pilot in those operations being 16 rather than 18 years old. Thus, while the FAA agrees that a visual observer enhances safety by providing additional situational awareness to the remote pilot, it is not necessary to mandate a visual observer based on the age of the remote pilot certificate holder or the type of operation being conducted.

Accordingly, the FAA has amended proposed § 107.61(a) to lower the minimum age to be eligible for a remote pilot certificate with a small UAS rating to 16 years old. The FAA notes, however, that an academic institution is permitted to establish its own (more restrictive) policies and procedures for operational small UAS training, which may include requiring the presence of adult visual observers for students who are younger than 18.

b. English Language Proficiency

In the NPRM, the FAA proposed to require that applicants for a part 107 airman certificate be able to read, speak, and understand the English language. These proposed English-language requirements would be consistent with all other airman certificates issued by the FAA, as well as the international standard for aircraft operations accepted by ICAO. However, the FAA also proposed an exception for people who are unable to meet one of the English-language requirements due to medical reasons. Such a person would be eligible for a certificate, but the FAA would be able to specify limitations on the certificate to account for that person's medical condition.

Five commenters expressed support for requiring airman-certificate applicants to be able to read, speak, and understand the English language. There were no comments opposing this aspect of the proposal. Accordingly, this rule will require that applicants for an airman certificate be able to read, speak, and understand the English language.

[132] *http://www.ghsa.org/html/stateinfo/laws/license_laws.html*

[133] Section III.C.4 of this preamble contains further discussion of model aircraft operations.

Three commenters opposed the proposed exception to the English-language requirements. One of these commenters stated that there should be no exceptions to the English-language requirement, while another commenter stated that there should be no exception for persons whose medical reasons would preclude them from effectively communicating procedures or reading flight logs. A third commenter stated that a person who cannot speak English should not be permitted to operate anywhere near people on the ground because that person would be unable to communicate safety-relevant information to people in the vicinity of the operation.

Limiting the exception for the English-language requirements of this rule would impose a needless burden on airman-certificate applicants who have a medical condition. Specifically, if an applicant cannot read, speak, or understand the English language, the proposed exception would allow the FAA to impose restrictions on that applicant's certificate ensuring that the person's English-language inability does not adversely affect safety. For example, if an applicant is unable to communicate using speech, then the FAA may restrict that applicant's certificate to operations where speech is not necessary for the safe operation of a small UAS.

Restrictions issued under this provision will be specific to each applicant, and as such, the FAA cannot make the categorical statements suggested by the commenters as to what will or will not be permitted for applicants with a specific English-language inability. The FAA notes that its English-language regulations for other airman certificates have a similar exception for applicants who have a medical issue,[134] and the FAA has not observed any adverse safety effects from having this exception in the regulations.

Accordingly, this final rule will retain the proposed exception for people who are unable to meet one of the English language requirements due to a medical condition. 14 CFR 107.61(b). However, the FAA emphasizes that, as with other airmen, it may specify limitations on a person's airman certificate to ensure that the person's medical condition does not endanger the safety of the NAS.

c. No Airman Medical Certificate Required

For the reasons discussed below, this rule will not require an airman medical certificate but will prohibit a person from manipulating the flight controls of a small UAS or acting as a remote pilot in command or visual observer if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of a small UAS.

The FAA received approximately 115 comments from organizations and individuals on this subject. Several commenters stated than an airman medical certificate is not necessary to operate a UAS. Other commenters suggested adding a requirement for an airman medical certificate.

The FAA disagrees that a medical certificate should be required in this rule. With certain exceptions, the FAA currently requires an airman medical certificate for exercising the privileges of a student pilot certificate, a recreational pilot certificate, a private pilot certificate, a commercial pilot certificate, and an airline transport pilot certificate.[135] The primary reason for medical certification is to determine if the airman has a medical condition that is likely to manifest as subtle or sudden incapacitation that could cause a pilot to lose control of the aircraft, or impair the pilot's ability to ''see and avoid.''

Small UAS operations present a lower risk than manned operations to manned aircraft and non-participating people on the ground, especially because the operations do not involve any human beings onboard the aircraft who could be injured in the event of an accident. Additionally, unlike manned-aircraft operations, remote pilots and visual observers will be operating within a confined area of operation, subject to operational limitations intended to minimize the exposure of the small unmanned aircraft to manned aircraft in flight and people on the ground. Because of these operational limitations, traditional FAA medical certification is not warranted for remote pilots or visual observers.

The FAA also notes that the risks associated with pilot incapacitation are similar to the risks associated with loss of positive control. As discussed in that section, risks associated with loss of positive control are mitigated in this rule through: (1) Preflight inspection of the control links, (2) a speed limit of 87 knots, and (3) a prohibition on operations of small unmanned aircraft over people not directly participating in the operation. Just as § 107.49(a)(3) will require remote pilots to ensure that all links between ground station and the small unmanned aircraft are working properly, § 107.17 will require the remote pilot in command to abstain from small UAS operations if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of the flight.

Federal Airways & Airspace, ALPA, and several individual commenters expressed concern about the lack of a required vision exam. General Aviation Manufacturers Association and Aerospace Industries Association suggested that remote pilots hold a valid U.S. driver's license to ensure a basic eye exam.

The FAA considers the visual-line-of-sight requirement for the remote pilot, the person manipulating the flight controls of the small UAS (if that person is not the remote pilot), and the visual observer (if one is used) to be able to see the aircraft's direction, altitude, and attitude of flight to be preferable to a prescriptive vision standard. Even with normal vision, it is foreseeable that a small unmanned aircraft may be so small that the operational space must be reduced to meet the visual-line-of-sight requirements of § 107.31. Therefore, any demonstration of completing a vision exam would be less effective than this rule's visual-line-of-sight requirements, and as such, the FAA will not adopt a vision exam requirement in the final rule.

The FAA also disagrees with comments suggesting the FAA require a U.S. driver's license. According to the DOT Office of Highway Policy Information, 13 percent of the population aged 16 or older does not hold a state-issued driver's license.[136] As such, requiring a U.S. driver's license would create an undue burden for many remote pilots without an equivalent increase in safety because the skills necessary to obtain a driver's license are not the same as the skills needed to pilot a small UAS. Further, the FAA has historically allowed pilots of gliders and balloons to exercise the privileges of their pilot certificates without requiring a medical certificate or U.S. driver's license, and this practice has resulted in no adverse effects on the NAS.

The Golden Gate Bridge, Highway and Transportation District supported the proposed requirement to disqualify persons with known physical or mental conditions that could interfere with the safe operation of the aircraft. Conversely, DronSystems commented that it would be impossible to enforce a prohibition on operations if an operator knows he or she has a medical

[134] *See, e.g.,* 14 CFR 61.83(c).

[135] 14 CFR 61.23(a).

[136] *See https://www.fhwa.dot.gov/policyinformation/pubs/hf/pl11028/chapter4.cfm* (stating that 87% of the population holds a driver's license).

condition that could interfere with the safe operation of the small UAS.

The FAA notes that a similar regulatory provision already exists in part 61. Under § 61.53, a pilot certificate holder is obligated to abstain from acting as pilot in command during a period of medical deficiency. The requirement of § 61.53 applies regardless of whether or not a pilot certificate holder also holds a medical certificate.

One individual suggested that the FAA provide a list of disqualifying medical conditions.

The FAA has not established a list of disqualifying medical conditions under § 107.17 because there are a wide range of small UAS operations that could be affected differently by different medical conditions. For example, a person who is incapable of moving his fingers would not be able to safely operate a small UAS whose control station interface is manually manipulated with the fingers. However, that person may be able to safely operate a small UAS whose control station is operated through voice controls.

A person participating in a small UAS operation is responsible for knowing his or her physical and mental limitations and evaluating whether those limitations would allow him or her to safely participate in the specific small UAS operation that he or she is considering. If that person is unsure as to the limitations of his or her physical or mental condition, he or she should consult with a physician. The FAA emphasizes that those with a medical history or who are experiencing medical symptoms that would prevent them from safely participating in a small UAS operation or that raise a reasonable concern cannot claim to have no known medical conditions.

One commenter stated that residents of Alaska have a disproportionately high rate of ''seasonal bipolar disorder'' or ''polar night-induced solipsism syndrome,'' and that Alaskans might therefore be disproportionately affected by this provision. This commenter suggests that the FAA remove ''bipolar disorder—or at the least bipolar disorder and related conditions 'with seasonal pattern'—from the list of mental conditions which may prevent someone from being able to operate'' a small UAS.

The FAA notes that the commenter is referring to a list of medical conditions enumerated in § 67.107(a)(3), § 67.207(a)(3), and § 67.307(a)(3), referring to a candidate for a first, second, or third class medical certificate to have no established medical history or clinical diagnosis of a bipolar disorder. However, as discussed previously, part 107 does not include a list of disqualifying medical conditions. A person with bipolar disorder would violate § 107.17 only if his or her bipolar disorder was such that it would interfere with the safe operation of a small UAS.

The FAA also notes that in the NPRM it proposed to require that an applicant for an airman certificate must submit a certified statement attesting to his or her physical and mental condition at the time of the application. However, upon further review, the FAA has decided to remove this provision from the rule because an applicant's medical condition at the time he or she submits his or her application for a remote pilot certificate may change prior to operation of the small UAS.

d. Flight Proficiency and Aeronautical Experience

Because of the significantly reduced risk associated with small UAS operations conducted under part 107, the NPRM proposed to not impose flight proficiency or aeronautical experience requirements on applicants seeking a small UAS airman certificate. However, the FAA invited comments on whether flight proficiency or aeronautical experience should be required. For the reasons discussed below, this rule will not require applicants for a remote pilot certificate with a small UAS rating to demonstrate flight proficiency or aeronautical experience.

Several commenters, including NBAA, Colorado Cattlemen's Association, and NetMoby, agreed with the NPRM that the FAA should not require small UAS operators to demonstrate their proficiency in operating a small UAS prior to obtaining an operator certificate. These commenters reasoned that requiring a proficiency test is unnecessary because small UAS are not very difficult to operate and the test could be cost prohibitive for some operators. NetMoby added that there will be a market incentive for manufacturers to ensure that future operators are capable of flying their UAS.

Other commenters, including the AFL–CIO, AIA, and NAAA, disagreed with the proposal and suggested that the FAA require small UAS operators to demonstrate their proficiency in operating a small UAS prior to obtaining a remote pilot certificate. Some of the commenters asserted that this would be consistent with testing requirements used for part 61 pilot certificates.

Aviation Management and Modovolate Aviation suggested requiring a practical test or demonstration of aeronautical knowledge for certain aircraft or flying conditions (*e.g.,* those weighing more than 4.4 pounds, operation beyond visual line-of-sight), but not for others (*e.g.,* micro UAS, operation in only Class G airspace). Virginia Commonwealth University Honors Students suggested that separate tests should be required for each type of small UAS.

As discussed in section III.E.3.a of this preamble, small UAS operations conducted under this rule will operate in a confined area of operation. As a result of this confined area and due to the very low weight of the small unmanned aircraft, small UAS operations conducted under part 107 will generally pose a very low risk as compared to manned aircraft. As such, flight proficiency and aeronautical experience requirements (which apply to part 61 pilots) are unnecessary for remote pilots of a small UAS.

Flight proficiency testing is also not necessary for small UAS operations because, unlike a manned aircraft pilot, the remote pilot of a small UAS can easily terminate flight at any point. The light weight and lack of people onboard the small unmanned aircraft provides the remote pilot of that aircraft with a multitude of safe landing options. The remote pilot also has the option to sacrifice the small unmanned aircraft because there are no people onboard who would be endangered by that action. Conversely, a manned aircraft can only land at a location that can safely accommodate its large weight. The landing of a manned aircraft must also be accomplished in a manner that does not endanger the people onboard the aircraft. Because of the ease with which the flight of a small unmanned aircraft can be terminated and because of the overall low risk posed by small UAS operations that will be conducted under part 107, this rule will not include practical testing or flight experience requirements for a remote pilot certificate.

The FAA notes, however, that certain operational restrictions of part 107, such as operations within visual line of sight, are waivable if the applicant can demonstrate that his or her operation can safely be conducted under the terms of a certificate of waiver. In processing a waiver, the FAA may request additional mitigations, such as a demonstration of remote pilot proficiency, to ensure that the operation can be conducted safely.

The Nez Perce Tribe requested that the FAA provide additional flexibility to small UAS operators by allowing them to qualify for an operator certificate

either via a written test, a practical test, or a demonstration of aeronautical experience. In response, the FAA notes that practical testing, aeronautical experience, and knowledge testing measure different things. Knowledge testing determines whether an applicant has acquired proficiency in the areas of knowledge being tested. Practical testing and aeronautical experience determines the applicant's flight proficiency. Although practical testing and aeronautical experience may be used to assess some level of a person's knowledge, the aeronautical knowledge test is the method used to directly assess an applicant's knowledge. In this case, the FAA has determined that a remote pilot needs to have acquired the knowledge needed to safely operate a small UAS because small UAS operations will generally pose a very low risk as compared to manned aircraft. Thus, an aeronautical knowledge test is the appropriate vehicle to determine whether an applicant for a remote pilot certificate has acquired the necessary knowledge.

e. Formal Training

The NPRM did not propose to require formal training, but it invited comment on whether passage of an FAA-approved training course should be required either instead of or in addition to the aeronautical knowledge test. After reviewing the comments, the FAA has determined that it will not impose any specific training or flight instruction requirements for small UAS remote pilot certificate applicants.

Many commenters, including NAFI, NAAA, and A4A, stated that the FAA should require individuals to attend a training course before obtaining a small UAS operator certificate. NAFI asserted that an applicant may be able to pass an initial knowledge test through rote memorization and retain little useful information or application after passing the knowledge test. According to NAFI, the present FAA test management systems do not allow for the robust, multi-version testing that is truly able to test to the application level of learning. Commenters argued that training should encompass various topics and forms such as scenarios, multi-rotor aircraft, educational contact time from a flight instructor, and simulations.

Conversely, National Roofing Contractors Association, NBAA, Southern Company, Aerospace Industries Association, and Nez Perce Tribe argued that the FAA should not require a training course. Aviation Management suggested that the FAA make informational and training materials available online and also create online training programs, but should not require training courses. National Roofing Contractors Association, NRECA, and Team Rubicon suggested allowing industries to have tailored certification processes or training specific to their needs, or to allow agencies and organizations to conduct tailored in-house training.

The FAA took a risk-based approach to defining the airman certification requirements for small UAS remote pilots, and in light of the contained nature of operations, opted not to propose specific training, flight experience, or demonstration of proficiency in order to be eligible for a certificate. A remote pilot certificate applicant's knowledge of small UAS, as well as regulations concerning safe operations in the NAS, can adequately be evaluated through an initial and recurrent knowledge tests. A person who has acquired the pertinent knowledge will pass the knowledge tests while a person who has not done so will fail the test.

In response to commenters' concerns about rote memorization, the FAA notes that in addition to passing the initial knowledge test, remote pilot certificate holders will also have to pass a recurrent knowledge test every two years to ensure that they have retained the knowledge necessary to safely operate in the NAS. Further, remote pilot certificate holders will also be subject to continuing FAA oversight. The FAA emphasizes that under 49 U.S.C. 44709 and § 107.7(b), the FAA may reexamine a certificated remote pilot if it has sufficient reason to believe that the remote pilot may not be qualified to exercise the privileges of his or her certificate.[137] Because the qualification framework for the remote pilot certificate is based on aeronautical knowledge, a reexamination under section 44709 and § 107.7(b) would be limited to the certificate holder's aeronautical knowledge. The reexamination may be conducted using an oral or written knowledge test.

A prescriptive formal training requirement is not necessary in this rule. Instead, this rule will allow remote pilot certificate applicants to attain the necessary aeronautical knowledge through any number of different methods, including self-study, enrolling in a training seminar or online course, or through one-on-one instruction with a trainer familiar with small UAS operations and part 107. This performance-based approach is preferable because it will allow individuals to select a method of study that works best for them. These methods of study will then be validated by whether or not the individual is able to pass the knowledge test. As noted in OMB Circular A–4, performance-based standards are generally preferable in a regulation because they allow the regulated parties ''to choose the most cost-effective methods for achieving the regulatory goal and create an incentive for innovative solutions.'' [138]

The FAA will publish Advisory Circulars to assist remote pilots in operating small UAS safely in the NAS. The FAA Safety Team (FAASTeam) will also host online training courses. These training courses could be used as one method of studying for the knowledge test. Lastly, because there is already a robust network of nearly 700 testing centers located throughout the country set up to administer FAA knowledge tests, the FAA has opted not to establish new standards for small UAS remote pilot testing centers.

f. General Requirement for Initial Aeronautical Knowledge Test

The NPRM proposed requiring applicants for a remote pilot airman certificate with a small UAS rating to pass an initial aeronautical knowledge test to demonstrate that they have sufficient aeronautical knowledge to safely operate a small UAS. The FAA adopts the provisions as proposed with three changes. First, as discussed in III.F.2.i below, the FAA exempts part 61 pilot certificate holders from the requirement to complete an initial knowledge test as long as they satisfy the flight review requirements of their part 61 pilot certificate and complete an online training course within the preceding 24 months. Second, as discussed in III.F.2.h below, the FAA will require that pilots with military experience operating unmanned aircraft pass an initial knowledge test in order to obtain a remote pilot certificate with small UAS rating, and pass a recurrent knowledge test every 24 months subsequent in order to continue to exercise the privileges of that certificate.

Many commenters, including National Association of State Aviation Officials, NAAA, ALPA, and NAMIC, supported the FAA's proposal to require an initial aeronautical knowledge test in order to operate a small UAS. Conversely, several commenters opposed the initial aeronautical knowledge test. Commenters argued that initial testing is ''overkill'' and the FAA should treat small UAS pilots like part

[137] *See* FAA Order 8900.1, ch. 7, sec. 1 (providing guidance with regard to how the FAA exercises its reexamination authority).

[138] OMB Circular A–4 at 6.

103 ultralight vehicle pilots and not require airman certification or testing. The commenters further argued that all testing is unnecessary and inappropriate.

The FAA disagrees with the commenters who asked that the knowledge test be abolished. Title 49 U.S.C. 44703 requires the FAA to ensure that an airman certificate applicant is qualified and able to perform the duties related to the position to be authorized by the certificate.

Here, in order to meet its statutory obligation to determine that an applicant for a remote pilot certificate possesses the knowledge necessary to safely operate in the NAS, the FAA is requiring that those persons pass an initial aeronautical knowledge test. Knowledge testing is the most flexible and efficient means for ensuring that a remote pilot possesses the requisite knowledge to operate in the NAS because it allows the applicant to acquire the pertinent knowledge in whatever manner works best for him or her. The applicant can then take and pass the aeronautical knowledge test to verify that he or she has indeed acquired the pertinent areas of knowledge.

NAFI recommended that an applicant should be required to obtain an instructor endorsement to take the initial aeronautical knowledge test. SkyView Strategies suggested that to protect the public from a poorly prepared UAS operator who receives a passing grade but gets important questions wrong, the UAS operator should be required to present to a flight training instructor his or her written test results, noting areas where knowledge is lacking.

The FAA disagrees with the recommendation that an applicant should be required to obtain an instructor endorsement to take the initial aeronautical knowledge test. While an instructor endorsement is generally required for part 61 pilot certificates, the significantly reduced risk associated with small UAS operations conducted under part 107 would make this framework unduly burdensome in this case. Instead, a stand-alone knowledge test is sufficient to verify the qualification of the remote pilot certificate applicant.

Because the aeronautical knowledge test will determine whether an applicant possesses the knowledge needed to safely operate a small UAS, a separate flight instructor endorsement should not be required to take the knowledge test. The FAA also notes that the costs associated with failing and having to retake the knowledge test will provide an incentive to applicants to pick a method of study that maximizes the chance of them passing the aeronautical knowledge test on the first try.

The FAA also does not agree that a certificate applicant should be required to present to a flight instructor his or her knowledge test results for remedial training. The FAA maintains that if a candidate is ''poorly prepared,'' then that person is unlikely to pass the knowledge test.

The University of Arkansas Division of Agriculture suggested that a more appropriate ''aeronautical knowledge exam'' needs to be developed with input from UAS users. It further suggested that the FAA should periodically revisit the scope of the aeronautical knowledge test as operational experience data increases.

FAA knowledge test banks are continuously updated to address changes to the industry, safety, and special emphasis areas. While the FAA responds to industry and user community feedback, the small UAS knowledge test bank is developed internally within the agency to protect the integrity of test.

g. General Requirement for Recurrent Aeronautical Knowledge Test

The FAA proposed that a certificated remote pilot must also pass a recurrent aeronautical knowledge test every 24 months. Like the flight review requirement specified in § 61.56, the recurrent knowledge test provides the opportunity for a remote pilot's aeronautical knowledge to be reevaluated on a periodic basis. The FAA adopts this provision as proposed, with one change. As discussed in III.F.2.i, the FAA exempts part 61 pilot certificate holders from the requirement to complete recurrent knowledge tests as long as they satisfy the flight review requirements of § 61.56 and complete an online training course every 24 months.

ALPA, AOPA, AUVSI and several other commenters supported the requirement for a recurrent knowledge test. Conversely, Colorado Cattlemen's Association and a few individual commenters argued that a recurrent knowledge test is unnecessary. The Colorado Cattlemen's Association explained that small UAS operations present a substantially reduced risk as compared to manned-aircraft operations. Therefore, the commenter argued, it is appropriate to impose different, and in some instances lesser, operational requirements.

The FAA disagrees with the notion that no periodic reevaluation of knowledge is necessary. Knowledge of rules, regulations, and operating principles erodes over time, particularly if the remote pilot is not required to recall such information on a frequent basis. This is a fundamental principle of airman certification, and it applies to all FAA-certificated airmen. For part 61 pilot certificate holders, the flight review, conducted under § 61.56, specifically requires ''[a] review of the current general operating and flight rules of part 91'' in addition to maneuvers necessary to safely exercise the privileges of the certificate. Likewise, the FAA considers a recurrent knowledge test to be an effective means of evaluating a remote pilot's retention of knowledge necessary to safely operate small unmanned aircraft in the NAS. Because of the reduced risk posed by small UAS, the FAA is not requiring remote pilots to demonstrate a minimum level of flight proficiency to a specific standard or recency of flight experience in order to exercise the privileges of their airman certificate.

Drone Labs suggested extending the time period between recurrent tests to 5 years, and/or making the test available online to ease recertification. Kansas Farm Bureau recommended a 6-year interval between recurrent tests, similar to the interval for renewal of a driver's license.

The FAA does not agree that the recurrent testing interval should be longer than two years. Unlike the privileges afforded by a driver's license, which are exercised on a frequent basis by most drivers, many holders of remote pilot certificates may only exercise their privileges occasionally or may not regularly conduct operations that apply all of the concepts tested on the aeronautical knowledge test. For example, a remote pilot in command may spend years never operating outside of Class G airspace, and then may move to a different location that requires him or her to begin conducting small UAS operations in Class D airspace. Based on experience with manned pilots, those persons who exercise the privileges of their certificate on an infrequent basis are likely to retain the knowledge for a shorter period of time than those who exercise the privileges of their certificate on a regular basis.

Further, as unmanned aircraft operations increase in the NAS, the FAA anticipates the possibility of further changes to rules and regulations. By requiring evaluation on a two-year cycle, the FAA is able to ensure that remote pilots are aware of the most recent changes to regulations affecting their operations.

The FAA acknowledges, however, the burden associated with in-person testing every two years. As such, the FAA intends to look at (in the *Operations of Small Unmanned Aircraft Over People* rule) alternative methods to further reduce this burden without sacrificing the safety benefits afforded by a two-year recurrent knowledge check.

h. Pilots With Military Experience

The NPRM proposed allowing pilots with military experience operating unmanned aircraft to take the recurrent knowledge test in lieu of the initial knowledge test in order to be eligible for an unmanned aircraft operator certificate with a small UAS rating. For the reasons discussed below, this rule will require pilots with military experience operating unmanned aircraft to comply with the initial and recurrent knowledge testing requirements discussed in the previous sections.

NBAA, Small UAV Coalition and Texas A&M University agreed with the proposed rule requiring only a recurrent knowledge test in lieu of the initial knowledge test to qualify for a UAS operator airman certificate. Prioria said that military UAS operators and OEM-certified UAS operators should be grandfathered in without the need to take an initial knowledge test because their prior operational experience should suffice. In addition, Aviation Model Code of Conduct Initiative, Boeing Commercial Airplanes, Small UAV Coalition, and others supported accepting existing pilot credentials, especially military pilot credentials, in lieu of requiring those pilots to take an initial knowledge test or obtain a separate small UAS certificate. ArgenTech Solutions suggested that FAA should put a time limit on when military experience is acceptable for taking the recurrent knowledge test.

In contrast, ALPA and others suggested that an initial knowledge test, rather than just a recurrent test, is appropriate for applicants with military experience flying UAS. ALPA noted that such pilots do not necessarily have experience operating in the NAS, and therefore cannot be assumed to be familiar with all the subject areas included in the initial test. ALPA also pointed to the wide variety of UAS used in the military and suggested that a given pilot's experience may not necessarily be relevant to the operation of a small UAS in the NAS. ALPA also stated that the FAA should review a military pilot's specific training, skills, and experience before determining what ''supplemental training, knowledge testing, or skills demonstration'' might be needed.

Similarly, one commenter asserted that experience operating military UAS is not relevant to the operation of a civil small UAS, and that therefore those with military experience should be subject to the same testing requirements as other applicants. Another individual echoed ALPA's concern that military operations are conducted almost exclusively in military airspace, not in the NAS. One commenter, while supporting an initial-test exemption for applicants with military experience, added that former military UAS pilots do not necessarily understand civil operations in the NAS.

Planehook Aviation, NOAA, DOD, and an individual commenter said that the prior military experience provision proposed in § 107.75 should apply to both military and non-military COA UAS operators. One commenter provided supporting reasoning stating that ''[t]here are several non-military Federal agencies that have well established sUAS programs and, as is the case with NASA, they have decades of experience with sUAS and operating sUAS in the NAS.'' NOAA argued that there are no practical differences between NOAA pilots and military pilots because they are both trained in the same facilities. DOD raised a similar argument, asking that the rule recognize DOD civilian and contractor personnel that have a level of training equivalent to military personnel. One individual suggested that the FAA allow civilian operators with a minimum of 1,000 logged hours as operators of UAS for government and military agencies to qualify for taking the recurrent knowledge test instead of the initial test.

The FAA agrees with commenters who expressed concern about applicants obtaining a remote pilot certificate to operate civil small UAS without passing an initial knowledge test. The levels of training and certification for unmanned aircraft differ greatly between branches of the armed services, and therefore there is no consistent training the FAA can use as a comparison to its requirements in order to credit military UAS pilots. Further, many of the required knowledge areas for the part 107 initial knowledge test, such as airspace classification, airport operations, and radio communications, are not consistently covered in training across all branches of the U.S. military. Accordingly, at this time, this rule will not allow military UAS pilots to bypass the initial aeronautical knowledge test. This applies to NOAA UAS pilots as well, because, as NOAA pointed out, they are trained in the same military facilities.

The FAA notes, however, that in some cases, government and military UAS pilots are trained as pilots of manned aircraft, in which case they may qualify for a part 61 pilot certificate through military competency. Specifically, manned-aircraft military pilots are frequently able to qualify for a part 61 pilot certificate under § 61.73 without taking a practical test by providing specific documentation and passing a military competency knowledge test. Provided those pilots obtain a part 61 pilot certificate and meet the flight review and online training course requirements discussed in the next section, they may qualify for a remote pilot certificate with small UAS rating without having to take any UAS knowledge test.

i. Credit to Holders of Part 61 Pilot Certificates

For the reasons discussed below, this rule will allow part 61 pilot certificate holders (other than the holders of a student pilot certificate) with current flight reviews [139] to substitute an online training course for the aeronautical knowledge testing required by this rule.

Airborne Law Enforcement Association and Texas A&M University-Corpus Christi, suggested requiring only the recurrent knowledge test for part-61-certificated pilots. Numerous commenters also suggested that holders of part 61 airman certificates should be required to take only the recurrent knowledge test, not the initial knowledge test, or should be exempted entirely from knowledge-testing requirements. One commenter suggested that the holders of private, commercial, and ATP certificates who have operated UAS under exemptions be exempted from the initial knowledge test requirement. Another commented that non-military COA pilots should be permitted to take just the recurrent test, since the applicants will usually hold at least a private pilot certificate. One commenter stated that those applicants who hold part 61 pilot certificates should be required only to complete UAS-specific modules as part of the existing FAA Wings program. Another commenter stated that there should be a provision to enable existing small UAS pilots with a certain amount of

[139] Under § 61.56(c), no person may act as pilot in command of an aircraft unless, since the 24th calendar month before the month in which the person acts as pilot in command, he or she has completed a flight review with an authorized instructor in an aircraft for which that person is rated. The flight review must consist of at least one hour of ground training and one hour of flight training that includes the general operating and flight rules of part 91. 14 CFR 61.56(a).

logged PIC time to fly a small UAS without having to take a knowledge test.

The FAA agrees with commenters who suggested that requiring part-61-certificated pilots who satisfy the flight-review requirements of § 61.56 to take an initial or recurrent knowledge test is unduly burdensome. Through initial certification and subsequent flight reviews, a part-61-certificated airman is required to demonstrate knowledge of many of the topic areas tested on the UAS knowledge test. These areas include: Airspace classification and operating requirements, aviation weather sources, radio communication procedures, physiological effects of drugs and alcohol, aeronautical decision-making and judgment, and airport operations. Because a part 61 pilot certificate holder is evaluated on these areas of knowledge in the course of the part 61 certification and flight review process, reevaluating these areas of knowledge on the initial and recurrent knowledge tests conducted under part 107 would be needlessly duplicative.

However, there are UAS-specific areas of knowledge (discussed in section III.F.2.j of this preamble) that a part-61-certificated pilot may not be familiar with. Accordingly, instead of requiring part-61-certificated pilots who are current on their flight reviews to take the initial and recurrent knowledge tests, this rule will provide those pilots with the option to take an online training course focusing on UAS-specific areas of knowledge. Just as there is an initial and recurrent knowledge test, there will also be an initial and recurrent training course available to part 61 pilot certificate holders. Those certificate holders will be able to substitute the initial training course for the initial knowledge test and the recurrent training course for the recurrent knowledge test. To ensure that a certificate holder's UAS-specific knowledge does not become stale, this rule will include the requirement that a part 61 pilot certificate holder must pass either the recurrent training course or the recurrent knowledge test every 24 months.

The FAA emphasizes that the online training course option in lieu of taking the knowledge test will be available only to those part 61 pilot certificate holders who satisfy the flight review required by § 61.56. This is to ensure that the certificate holder's knowledge of general aeronautical concepts that are not included on the training course does not become stale. Part 61 pilot certificate holders who do not meet the flight review requirements of § 61.56 will be unable to substitute the online training course for the required aeronautical knowledge test. Thus, under § 107.63(a)(2), a part 61 pilot certificate holder seeking to substitute completion of the initial training course for the initial aeronautical knowledge test will have to present his or her logbook upon application for a remote pilot certificate with a small UAS rating to demonstrate that he or she has satisfied this requirement. The applicant will also have to present a certificate of completion showing that he or she has completed the initial online training course.

The FAA also notes that the above discussion does not apply to holders of a part 61 student pilot certificate. A person is not required to pass an aeronautical knowledge test, pass a practical (skills) test, or otherwise demonstrate aeronautical knowledge in order to obtain a student pilot certificate. Further, student pilot certificate holders who have received an endorsement for solo flight under § 61.87(b) are only required to demonstrate limited knowledge associated with conducting a specific solo flight. For these reasons, the option to take an online training course instead of an aeronautical knowledge test will not extend to student pilot certificate holders.

j. Areas of Knowledge on the Aeronautical Knowledge Tests and Training Courses for Part 61 Pilot Certificate Holders

The NPRM proposed that the initial aeronautical knowledge test would test the following areas of knowledge: (1) Regulations applicable to small UAS operations; (2) airspace classification and operating requirements, obstacle clearance requirements, and flight restrictions affecting small unmanned aircraft operation; (3) official sources of weather and effects of weather on small unmanned aircraft performance; (4) small UAS loading and performance; (5) emergency procedures; (6) crew resource management; (7) radio communication procedures; (8) determining the performance of small unmanned aircraft; (9) physiological effects of drugs and alcohol; (10) aeronautical decision-making and judgment; and (11) airport operations. The NPRM also proposed the following areas of knowledge for the recurrent knowledge test: (1) Regulations applicable to small UAS operations; (2) airspace classification and operating requirements, obstacle clearance requirements, and flight restrictions affecting small unmanned aircraft operation; (3) official sources of weather; (4) emergency procedures; (5) crew resource management; (6) aeronautical decision-making and judgment; and (7) airport operations.

For the reasons discussed below, this rule will remove obstacle clearance requirements and add maintenance and inspection procedures as areas of knowledge that will be tested on both the initial and recurrent aeronautical knowledge tests. Further, aviation weather sources will be removed from the recurrent aeronautical knowledge tests. Except for these changes, this rule will finalize all other areas of knowledge as proposed in the NPRM.

With regard to the initial and recurrent training courses for part 61 pilot certificate holders, those courses will only cover UAS-specific areas of knowledge that are not included in the training and testing required for a part 61 pilot certificate. Thus, the initial training course will cover: (1) Regulations applicable to small UAS operations; (2) small UAS loading and performance; (3) emergency procedures; (4) crew resource management; (5) determining the performance of the small unmanned aircraft; and (6) maintenance and inspection procedures. The recurrent training course will cover: (1) Regulations applicable to small UAS operations; (2) emergency procedures; (3) crew resource management; and (4) maintenance and inspection procedures.

i. Regulations Applicable to Small UAS

The NPRM proposed to include an area of knowledge on both the initial and recurrent knowledge tests that determines whether the test taker knows the regulations applicable to small UAS. By testing the applicant for an airman certificate on knowledge of applicable regulations, the initial and recurrent knowledge tests would ensure that the applicant understands what those regulations require and does not violate them due to ignorance.

The FAA did not receive any adverse comments on this aspect of its proposal, and as such, this rule will include regulations applicable to small UAS as an area of knowledge that is tested on both initial and recurrent aeronautical knowledge tests. This area of knowledge will also be included on the initial and recurrent training courses that can be taken by part 61 pilot certificate holders instead of a knowledge test because regulations applicable to a small UAS are a UAS-specific area of knowledge that is not included in the training and testing required for a part 61 pilot certificate.

ii. Airspace Classifications and Operating Requirements, and Flight Restrictions Affecting Small Unmanned Aircraft Operation

The NPRM also proposed testing (on both the initial and recurrent knowledge tests) knowledge of airspace classification and operating requirements, as well as knowledge of flight restrictions affecting small unmanned aircraft operation. The NPRM explained that part 107 would include airspace operating requirements, such as the requirement to obtain ATC permission prior to operating in controlled airspace, and in order to comply with those requirements, an airman would need to know how to determine the classification of the airspace in which he or she would like to operate. The NPRM also proposed to test knowledge of how to determine which areas of airspace are prohibited, restricted, or subject to a TFR.

Under the NPRM, this area of knowledge would also be included in the recurrent knowledge test because: (1) Airspace that the airman is familiar with could become reclassified over time; (2) the location of existing flight restrictions could change over time; and (3) some airmen may not regularly encounter these issues in their operations. For the reasons discussed below, this rule will include knowledge of airspace classification and operating requirements and knowledge of flight restrictions affecting small unmanned aircraft operation as an area of knowledge tested on both the initial and recurrent knowledge tests.

The California Agricultural Aircraft Association supported testing on how the airspace is managed, what the rules and regulations are, and how manned aircraft operate in the airspace. Aerius suggested that the knowledge test should include special use airspace, right-of-way rules, visual scanning, aeromedical factors (*e.g.,* the limitations of the human eye), and accident reporting. On the other hand, the Electronic Frontier Foundation asserted that airspace classification is not relevant for low altitude micro UAS flights far away from airports and should not be tested for airmen seeking to operate micro UAS.

The FAA declines to eliminate airspace classification as an area of knowledge tested for small UAS operations. As an initial matter, the FAA notes that this rule will not prohibit any small UAS (including micro UAS) from operating near airports. For UAS not operating near an airport, the FAA notes that controlled airspace can extend a significant distance away from an airport. For example, the surface area of Class B airspace can extend up to 8 nautical miles away from an airport. Additionally, airspace classification may change over time; uncontrolled (Class G) airspace may be changed to controlled airspace and vice versa. A remote pilot of any small UAS will need to have the ability to determine what class of airspace his or her small UAS operation will take place in to ensure that the operation complies with the airspace rules of part 107.

In response to Aerius, the FAA notes that special-use airspace will be covered under knowledge of flight restrictions, which will determine the test taker's knowledge of regulatory restrictions on small UAS flight imposed through means such as prohibited airspace or a TFR. Right-of-way rules, visual scanning, and accident reporting will be covered by the knowledge area of regulations applicable to small UAS operations because all of these concepts are codified in the operational regulations of part 107. Aeromedical factors will not specifically be included on the knowledge test, but the FAA may publish further guidance to remote pilots on topics such as aeromedical factors and visual scanning techniques.

AUVSI recommended that the FAA require more extensive knowledge testing than what was proposed for an operator desiring to fly in Class B, C, D, or E airspace, operate small UAS for commercial purposes, or operate small UAS beyond visual line of sight with risk-based approval. The commenter did not, however, specify what should be included in this more extensive testing, and as such, the FAA is unable to evaluate AUVSI's suggestion.

iii. Obstacle Clearance Requirements

The NPRM proposed to include obstacle clearance requirements as an area of knowledge to be tested on the initial knowledge test to ensure that an applicant for a remote pilot certificate knows how to avoid creating a collision hazard with a ground structure.

One commenter suggested removing this area of knowledge from the knowledge test because, according to the commenter, there are no obstacle clearance requirements in part 107, and therefore, there should be nothing to test. The FAA agrees with this comment and has removed obstacle clearance requirements as an area of knowledge to be tested on the initial knowledge test.

The FAA notes that although the test taker will not be tested on knowledge of obstacle clearance requirements, they will be tested for knowledge of regulations applicable to small UAS, including the requirements of §§ 107.19(c) and 107.23(a), which: (1) Prohibit operating a small unmanned aircraft in a careless or reckless manner so as to endanger the life or property of another; and (2) require the remote pilot in command to ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property in the event of loss of control of the aircraft. A small unmanned aircraft flown in a manner that creates a collision hazard with a ground structure may violate one or both of these regulations, especially if there are people near the ground structure who may be hurt as a result of the collision.

iv. Aviation Weather Sources and Effects of Weather on Small Unmanned Aircraft Performance

The NPRM proposed to test, on the initial and recurrent knowledge test, knowledge of official sources of weather. The NPRM also proposed to test on the initial knowledge test whether the applicant understands the effects of weather and micrometeorology (weather on a localized and small scale) on a small unmanned aircraft operation. The NPRM explained that knowledge of weather is necessary for the safe operation of a small unmanned aircraft because, due to the light weight of the small unmanned aircraft, weather could have a significant impact on the flight of the aircraft.

One commenter recommended the removal of ''official'' from ''official weather sources,'' saying that operation of a UAS calls for assessment of ''local'' weather conditions, and, furthermore, that there are no clearly identified ''official sources of weather.'' Aviation Management suggested that official sources of weather be excluded from the recurrent knowledge test.

The FAA agrees with the commenter that there are no specific ''official sources of weather,'' and has removed that terminology from this rule. However, the FAA emphasizes that there are several sources of aviation weather useful to remote pilots. Accordingly, remote pilots will be required to be familiar with aviation weather products such as the ones provided by the National Weather Service through Flight Service Stations, Direct User Access Terminal Systems (DUATS), and/or Flight Information Services-Broadcast (FIS–B).[140] While this rule does not require the use of those sources of weather for planning flights, aviation weather sources could

[140] *See* Aeronautical Information Manual, ch. 1, sec. 1.

be a valuable resource for remote pilots that choose to use them. For example, a remote pilot conducting an operation in an area with quickly changing weather may wish to access weather information from an aviation weather source for the most up-to-date weather data to ensure that the small UAS operation will comply with the minimum visibility and cloud clearance requirements of § 107.51. The FAA notes that aviation weather sources include weather data that can be used to evaluate local weather conditions.[141] Because there is no requirement for remote pilots to use aviation weather products on an ongoing basis, the FAA has removed this area of knowledge from the recurrent aeronautical knowledge test.

Accordingly, this rule will include knowledge of aviation weather sources and the effects of weather on small unmanned aircraft performance on the initial knowledge test. Additionally, this rule will include knowledge of the effects of weather on small unmanned aircraft performance as an area of knowledge on the initial training course available to part 61 pilot certificate holders because this is a UAS-specific area of knowledge that is not included in the training and testing required for a part 61 pilot certificate. The training course will not include knowledge of aviation weather sources because that is not a UAS-specific area of knowledge.

v. Small UAS Loading and Performance

The NPRM proposed to include weight and balance as an area of knowledge to be tested on the initial knowledge test to ensure that an applicant for a remote pilot certificate knows how to calculate the weight and balance of a small unmanned aircraft to determine impacts on performance. The NPRM noted that in order to operate safely, operators need an understanding of some fundamental aircraft performance issues, including load balancing and weight distribution as well as available power for the operation.

University of Arkansas Division of Agriculture suggested that the FAA's proposal suggests a lack of understanding by the FAA of these lightweight aircraft. The commenter added that when they place a battery or camera on their aircraft, it is immediately obvious if something is not balanced.

While the FAA agrees that in some circumstances the effect certain loads may have on the weight, balance, and performance of the aircraft may be obvious—such as adding a five pound weight to one side of a 0.5 pound small unmanned aircraft—other weight distributions and how they affect the balance of the aircraft may be more difficult to surmise. For example, it may not be intuitive for a remote pilot to determine the effect a half-pound battery will have when added to a forty-pound aircraft. Additionally, a remote pilot needs to understand the effect that the added weight will have on the aircraft's operation over time. For example, while a small unmanned aircraft may be balanced for the first few flights after a weight is added, that weight may influence the aircraft over time such that during later flights the aircraft is no longer balanced and no longer flying safely.

For these reasons, the FAA will include a section on the initial knowledge test ensuring that a remote pilot applicant understands how to calculate the weight and balance of a small unmanned aircraft and the resulting impacts on performance. Because small unmanned aircraft loading is a UAS-specific area of knowledge, the FAA will also include it on the initial training course that part 61 pilot certificate holders can take in place of the knowledge test.

vi. Emergency Procedures

The NPRM noted that a small UAS airman may have to deal with an emergency situation during a small UAS operation. As such, the NPRM proposed to include an area of knowledge on the initial knowledge test that would determine whether the applicant knows how to properly respond to an emergency. The NPRM also proposed to include knowledge of emergency procedures on the recurrent knowledge test because emergency situations will likely be infrequent and as such, a certificate holder's knowledge of emergency procedures may become stale over time. The FAA did not receive adverse comments on including emergency procedures on the initial knowledge test, and as such, this area of knowledge will be included on the initial knowledge test.

Turning to the recurrent knowledge test, Aviation Management recommended that the FAA remove emergency procedures as an area of knowledge covered on that test. The FAA declines to remove emergency procedures from the recurrent knowledge test. As discussed in the NPRM, emergency situations will likely arise infrequently, and as such, a remote pilot's knowledge of emergency procedures may become stale over time. Accordingly, including this area of knowledge on the recurrent knowledge test will ensure that the remote pilot retains the knowledge of how to properly respond to an emergency.

Because this area of knowledge is UAS-specific, it will also be included on the initial and recurrent training courses that can be taken by part 61 pilot certificate holders instead of an initial or recurrent knowledge test.

vii. Crew Resource Management

The NPRM proposed to include crew resource management as an area of knowledge to be tested on the initial and recurrent knowledge tests to ensure that an applicant for a remote pilot certificate knows how to function in a team environment, such as when visual observers are used to assist a remote pilot. In those circumstances, the remote pilot would be in charge of those observers and therefore need an understanding of crew resource management.

Several commenters, including the Small UAV Coalition, Princeton University, and the Electronic Frontier Foundation, argued that crew resource management may not be relevant for all small UAS operations and, as such, should be removed from the knowledge test. Princeton University added that crew resource management would be an irrelevant area of knowledge for student operators who will be operating the aircraft at a low altitude, for a limited distance, on university property, and under the direct supervision of a faculty member. Electronic Frontier Foundation stated that this area of knowledge is irrelevant for micro UAS operations.

One commenter suggested removal of crew resource management stating it is ''overkill'' and is really just referring to possible communications between the pilot and the visual observer. If kept, the commenter suggested modifying it to ''Crew resource management as it may pertain to operation of a small unmanned aircraft system.''

The FAA acknowledges that not all small UAS operations will utilize a visual observer or more than one manipulator of the controls of the small unmanned aircraft. However, the FAA anticipates that many remote pilots operating under part 107 will likely use a visual observer or oversee other individuals that may manipulate the controls of the small unmanned aircraft. In order to allow flexibility for certificated remote pilots to determine whether or not to use a visual observer or oversee other individuals manipulating the controls of the small unmanned aircraft, the FAA must ensure that an applicant for a remote

[141] Additional guidance on aviation weather for pilots can be found in AC 00–6.

pilot certificate is able to function in a team environment and maximize team performance. This includes situational awareness, proper allocation of tasks to individuals, avoidance of work overloads in self and in others, and effectively communicating with other members of the crew such as visual observers and individuals manipulating the controls of a small UAS.

The scenario Princeton University provided in its comment is precisely the type of scenario that would require a certificated remote pilot in command to have an understanding of crew resource management. The remote pilot in command in Princeton University's scenario would be supervising a student who is manipulating the controls of the small unmanned aircraft. Therefore, the remote pilot in command in that scenario would need to know how to effectively communicate and guide his or her crew (the student). In response to Electronic Frontier Foundation, the FAA notes that even remote pilots operating smaller UAS may choose to use a visual observer or supervise other manipulators of the controls.

It is not necessary to change the title of this area of knowledge because crew resource management correctly captures what this area of knowledge will cover. The FAA also notes that this rule will include crew resource management as an area of knowledge on the initial and recurrent training courses available to part 61 pilot certificate holders because this is a UAS-specific area of knowledge.

viii. Determining the Performance of the Small Unmanned Aircraft

The NPRM proposed to include an area of knowledge on the initial aeronautical knowledge test to ensure that an applicant knows how to determine the performance of the small unmanned aircraft. Aviation Management suggested that this area of knowledge be excluded from the initial knowledge test because, the commenter argued, this knowledge is unnecessary for all small UAS operations.

The FAA will retain determining the performance of the small unmanned aircraft as an area of knowledge on the initial knowledge test. As discussed in section III.E.6.a.i of this preamble, the remote pilot in command will be required to conduct a preflight assessment of the area of operation and ensure that the small unmanned aircraft will pose no undue hazard to other aircraft, people, or property if there is a loss of positive control. In order to be able to do that, the remote pilot in command will need to be able to assess how a small unmanned aircraft will perform in a given operating environment. This area of knowledge will determine whether an applicant for a remote pilot certificate has acquired the knowledge necessary to conduct this assessment.

This rule will also include this area of knowledge on the initial training course that can be taken by part 61 pilot certificate holders instead of an initial knowledge test because it is a UAS-specific area of knowledge.

ix. Physiological Effects of Drugs and Alcohol

The NPRM proposed to include the physiological effects of drugs and alcohol as an area of knowledge covered by the initial knowledge test. The Electronic Frontier Foundation argued that knowledge of the effects of drugs and alcohol is irrelevant for micro UAS operations and should not be tested for pilots of a micro UAS.

The FAA disagrees. As explained in the NPRM, there are many prescription and over-the-counter medications that can significantly reduce an individual's cognitive ability to process and react to events that are happening around him or her. This can lead to impaired decision-making, which could adversely affect the safety of any small UAS operation. Accordingly, the initial aeronautical knowledge test will include an area of knowledge to determine whether the applicant understands how drugs and alcohol can impact his or her ability to safely operate a small UAS.

x. Aeronautical Decision-Making and Judgment

The NPRM proposed to include aeronautical decision-making and judgment as an area of knowledge tested on the initial and recurrent knowledge tests. Aviation Management suggested that this area of knowledge be excluded from the knowledge tests because this knowledge is unnecessary for all small UAS operations.

The FAA disagrees. As discussed in the NPRM, even though small unmanned aircraft will be limited to a relatively low altitude by the provisions of this rule, they will still share the airspace with some manned-aircraft operations. To safely share the airspace, a remote pilot in command will need to understand the aeronautical decision-making and judgment that manned aircraft pilots engage in so that he or she can anticipate how a manned aircraft will react to the small unmanned aircraft. Accordingly, this rule will retain aeronautical decision-making and judgment as an area of knowledge covered on the initial and recurrent knowledge tests.

xi. Airport Operations

Noting that some small UAS operations could be conducted near an airport, the NPRM proposed to include airport operations as an area of knowledge tested on the initial and recurrent knowledge tests.

Several commenters, including the Small UAV Coalition, Princeton University, and Predessa, argued that airport operations may not be relevant to all small UAS operations, and as such, should be removed from the knowledge tests. The Electronic Frontier Foundation argued that this area of knowledge is ''clearly irrelevant'' for micro UAS flights conducted far away from airports.

There are over 5,000 public use airports in the United States. As such, the FAA expects that a number of small UAS operations may take place near an airport. The FAA also expects that there could be instances where a small unmanned aircraft unexpectedly ends up flying near an airport due to adverse conditions, such as unexpectedly strong winds that carry the aircraft toward the airport. In those instances, the remote pilot in command will need to have an understanding of airport operations so that he or she knows what actions to take to ensure that the small unmanned aircraft does not interfere with airport operations or traffic patterns. Accordingly, this rule will retain airport operations as an area of knowledge tested on the initial and recurrent knowledge tests.

xii. Radio Communication Procedures

Finally, the NPRM proposed to include radio communication procedures as an area of knowledge covered on the initial aeronautical knowledge test.

Several commenters, including Princeton University, Predesa, and Aviation Management, argued that radio communications may not be relevant for all small UAS operations and as such, should be removed from the knowledge test. Predesa suggested that the FAA design a new ''Class G-only unmanned aircraft operator certificate with a small UAS rating'' that, among other things, does not include radio communication procedures as an area of knowledge that is tested on the knowledge test. One commenter recommended removal of ''radio communication procedures'' because there is no requirement for radio communications of any sort with small UAS operations.

As discussed earlier, the FAA expects that a number of small UAS operations

will take place near an airport. That is why § 107.43 prohibits a small unmanned aircraft from interfering with airport operations or traffic patterns. Understanding radio communication procedures will assist a remote pilot in command operating near a Class G airport in complying with this requirement. Understanding radio communication procedures will assist a remote pilot in command operating near a Class G airport in complying with this requirement if that pilot chooses to use a radio to aid in his or her situational awareness of manned aircraft operating nearby. As described in section 4–1–9 of the Aeronautical Information Manual, manned-aircraft pilots may broadcast their position or intended flight activity or ground operation on the designated Common Traffic Advisory Frequency (CTAF). This procedure is used primarily at airports that do not have an airport traffic control tower, or have a control tower that is not in operation. Pilots of radio-equipped aircraft use standard phraseology to announce their identification, location, altitude, and intended course of action. Self-announcing for arriving aircraft generally begins within 10 nautical miles of the airport and continues until the aircraft is clear of runways and taxiways. Aircraft on the ground intending to depart will begin to make position reports prior to entry of the runway or taxiway and continue until departing the traffic pattern. Aircraft remaining in the pattern make position reports on each leg of the traffic pattern.

Thus, knowledge of radio communication procedures will provide a remote pilot in command with the ability to utilize a valuable resource, CTAF, to help determine the position of nearby manned aircraft. As such, this rule will retain this area of knowledge on the initial aeronautical knowledge test.

xiii. Other Areas of Knowledge Suggested by the Commenters

The NPRM invited comment on whether additional areas of knowledge should be tested on the initial and recurrent knowledge tests. In response, the FAA received comments listing additional areas of knowledge that commenters would like to see on the knowledge tests. For the reasons discussed below, the FAA will add a section on maintenance and inspection to the initial and recurrent knowledge tests and the online training courses. The FAA will not add any other areas of knowledge to the knowledge tests or training courses.

The National Transportation Safety Board (NTSB) suggested that the test content should include awareness of lost-link failsafe procedures, operator development, use of maintenance and inspection steps and guides, and the characteristics and proper handling of lithium batteries. The NTSB referred to an April 2006 accident involving a U.S. Customs and Border Protection unmanned aircraft and encouraged the FAA to review its recommendations and supporting information stemming from that accident for potential lessons learned when developing guidance material and specific content for the written knowledge tests outlined in proposed part 107.

The FAA notes that topics associated with lost-link failsafe procedures will be covered by the area of knowledge testing an applicant's understanding of the applicable small UAS regulations. With regard to maintenance and inspection, the FAA has taken action by adding maintenance and inspection knowledge test topic area requirements to the initial and recurrent knowledge tests. The addition of maintenance and inspection knowledge test topics will consist of small UAS basic maintenance and inspection knowledge that is common to all small UAS regardless of complexity. An understanding of maintenance and inspection issues will ensure that remote pilots are familiar with how to identify when a small unmanned aircraft is not safe to operate, and how to maintain a small unmanned aircraft to mitigate the possibility of aircraft failure during flight. Although this area of knowledge will not cover every possible inspection and maintenance method, it will provide a baseline of knowledge that will be useful to all small UAS remote pilots.

The FAA disagrees with NTSB's recommendation that the knowledge test include a topic on the characteristics and proper handling of lithium batteries. Under § 107.36, small UAS are prohibited from carriage of hazardous materials. When installed in the aircraft for use as a power source (as opposed to carriage of spares or cargo), lithium batteries are not considered hazardous material.[142]

NOAA suggested that the knowledge test include questions relating to protecting and operating in the context of wildlife. The Ventura Audubon Society also suggested that the FAA test an applicant's understanding of Federal and State wildlife protection laws.

The FAA is required by statute to issue an airman certificate to an individual when the Administrator finds that the individual is qualified and physically able to safely perform the duties authorized by the certificate. *See* 49 U.S.C. 44703(a) (stating that the Administrator ''shall issue'' an airman certificate to an individual who is qualified and physically capable). Therefore, the FAA cannot deny or delay the issuance of an airman certificate if an applicant has demonstrated that he or she is qualified and physically able to safely perform the duties authorized by the certificate. In this case, a remote pilot certificate with small UAS rating authorizes the holder to operate a small UAS safely in the NAS. Thus, under § 44703(a), the FAA is required to issue an airman certificate to an individual who has demonstrated an ability to safely operate a small UAS, and may not require that individual to also demonstrate an understanding of Federal and State wildlife protection laws.

The FAA emphasizes, however, that a small UAS operation may be subject to other legal requirements independently of this rule. A remote pilot in command is responsible for complying with all of his or her legal obligations and should thus have a proper understanding of wildlife protection laws in order to comply with the pertinent statutes and regulations.

Drone User Group Network suggested the following topics for the knowledge test: the concepts of lift, weight, thrust and drag, Bernoulli's principle, weight and balance, weather, situational awareness, safety in preflight, in flight and post flight, battery theory, radio frequency theory, electrical theory, understanding flight modes, fail-safes, and aircraft types and limitations.

The FAA notes that weight and balance, weather, and preflight requirements will be tested under § 107.73. The FAA agrees with the commenter that technical topics such as principles of flight, aerodynamics, and electrical theory may enhance the knowledge and technical understanding of the remote pilot. However, these topics are not critical subject areas for safe operation of small UAS. The FAA includes many of these topics in the curriculum of part 61 knowledge testing because they are critical knowledge areas for persons operating an aircraft with passengers over populated areas that may need to respond to an emergency resulting from engine failure, unexpected weather, or onboard fire. Conversely, small UAS operations take place in a contained area in a light-weight aircraft that has no people onboard, so these topics are not applicable to the same extent as they are to a manned-aircraft operation. However, the remote pilot in command should familiarize him or herself with

[142] *See* 49 CFR 175.8(a)(2).

all of the necessary information to be able to fly the unmanned aircraft without causing damage to the aircraft.

Southwest Airlines Pilots' Association encouraged the FAA to require that operators be knowledgeable about Safety Management Systems (SMS) and the Aviation Safety Reporting System (ASRS), which could be used to collect data to support a risk managed growth of the industry and the integration into the NAS.

The FAA disagrees that SMS and ASRS systems should be covered on the knowledge tests. Participation in a formal SMS program is currently required only for part 121 operations, which are the largest and most complex manned-aircraft operations regulated by the FAA. Requiring small UAS to participate in this program would not be justified considering the fact that the FAA does not require non-part-121 manned-aircraft operations to have an SMS. Similarly, the FAA will not require testing on ASRS knowledge because ASRS is not currently required knowledge for part 61 pilot certificate holders.

k. Administration of the Knowledge Tests and Training Courses

This section discusses how the initial and recurrent knowledge tests and online training courses will be administered under this rule. Specifically, this section addresses: (1) The location at which a knowledge test can be taken; (2) the prohibition on cheating and engaging in unauthorized conduct during a knowledge test; (3) the identification of the test taker; and (4) retesting after failing a knowledge test.

i. Location of the Knowledge Test and Online Option for Training Course

Knowledge tests currently administered to prospective pilots under 14 CFR part 61 are created by the FAA and administered by knowledge testing centers. A knowledge testing center is a private company that has been approved to administer airman knowledge tests. These centers are overseen by the FAA to ensure that the testing center meets FAA requirements. The NPRM proposed to apply this existing framework to knowledge testing under part 107. The NPRM also noted that the FAA considered an online test-taking option, but ultimately rejected this option due to concerns about cheating and the protection of personally identifiable information (PII). The NPRM invited comments on whether online testing should be permitted under this rule.

For the reasons discussed below, the FAA will finalize this provision as proposed with one exception. That exception is that the training course available to part 61 pilot certificate holders in place of an aeronautical knowledge test will be administered online rather than at a knowledge testing center.

Texas A&M University-Corpus Christi/LSUASC suggested that the FAA UAS test sites should be involved in the training, testing, and certification processes. NRECA suggested allowing NRECA members to administer the tests for their employees. NRECA asserted that its members already have extensive experience with training and testing, and are well equipped to administer the testing contemplated in this rule without compromising the integrity of such tests.

Additionally, the Small UAV Coalition suggested that DPEs, ACRs, CFIs, or other persons authorized by the Administrator be authorized to conduct the aeronautical test and issue the certificate. These commenters generally noted that these approaches would increase efficiency regarding the issuance of unmanned aircraft operator certificates with a small UAS rating.

The Property Drone Consortium suggested that another way to increase efficiency would be for the FAA to allow certain industries to conduct internal training that would satisfy the requirement for applicants to pass an initial aeronautical knowledge test given by an FAA knowledge testing center. Property Drone Consortium and several individuals also suggested that the FAA begin planning for the establishment of testing centers so that there will be adequate capacity for operators to take the initial small UAS operator certification test.

After considering the comments, the FAA has decided to use its existing system of knowledge testing centers to administer the aeronautical knowledge tests. There are currently about 700 knowledge testing centers spread throughout the country. The FAA anticipates that this system has adequate capacity for individuals to take the initial aeronautical knowledge test. An updated list of commercial testing center locations and contact information may be accessed at: *https://www.faa.gov/training_testing/testing/media/test_centers.pdf*.

The FAA also has the ability to designate additional knowledge testing centers if demand for the knowledge test exceeds existing capacity and the existing knowledge testing centers become incapable of meeting the increased demand, provided the FAA also has the ability to provide adequate oversight. Airman Knowledge Testing Organization Designation Authorization Holders are designated to administer airman knowledge tests under the authority of FAA Orders 8100.15, 8080.6G and 49 U.S.C. 44702(d). To ensure FAA jurisdictional and surveillance oversight, only companies, schools, universities, or other organizations that meet the requirements of this order may be eligible for designation. The FAA also notes that there is nothing in the final rule that prohibits industries from conducting internal training for employees to prepare them for the initial or recurrent aeronautical knowledge test.

A number of commenters, including the Professional Society of Drone Journalists, AUVSI, and NBAA, supported allowing applicants to take both the initial and recurrent aeronautical knowledge tests online. NRECA, Cherokee Nation Technologies, and the Nez Perce Tribe pointed to the benefits of online testing to applicants living in rural locations, who would otherwise have to travel great distances to take the knowledge test in-person.

Other commenters, including AOPA, News Media Coalition, and New Hampshire DOT, supported online testing for recurrent aeronautical knowledge tests. Associated Builders and Contractors also recommended allowing an online option for recurrent test takers, but said it should be supervised. The commenter asserted that the FAA missed a number of factors when looking at the economic impact on businesses and individuals of allowing online testing.

Several commenters addressed the FAA's concerns about positive identification of applications and the need to protect applicants' personally identifiable information (PII). NetMoby pointed out that there are numerous Federal judicial filing systems which protect PII, and recommended the FAA use these techniques to protect PII in online testing. The Colorado Cattlemen's Association said the FAA can address issues related to positive identification and PII protection through a combination of existing driver's license databases and existing measures used by the FAA to protect PII submitted by other applicants and certificated airmen. Planehook Aviation stated that ensuring the identity of test-takers in person using current ''identification credential fidelity methods'' is just as subject to falsification as pre-online testing identification verification. Airgon suggested that FAA could draw from the experience of online universities to verify an applicant's identity for

purposes of an online exam. The commenter noted that such techniques include posing challenge questions with personal information about a student, using video capture to record the student during the exam, using biometrics such as voice recognition, and using video proctoring, which connects a student to a live proctor who verifies the student's identity.

Other commenters addressed the FAA's concern that online test-takers could cheat on the test. Two individual commenters asserted that many cities allow drivers to take defensive driving courses online, and asserted that if this method is sufficient for defensive driving courses, it is more than sufficient for small UAS testing. Airgon asserted that there are software programs, such as Examsoft, that lock an examinee's computer, preventing the examinee from opening other applications during a test. The commenter also noted that companies are developing software that can track an examinee's keystrokes and other activities during the test, such as opening another browser window, talking on a phone, talking to someone else in the room, or using a book. The commenter also suggested the FAA could impose time limits on the test to limit the time available for an examinee to look up information covered on the test. NRECA argued that the risk of cheating is low and can be managed by requiring ''an appropriately worded sworn certification by the test-taker.''

Several commenters, including the National Association of State Aviation Officials, NAFI, and Aerius, opposed online aeronautical knowledge testing. Those commenters generally opposed online testing for security purposes (*i.e.,* difficulty of ensuring test-taker identity and securing test-taker PII) and because of concerns about cheating. Modovolate pointed out that it is not clear how online testing would avoid impermissible reference to materials.

Because an applicant for a remote pilot certificate with small UAS rating is not required to pass a practical test, knowledge testing is the only way for the FAA to determine that a remote pilot has the requisite aeronautical knowledge to operate safely in the NAS. Therefore, it is imperative that the testing methodology being used assures that knowledge is demonstrated. The FAA is still evaluating whether online testing technologies can provide adequate proctoring of a test to ensure, among other things, that the test-taker is not taking the test for someone else or using reference material or other unapproved aids to help answer the test questions. Concerns with online testing are not limited to cheating. Because the knowledge test questions are pulled from a test bank with a finite number of questions, limiting access to that database to knowledge testing centers ensures the continued security and integrity of the test questions.

At this time, the FAA is aware of no other Federal agency that has successfully implemented an online knowledge testing system for imparting privileges that can directly affect the safety of nonparticipating persons or property. The FAA acknowledges comments pointing out that there are States that either have or are considering online testing for driver's tests. However, in all cases, States require an in-person practical driving test for issuing a driver's license, which helps address concerns with online testing. Thus, the States' online drivers' license testing model is not directly analogous to the framework of this rule.

The FAA notes, however, that the above concerns do not apply as strongly to UAS-specific training for holders of part 61 pilot certificates other than student pilot. These part 61 pilot certificate holders have already passed extensive testing and training requirements on general aeronautical knowledge and have gone through the positive identification process in order to obtain a part 61 pilot certificate. While part 61 pilot certificate holders may not have UAS-specific knowledge (hence the requirement for the training course), the UAS-specific knowledge is simply an application of general aeronautical knowledge principles to a specific type of operation. Because part 61 pilot certificate holders have already demonstrated proficiency in areas of general aeronautical knowledge, administering the training course online would not pose a problem for this population of remote pilot certificate applicants.

The FAA acknowledges that technology in this area could evolve to address its concerns with online testing (discussed earlier). The FAA also notes that online testing would, if implemented, significantly reduce the costs associated with part 107 by eliminating the travel costs incurred as a result of a person having to physically travel to a knowledge testing center. As such, the FAA will consider allowing the initial and recurrent knowledge tests to be taken online if an online system becomes available that allows a knowledge test to be administered securely (with controls in place to prevent cheating) and that allows the test taker to be positively identified without an in-person interaction.

ii. Cheating or Engaging in Unauthorized Conduct

To ensure that the aeronautical knowledge test is properly administered, the NPRM proposed to prohibit an applicant from cheating or engaging in other unauthorized conduct during the knowledge test. This would include: (1) Copying or intentionally removing a knowledge test; (2) giving a copy of a knowledge test to another applicant or receiving a copy of the knowledge test from another applicant; (3) giving or receiving unauthorized assistance while the knowledge test is being administered; (4) taking any part of a knowledge test on behalf of another person; (5) being represented by or representing another person for a knowledge test; and (6) using any material not specifically authorized by the FAA while taking a knowledge test. Cheating or engaging in unauthorized conduct during a knowledge test would be grounds for suspending or revoking the certificate or denying an application for a certificate. In addition, a person who engages in unauthorized conduct would be prohibited from applying for a certificate or taking a knowledge test for a period of one year after the date of the unauthorized conduct.

The FAA did not receive any adverse comments on this component of the proposed rule. Accordingly, this rule will finalize the cheating or engaging-in-unauthorized-conduct provisions of the NPRM as proposed. 14 CFR 107.69.

iii. Identification of the Test-Taker

The NPRM proposed to ensure that an applicant who is about to take the knowledge test is properly identified by requiring the applicant to present identification to the knowledge testing center prior to taking the knowledge test. This identification would have to include the applicant's: (1) Photograph; (2) signature; (3) date of birth, which shows the applicant meets or will meet the age requirement for a remote pilot certificate; and (4) the applicant's current residential address. For the reasons discussed below, this rule will finalize this aspect of the NPRM as proposed.

An individual commenter questioned an apparent contradiction in the NPRM, which would allow knowledge testing centers to verify an applicant's identification for the purposes of administering a knowledge test but would prohibit knowledge testing centers from verifying identification for the purposes of submitting an airman application. The commenter added that if the goal of this rule is to achieve the least burdensome process, then

knowledge testing centers should be permitted to verify a person's identification for both testing and application submission to the FAA.

The FAA acknowledges the positive identification conducted by the knowledge testing centers, and has determined that there is no need to repeatedly identify a person who has already been positively identified for the purposes of taking the knowledge test. Accordingly, as discussed later in section III.F.l, this rule will allow an applicant to submit his or her remote pilot application without having to be positively identified a second time.

iv. Retesting After Failure

The NPRM noted that some applicants may fail the initial aeronautical knowledge test the first time that they take it. To ensure that those applicants take the time to do additional studying and/or training (rather than simply take the test over and over again), the NPRM proposed to require that a person who fails the aeronautical knowledge test must wait 14 calendar days before retaking it. For the reasons discussed below, this rule will finalize this provision as proposed in the NPRM. 14 CFR 107.71.

One commenter suggested that an applicant who fails the knowledge test should be required to receive additional training in the area(s) of deficiency and receive an endorsement from a flight instructor in order to retake the test. The commenter rationalized that this would be consistent with current policy for pilot applicants with regards to failure and retesting, and will enhance safety by ensuring some level of oversight in the training process.

A person who fails the aeronautical knowledge test will receive a knowledge test report pointing out the areas of knowledge on which he or she did not test well. That person will then have 14 days to conduct additional study or training in those areas of knowledge prior to retaking the knowledge test. Specifying a prescriptive method of study is not necessary in this rule. Instead, the applicant will be incentivized to select the method of study that works best for him or her.

l. Transportation Security Administration Vetting and Process for Issuance

i. TSA Vetting and Temporary Remote Pilot Certificates

Prior to the issuance of a remote pilot certificate with a small UAS rating, the NPRM proposed requiring all applicants to be vetted by the Transportation Security Administration (TSA). Under the proposed rule, the FAA would transmit an airman certificate applicant's biographical information for security vetting to TSA and issue an airman certificate only after receiving a successful response from TSA. However, if TSA determines that an airman certificate applicant poses a security risk, 49 U.S.C. 46111 requires the FAA to deny the application for a certificate or amend, modify, suspend, or revoke (as appropriate) any part of an airman certificate based on TSA's security findings.

Additionally, the proposed rule would have required an applicant for a remote pilot certificate with a small UAS rating to submit the application to a Flight Standards District Office (FSDO), a designated pilot examiner (DPE), an airman certification representative (ACR) for a pilot school, a certificated flight instructor (CFI), or other persons authorized by the Administrator. The person accepting the application submission would be required to verify that the identity of the applicant matches the identity that is provided on the application.

For the reasons discussed below, this rule will, with one exception, allow an applicant who has passed the aeronautical knowledge test to submit an application for a remote pilot certificate directly to the FAA without having to travel to a Flight Standards District Office (FSDO), designated pilot examiner (DPE), airman certification representative (ACR), or certificated flight instructor (CFI). Holders of a part 61 pilot certificate who elect to take the online training course instead of the aeronautical knowledge test will, as proposed in the NPRM, be required to submit their certificate to a FSDO, DPE, ACR, or CFI in order to verify their identity. Part 61 pilot certificate holders will be issued a temporary remote pilot certificate immediately upon acceptance of their certificate application while all other applicants will be issued a temporary remote pilot certificate upon successful completion of TSA security vetting.

Many commenters, including Google, NAMIC, and Edison Electric Institute, agreed that applicants for a remote pilot certificate with a small UAS rating should be vetted by TSA as a prerequisite for obtaining a certificate. The City and County of Denver noted that a specific vetting mechanism is not detailed in the proposed regulations, and recommended that the FAA expressly require a completed Security and Threat Assessment (STA) as a prerequisite for obtaining an operating license. Virginia Commonwealth University Honors Students recommended that the vetting process include a criminal background check and that FAA decline operators who have been charged with a violent or sexual crime. The American Fuel & Petrochemical Manufacturers and the IME suggested that the FAA state explicitly in the final rule that failing the security threat assessment will disqualify an individual from obtaining an unmanned aircraft operator certificate with a small UAS rating. These and other commenters also generally noted that the FAA should ensure that there is a redress procedure for cases where an individual believes he or she improperly failed the security threat assessment. IME recommended that the certificate action processes codified in 49 U.S.C. 46111, including revocations, hearings, timely appeals and reviews, be included in the final rule.

The governing statute requires that ''individuals are screened against all appropriate records in the consolidated and integrated terrorist watchlist maintained by the Federal Government before . . . being certificated by the Federal Aviation Administration.'' 49 U.S.C. 44903(j)(2)(D)(i). Also, if TSA determines that an applicant poses a security risk as a result of the security vetting, 49 U.S.C. 46111 requires the FAA to deny that applicant's certificate application or amend, modify, suspend, or revoke (as appropriate) any part of an airman certificate based on the TSA's security findings.

The current certificate vetting program that the TSA administers satisfies the statutory vetting requirements. The FAA collects and provides the biographic information of FAA Airmen Certificate applicants, certificate holders, and those applying for airmen certificates on the basis of a foreign license to TSA for use in the security vetting. Under this final rule, the FAA will leverage the current process for the vetting of remote pilot certificate applicants. As stated in the NPRM and in accordance with the governing statute, the FAA may issue certificates to individuals who have first successfully completed an STA conducted by the TSA. The STA that TSA conducts adheres to the statutory mandate to vet certificate applicants against the government's consolidated terrorist watchlists to determine whether they may pose a threat to national or transportation security. The FAA defers to TSA's established STA, and TSA's determination of what factors, such as items contained within an individual's criminal record, will rise to the level of disqualification for a remote pilot certificate. The authority

for TSA to establish these criteria and make this determination is codified in 49 U.S.C. 44903(j)(2)(D)(i). Because section 44903 vests the pertinent authority in the TSA, the Department cannot, in this DOT rulemaking, specify what factors the TSA should consider to be disqualifying.

Additionally, TSA provides a substantial amount of due process to individuals who believe that they improperly failed an STA. Specifically, upon finding that an individual poses a security threat, the TSA issues a Determination of Security Threat to the individual. That individual may then make a written request for copies of releasable materials upon which the Determination of Security Threat was based. The TSA must respond no later than 60 days after receiving the request, and the individual may submit a written reply to the TSA's response. Upon receiving TSA's response, an individual who is a citizen of the United States is entitled to a hearing on the record in front of an administrative law judge (ALJ). That individual may then appeal the results of the hearing to the Transportation Security Oversight Board. If unsatisfied with the results of this appeal, the individual can obtain further review of the decision in Federal court.

Non-citizen U.S. nationals (which generally includes individuals born in American Samoa and Swains Island) and permanent residents may also have a hearing before the ALJ, but the ALJ's decision is reviewed by the TSA. TSA's decision on appeal is a final agency action appealable to a Federal court. A foreign national does not have the right to a hearing before an ALJ, but may seek review of the final agency decision in Federal court.

SkyView recommended that the FAA collect and verify additional information such as email address or home/cell phone numbers that could be used to contact the applicant quickly should the need arise. NBAA asserted that it had reviewed TSA's STA requirements, which the association said seem to presume that a larger organization is involved rather than an individual. The association subsequently questioned how, in cases where an operator is a single person, the FAA and TSA plan to address requirements that NBAA believes were developed for larger, more complex organizations.

In response to Skyview's comment asking the FAA to collect applicant contact information, the FAA notes that an applicant will be required to provide pertinent contact information on the application for a remote pilot certificate. Additionally, the FAA clarifies that the STAs that are currently being conducted by TSA for the FAA Airmen Certification Branch are being conducted for individuals, not organizations.

Several commenters suggested amending the TSA vetting process, creating exceptions for certain individuals, or eliminating the requirement altogether. Commenters, including Event 38 Unmanned Systems, Associated General Contractors of America, and Edison Electric Institute, expressed concern over the estimated 6-to-8-week time-frame between receipt of an application and issuance of a remote pilot certificate with small UAS rating as proposed in the NPRM. It is important to note that TSA's security vetting is complete in less than 7 days unless derogatory information related to the applicant is discovered and must be investigated to complete the STA.

Several commenters, including the Electronic Frontier Foundation, Washington Aviation Group, and Event 38 Unmanned Systems, opposed the requirement for small UAS operator applicants to undergo a TSA background check prior to receiving their operator certificate. Many of these commenters pointed out that it is highly unlikely that an individual who poses a threat to national security would seek to obtain an airman certificate and go through the TSA vetting process.

Several commenters argued that pre-screening applicants is extremely burdensome for entrepreneurs and small businesses, and creates a barrier to market entry. Some commenters argued that 49 U.S.C. 46111 does not require the FAA to wait until hearing back from TSA prior to granting the certificate, or that it does not confer the authority to pre-screen applicants for an airmen certificate. One commenter suggested that the knowledge testing centers be able to issue temporary certificates upon passing the knowledge test, which could be revoked if the TSA vetting process indicated that the individual should not be issued a remote pilot certificate.

As discussed previously, 49 U.S.C. 44903(j)(2)(D)(i) is unambiguous and states that the vetting must be completed before the FAA may issue an airman certificate. Given the relatively short time the vetting takes for the overwhelming majority of applicants, it is difficult to identify a burden that is not outweighed by the clear benefit of ensuring that certificate holders do not pose a threat to national or transportation security. Section 44903(j)(2)(D)(i) explicitly states that TSA screening of an individual must take place ''before'' that individual is certificated by the FAA.

In addition, 49 U.S.C. 44903(j)(2)(D) and 46111 vest the authority for vetting with TSA. Specifically, section 46111(a) states that ''[t]he Administrator of Federal Aviation Administration shall issue an order amending, modifying, suspending, or revoking any part of a certificate issued under this title if the Administrator is notified by the Under Secretary for Border and Transportation Security of the Department of Homeland Security that the holder of the certificate poses, or is suspected of posing, a risk of air piracy or terrorism or a threat to airline or passenger safety.'' (Emphasis added). Thus, under § 46111, the FAA's role in the vetting process is ministerial; the FAA acts on findings that have been made by the TSA, but it is TSA that makes the actual security determinations. Because the authority for making the pertinent security determination is vested with TSA, the Department does not have jurisdiction to alter the criteria and requirements of that determination in the manner suggested by the commenters.

The FAA acknowledges, however, the commenters' concern regarding the estimated 6-to-8-week timeframe associated with processing the certificate application. In response, this rule will allow an applicant who already holds a part 61 pilot certificate to obtain a temporary remote pilot certificate immediately upon FAA receipt of his or her application. The FAA is able to issue a temporary remote pilot certificate to part 61 pilot certificate holders prior to completion of new security vetting because these individuals have already been successfully completed the TSA vetting when they obtained their part 61 pilot certificates.

The FAA will also issue a temporary electronic remote pilot certificate to all other applicants who apply through IACRA upon successful completion of TSA security vetting. The FAA anticipates that, while it may take the FAA 6 to 8 weeks to issue a permanent remote pilot certificate, a temporary remote pilot certificate can be issued in about 10 business days. The temporary remote pilot certificate will allow the certificate holder to exercise all the privileges of the certificate, thus significantly reducing the waiting period prior to being able to operate as a remote pilot in command under part 107.

Just like a temporary pilot certificate issued under part 61,[143] a temporary remote pilot certificate with a small

[143] *See* 14 CFR 61.17.

UAS rating will be valid for 120 days after issuance. This will provide sufficient time for the FAA to complete its processing of the certificate application and issue the applicant a permanent remote pilot certificate. The temporary certificate will automatically expire once the applicant receives a permanent remote pilot certificate with a small UAS rating. The temporary certificate will also expire if the FAA discovers an issue with the certificate application and issues the applicant a notice that his or her certificate application is denied or the certificate (if one has already been issued) is revoked.

The FAA defers to TSA on whether current part 61 pilot certificate holders will have to continue to undergo the vetting process in order to receive a non-temporary remote pilot certificate with a small UAS rating. The FAA also notes that applicants who have passed STAs for other federal programs, received background checks, or hold U.S. passports will still need to satisfy TSA's STA specific to the statute that requires security vetting prior to issuance of an airmen's certificate (49 U.S.C. 44903). The FAA does not have jurisdiction to accept alternative documentation instead of a TSA security finding because, as discussed earlier, 49 U.S.C. 44903(j)(2)(D) and 46111 vest the pertinent jurisdiction in the TSA. In response to DJI, the FAA notes that a complete TSA vetting process is an integral part of the requirements of this rule because it reduces the risk of a person who poses a security threat obtaining an airman certificate under part 107.

ii. Issuance and Positive Identification

Regarding issuance and positive identification, many commenters suggested changes to the FAA's current process and responsibilities for testing, acceptance of airman applications, and issuance of airman certificates that would only apply to unmanned aircraft operator certificates with a small UAS rating. AirGon, as well as another individual commenter, generally suggested that the knowledge testing centers process the applications, verify the identity of the applicant and submit the applications to TSA.

As discussed in section III.F.2.k.iii above, knowledge testing centers will be required to positively verify the identity of the applicant prior to providing him or her with a knowledge test to ensure that someone else is not taking the test for the applicant. The NPRM proposed that an applicant who passes a knowledge test would then have to be positively identified a second time by a FSDO, DPE, ACR, or CFI. This second identification would impose a burden in the form of travel costs and service fees (charged by DPEs, ACRs, and CFIs) without benefits sufficient to justify this burden, as the applicant has already been positively identified. Accordingly, this rule will not require applicants who pass an aeronautical knowledge test to submit their application to a FSDO, DPE, ACR, or CFI. Instead these applicants may submit their paper application via mail or electronically via IACRA.

The FAA notes, however, that as discussed previously, part 61 pilot certificate holders who have completed a flight review within the previous 24 months will have the option to take an online training course instead of an aeronautical knowledge test. Because part 61 pilot certificate holders who elect to exercise this option will not be positively identified at a knowledge testing center, this rule will require them to submit their remote pilot application to a FSDO, DPE, ACR, or CFI so that the person accepting their application can positively verify the identity of the applicant and establish that the applicant has met the eligibility requirements of the remote pilot certificate with small UAS rating.

Under this approach, FSDOs, DPEs, and ACRs, who can currently accept applications for an airman certificate, will continue doing so for part 61 pilot certificate holders who take the online training course instead of a knowledge test. Additionally, as proposed in the NPRM, CFIs will also be able to accept remote pilot certificate applications because CFIs are recognized by TSA regulations as being able to verify identity.[144] The FAA notes that there is an approximate combined total of 100,000 DPEs, ACRs, and CFIs, all of whom will be able to accept an airman application and verify identity of part 61 pilot certificate holders under this rule.

ALPA questioned the use of the term ''student pilot'' in the TSA vetting section of the NPRM. The FAA acknowledges the terminology should have been ''applicant for remote pilot certificate with small UAS rating'' and will correct the terminology in the final rule accordingly.

3. Remote Pilot Certificate Denial, Revocation, Suspension, Amendment, and Surrender

As proposed in the NPRM, this rule will allow the FAA to deny, suspend, or revoke a certificate for reasons including drug or alcohol offenses and refusal to submit to an alcohol test or furnish the results.[145] Additionally, as discussed in the Remote Pilot Certificate Issuance and Eligibility section of this preamble, this rule will allow the FAA to deny, suspend, or revoke a certificate if TSA makes a finding that the applicant or certificate holder poses a security risk. This rule will also require certificate holders to notify the FAA of any change in name or address. Finally, certificate holders will be able to voluntarily surrender their certificates.

a. Drugs and Alcohol Violations

The FAA adopts the provisions related to drug and alcohol violations as proposed in the NPRM. Accordingly, under § 107.57(a), the FAA may deny a remote pilot certificate application or take other certificate action for violations of Federal or State drug laws. Certificates could also be denied, suspended, or revoked under § 107.57(b) for committing an act prohibited by § 91.17 or § 91.19, as discussed in section III.I of this preamble.

One commenter stated that any remote pilot should lose his or her privileges under part 107 if found to be operating while in a condition that does not permit safe operation of the small UAS. Another commenter suggested that remote pilot certificates should be denied, suspended or revoked for committing an act prohibited by 14 CFR 91.17 or § 91.19.

The FAA agrees. Under this rule, if a person violates § 91.17 or § 91.19, the FAA can take enforcement action, which may result in the imposition of civil penalties or suspension or revocation of that person's airman certificate. Section 107.59 of this rule specifies that certificate action could be taken for: (1) failure to submit to a blood alcohol test or to release test results to the FAA as required by § 91.17; or (2) carriage of illegal drugs in violation of § 91.19.

b. Change of Name

Section 107.77(a) will allow a person holding a remote pilot certificate with a small UAS rating to change the name on the certificate by submitting a name-change application to the FAA accompanied by the applicant's: (1) Remote pilot certificate; and (2) copy of the marriage license, court order, or other document verifying the name change. After reviewing these documents, the FAA will return them to the applicant. These procedures mirror the regulations governing pilot

[144] *See* 49 CFR 1552.3(h)(1).

[145] These requirements are similar to the ones imposed on part 61 pilot certificates by §§ 61.15(a) and 61.16.

certificates currently issued under part 61. The FAA did not receive any adverse comments on these provisions when they were proposed in the NPRM.

c. Change of Address

This rule will extend the existing change-of-mailing-address requirement of part 61 to holders of a remote pilot certificate with a small UAS rating. Specifically § 107.77(c) will require a certificate holder who has made a change in permanent mailing address to notify the FAA within 30 days of making the address change. Failure to do so will prohibit the certificate holder from exercising the privileges of the airman certificate until he or she has notified the FAA of the changed address. This regulatory provision will help ensure that the FAA is able to contact airman certificate holders. The FAA did not receive any adverse comments on this provision when it was proposed in the NPRM.

d. Voluntary Surrender of Certificate

Section 107.79 will allow the holder of a remote pilot certificate with a small UAS rating to voluntarily surrender it to the FAA for cancellation. However, the FAA emphasizes that cancelling the certificate pursuant to § 107.79 will mean that the certificate no longer exists, and the individual who surrendered the certificate will need to again go through the entire certification process if he or she subsequently changes his or her mind. For individuals who are not part 61 pilot certificate holders, this includes passing the initial aeronautical knowledge test. Accordingly, § 107.79(b) will require the individual surrendering the certificate to include the following signed statement (or an equivalent) in his or her cancellation request:

> I voluntarily surrender my remote pilot certificate with a small UAS rating for cancellation. This request is made for my own reasons with full knowledge that my certificate will not be reissued to me unless I again complete the requirements specified in § 107.61 and § 107.63.

The FAA did not receive any adverse comments on this provision when it was proposed in the NPRM.

e. Additional Comments on Remote Pilot Certificate

Several commenters, including National Business Aviation Association, the State of Nevada, and Southern Company, agreed that unmanned aircraft operator certificates with a small UAS rating should not expire. On the other hand, two commenters suggested that the certificate should expire every 2 years, and that the FAA should require passing the recurrent knowledge test for renewal. The American Insurance Association said that employees of insurance companies who operate micro UAS should only have to be certificated once and there should be no annual two year renewal unless the insurance company elects to replace its selected micro UAS.

NetMoby commented that an unmanned aircraft operator certificate with a small UAS rating should be automatically revoked if the remote pilot fails a recurrent aeronautical knowledge test. Other commenters suggested that there should be a process for the FAA to revoke an unmanned aircraft operator certificate with a small UAS rating if the operator operates a UAS in an unsafe manner. NetMoby also suggested that a remote pilot who violates the prohibition regarding UAS operation in certain airspace should have their unmanned aircraft operator certificate with a small UAS rating revoked for life.

As with other pilot certificates issued by the FAA, a remote pilot certificate with a small UAS rating will never expire. However, under the provisions of this rule, after a person receives a remote pilot certificate with a small UAS rating, that person will have to demonstrate that they have retained the required aeronautical knowledge in order to retain the privileges to operate a small unmanned aircraft. As discussed in section III.F.2.g of this preamble, a remote pilot who does not hold a part 61 pilot certificate will have to pass a recurrent aeronautical knowledge test given by an FAA knowledge testing center every 24 calendar months after the issuance of a new remote pilot certificate with a small UAS rating to continue to exercise the privileges of that certificate in the NAS. A remote pilot who holds a part 61 pilot certificate will have to either maintain a current flight review and complete an online recurrent training course every 24 calendar months, or pass a recurrent aeronautical knowledge test as described above. This will ensure that a remote pilot continues to retain the knowledge necessary to safely operate a small unmanned aircraft.

The FAA disagrees with comments suggesting automatic revocation of the certificate if a remote pilot fails a recurrent aeronautical knowledge test. Revoking the airman certificate would impose the cost of having to eventually reissue the certificate on FAA and TSA without a corresponding safety benefit. A certificate holder unable to show that he or she has passed either the initial or recurrent knowledge test within the preceding two-year period, or has maintained a current flight review and completed the online training course within the preceding two-year period, will be unable to exercise the privileges of his or her certificate until he or she meets the applicable currency requirements.

In response to comments asking the FAA to establish penalties for certain regulatory violations, the FAA clarifies that there already exists a process for addressing regulatory violations, which can be found in 14 CFR part 13. Part 13 specifies the penalties that the FAA may impose in response to a regulatory violation, and, in appropriate circumstances, those penalties may include the revocation of an individual's airman certificate.[146] The FAA has also issued guidance on potential sanctions that may be imposed for specific regulatory violations. This guidance can be found in Chapter 7 and Appendix B of FAA Order 2150.3B.

G. Registration and Marking

The NPRM proposed applying to small UAS the then-existing registration requirements that applied to all aircraft. The NPRM also proposed requiring that all small UAS have their registration and nationality marks displayed in accordance with Subpart C of part 45.

Approximately 125 commenters provided input on the proposed registration requirement or the associated process, with most commenters stating that it was a reasonable or necessary requirement. Of the roughly 110 commenters that addressed the proposed marking requirements, most supported requiring identification markings on small UAS.

On December 16, 2015, subsequent to the issuance of the NPRM for this rule, the FAA published the *Registration and Marking Requirements for Small Unmanned Aircraft* interim final rule (Registration Rule).[147] In the Registration Rule, the FAA considered and addressed the comments it received in response to the registration and marking proposals in the NPRM for this rule. As a result, the Registration Rule provided a streamlined and simple web-based aircraft registration process for the registration of small unmanned aircraft, as well as a simpler method for marking small unmanned aircraft. The Registration Rule invited further comment on its contents and the FAA will consider any significant issues that are raised by the commenters.

Because the registration and marking components that were originally part of

[146] *See* 14 CFR part 13, subpart C.

[147] *Registration and Marking Requirements for Small Unmanned Aircraft,* 80 FR 78594 (Dec. 16, 2015).

the NPRM for this rule are now being addressed in a different rulemaking (the Registration Rule), these components are no longer a part of this rule. Thus, instead of imposing any new registration or marking requirements, this rule will simply require that any person operating a civil small UAS for purposes of flight comply with the existing requirements of § 91.203(a)(2). Section 91.203(a)(2) requires a person operating a civil small unmanned aircraft to have an effective U.S. registration certificate that is readily available to the owner or operator, as applicable.[148]

H. Fraud and False Statements

Currently, the U.S. criminal code prohibits fraud and falsification in matters within the jurisdiction of the executive branch.[149] The FAA too may impose civil sanctions in instances of fraud and falsification in matters within its jurisdiction.[150]

The NPRM proposed to prohibit a person from making a fraudulent or intentionally false record or report that is required for compliance with the provisions of part 107. The NPRM also proposed to prohibit a person from making any reproduction or alteration, for a fraudulent purpose, of any certificate, rating, authorization, record, or report that is made pursuant to part 107. Finally, the NPRM proposed to specify that the commission of a fraudulent or intentionally false act in violation of § 107.5(a) could result in the denial, suspension, or revocation of a certificate or waiver issued by the FAA pursuant to this proposed rule. For the reasons discussed below, this rule will finalize these provisions as proposed with some minor revisions for clarification purposes.

Three organizations and one individual commented on the proposal to prohibit fraud and false statements, and all of those commenters generally supported the proposal. For example, the Small UAV Coalition stated that they support the FAA's proposal to prohibit intentionally false or fraudulent documents used to show compliance with part 107, and added that such false or fraudulent records or reports warrant enforcement action. One individual supported ''heavy fines or jail'' for those providing false information.

Two commenters, the University of North Dakota's John D. Odegard School of Aerospace Sciences and the Institute of Makers of Explosives, requested clarification as to the penalties that could be imposed for violating the prohibition on fraud and false statements. The University of North Dakota's John D. Odegard School of Aerospace Sciences asked whether FAA Order 2150.3B would be applicable in its existing form to operations under part 107 and if so, whether the sanctions guideline ranges described in that publication are appropriate for violations of part 107.

Subpart C of 14 CFR part 13 specifies the penalties that the FAA may impose in response to a regulatory violation. To provide further clarity, the FAA has amended § 107.5 with a list of potential sanctions that could be imposed in response to a violation of § 107.5. Those sanctions may, among other things, include a civil penalty or certificate action. The FAA has also issued generally applicable guidance on sanctions that may be imposed for regulatory violations, which can be found in FAA Order 2150.3B. The FAA is currently considering whether Order 2150.3B addresses UAS-specific considerations that may arise in enforcement actions under part 107, and the agency may revise this order, as appropriate, to reflect this consideration.

I. Oversight

This section discusses two aspects of FAA oversight of part 107 small UAS operations. First, this section discusses inspection, testing, and demonstration of compliance requirements applicable to a part 107 operation. Second, this section discusses the accident-reporting requirements that part 107 will impose on the remote pilot in command.

1. Inspection, Testing, and Demonstration of Compliance

The FAA's oversight statutes, codified at 49 U.S.C. 44709 and 46104, provide the FAA with broad investigatory and inspection authority for matters within the FAA's jurisdiction. Under section 46104, the FAA may subpoena witnesses and records, administer oaths, examine witnesses, and receive evidence at a place in the United States that the FAA designates. Under section 44709, the FAA may ''reinspect at any time a civil aircraft, aircraft engine, propeller, appliance, design organization, production certificate holder, air navigation facility, or agency, or reexamine an airman holding a certificate issued [by the FAA].''

The NPRM proposed to codify the FAA's oversight authority in proposed § 107.7. First, § 107.7 would require the airman, visual observer, or owner of a small UAS to, upon FAA request, allow the FAA to make any test or inspection of the small unmanned aircraft system, the airman, and, if applicable, the visual observer to determine compliance with the provisions of proposed part 107. Second, § 107.7 would require an airman or owner of a small UAS to, upon FAA request, make available to the FAA any document, record, or report required to be kept by the applicable FAA regulations. For the reasons discussed below, this rule will finalize these provisions as proposed.[151]

The Department of Defense Policy Board on Federal Aviation suggested that § 107.7(a) be reworded to limit its applicability to ''civil operators,'' not operators in general. The commenter asserted that this change would preserve public operators' statutory authorities.

As discussed in section III.C.3 of this preamble, the applicability of part 107 is limited to civil aircraft. Thus, part 107 will not apply to public aircraft operations. Because public aircraft operations will not be subject to § 107.7 (or any other provision of part 107) there is no need to amend the regulatory text of § 107.7 with regard to civil aircraft.

The Kansas State University UAS Program asked the FAA to clarify, with respect to § 107.7(b), what types of tests or inspections could be performed on the remote pilot or visual observer. Specifically, the commenter suggested that the FAA define whether such persons could be subjected to blood alcohol tests, drug tests, or knowledge tests. They also recommend that the section be reworded to reference § 91.17(c).

Section 107.7(b) codifies the FAA's authority under 49 U.S.C. 44709 and 46104, which allow the FAA to inspect and investigate the remote pilot. This may involve a review, reinspection, or requalification of the remote pilot. With regard to requalification, 49 U.S.C. 44709 and § 107.7(b) allow the FAA to reexamine a remote pilot if the FAA has sufficient reason to believe that the remote pilot may not be qualified to exercise the privileges of his or her certificate. Additional guidance concerning the reexamination process can be found in FAA Order 8900.1, ch. 7, sec. 1.

Pertaining to the visual observer, as an active participant in small UAS operations, this person may be questioned with regard to his or her

[148] *Id.* at 78623.

[149] 18 U.S.C. 1001.

[150] The FAA has exercised this power in 14 CFR 61.59, 67.403, 121.9, and 139.115, which currently impose civil prohibitions on fraud and false statements made in matters within the FAA's jurisdiction.

[151] The original provisions in the NPRM referred to ''operator.'' However, due to the change in crewmember titles (discussed in section III.E.1 of this preamble), the term ''operator'' has been replaced by the remote pilot in command.

involvement in the operation. For example, if an FAA inspector has reason to believe that a visual observer was not provided with the preflight information required by § 107.49, the inspector may ask the visual observer questions to ascertain what happened. Because the visual observer is not an airman, the visual observer will not be subject to reexamination.

With regard to § 91.17(c), the FAA notes that, as discussed in section III.E.7.b of this preamble, § 107.27 will, among other things, require the remote pilot in command, the visual observer, and the person manipulating the flight controls of a small UAS to comply with § 91.17. This includes compliance with the alcohol-testing requirements of § 91.17(c).

The City and County of Denver, Colorado suggested that airports be given the same rights as those granted to the FAA under § 107.7(b). The commenter argued that airport operators have a duty to protect airport property, and that that duty can be fulfilled only when the airport operator has the opportunity to determine the nature and airworthiness of a small UAS.

AUVSI suggested that the FAA allow designated representatives pursuant to 14 CFR part 183 to act on behalf of the Administrator in order to determine compliance with the new regulatory standards. The commenter asserted that the FAA will not have the necessary manpower or financial resources required to allow the UAS industry and its technology to continue to evolve at its own pace. An individual commenter suggested that the FAA delegate compliance and enforcement authority to law enforcement officers and NTSB representatives.

The FAA's statute does not authorize the agency to delegate its formal enforcement functions. Because it lacks the pertinent statutory authority, the FAA cannot delegate its enforcement functions in the manner suggested by the commenters. The FAA notes, however, that even though it cannot delegate its formal enforcement functions, it has worked closely with outside stakeholders to incorporate their assistance in its oversight processes. For example, the FAA has recently issued guidance to State and local law enforcement agencies to support the partnership between the FAA and these agencies in addressing unauthorized UAS activities.[152] The FAA anticipates continuing its existing partnerships to help detect and address unauthorized UAS activities, and the agency will consider other stakeholders' requests to be part of the process of ensuring the safe and lawful use of small UAS.

One individual suggested that a remote pilot in command must enable and make available to the FAA any flight log recording if the aircraft and/or control station is capable of creating such a recording. In response, the FAA notes that this rule does not require that a small UAS operation have the capability to create a flight log recording. However, if a small UAS does create such a recording, § 107.7(b) will allow the FAA to inspect the small UAS (including the recording made by the small UAS) to determine compliance with the provisions of part 107.

One individual suggested that the wording of § 107.7(b) be modified to permit the FAA to conduct only ''non-destructive testing'' in the event of a reported violation of one or more provisions of part 107. The commenter asserts that, as written, § 107.7(b) would permit the FAA to ''destructively test'' every small UAS ''on whim.''

The FAA declines this suggestion because there could be circumstances where destructive testing of a small UAS may be necessary to determine compliance with part 107. The FAA emphasizes, however, that this type of decision would not be made lightly and would not be part of a typical FAA inspection. For example, the FAA's guidance to FAA inspectors about how to conduct a typical ramp inspection specifically focuses on non-destructive methods that the inspector can use to determine whether an aircraft is in compliance with FAA regulations.[153] The FAA anticipates that, just as with manned aircraft, destructive testing of a small UAS will, if ever conducted, occur highly infrequently.

One individual recommended that § 107.7 be modified to require a remote pilot to make a photo ID available to the FAA on demand. The FAA did not propose this requirement in the NPRM, and as such, it is beyond the scope of this rule.

2. Accident Reporting

To ensure proper oversight of small UAS operations, the NPRM proposed to require a small UAS operator to report to the FAA any small UAS operation that results in: (1) Any injury to a person; or (2) damage to property other than the small unmanned aircraft. The report would have to be made to the FAA within 10 days of the operation that resulted in injury or damage to property. After receiving this report, the FAA may conduct further investigation to determine whether any FAA regulations were violated.

The NPRM invited comments as to whether this type of accident reporting should be required. The NPRM also invited comments as to whether small UAS accidents that result in minimal amounts of property damage should be exempted from the reporting requirement, and, if so, what threshold of property damage should trigger the accident reporting requirement. For the reasons discussed below, this rule will require accident reporting of accidents that result in at least: (1) Serious injury to any person or any loss of consciousness; or (2) damage to any property, other than the small unmanned aircraft, unless the cost of repair (including materials and labor) or fair market value in the event of total loss does not exceed $500.

Most of the commenters who addressed this issue generally supported an accident reporting requirement. However, the commenters questioned whether the proposed requirement to report any injury or property damage is too broad because it does not consider the severity of the injury or property damage. To correct what they also saw as an overly broad accident reporting requirement, most of the commenters recommended the proposed requirement be amended to stipulate that reporting is required only for operations that cause injury or property damage above certain thresholds.

A number of commenters recommended general thresholds for reportable injuries and property damage. For example, the Drone User Group Network said an operation should be reportable if it involves ''significant'' injury or property damage. The University of North Dakota's John D. Odegard School of Aerospace Sciences said an operation should be reportable if it involves ''serious'' injury or ''substantial'' property damage; such a requirement, the commenter pointed out, is in line with the NTSB definition of ''occurrence'' and the FAA definition of ''accident.'' AIA suggested a reporting requirement for operations causing ''serious bodily harm (those requiring hospitalization, for instance)'' or ''substantial'' property damage. AUVSI, University of North Carolina System, and Prioria said operations resulting in minor injuries or minimal damage to property should not be required to be reported in the same manner as more serious injuries or substantial damage to property. UPS said an operation should be reportable if it causes an injury that requires medical attention or property

[152] A copy of the guidance document can be found at: *https://www.faa.gov/uas/regulations_policies/media/FAA_UAS-PO_LEA_Guidance.pdf.*

[153] *See* FAA Order 8900.1, ch. 1, sec. 4, par. 6–100(G)–(I).

damage that exceeds a threshold amount ''sufficient to exclude insignificant incidents.'' An individual commenter recommended a reporting requirement for operations that result in injury or property damage ''which is over the upper monetary limit of the small claims court jurisdiction.''

Several commenters recommended more specific thresholds for reportable injuries and property damage. These commenters generally recommended a requirement that the injury caused by the operation be one that necessitates some sort of medical attention and that the property damage caused by the operation exceed some minimum monetary threshold, ranging from $100 to $25,000. For example, commenters recommended some of the following specific thresholds be added to the proposed accident reporting requirement:

- Modovolate Aviation and Aviation Management said an operation should be reportable if it causes injury requiring ''hospitalization or other treatment by a provider of medical care,'' or ''professional medical assistance,'' respectively, or property damage of $1,000.
- NBAA said an operation should be reportable if a person has to seek medical treatment as a result of the operation or if property damage exceeds $1,000 or if a police report is filed.
- NAMIC said an operation should be reportable if it causes injury ''requiring professional medical treatment'' or property damage greater than $2,000.
- The Travelers Companies said an operation should be reportable if it causes '''serious' injuries caused by impact of the UAS'' or property damage of over $5,000.
- Clean Gulf Associations said an operation should be reportable if it causes injury ''which requires professional medical treatment beyond first aid or death to any person'' or property damage greater than $10,000.
- Jam Aviation said an operation should be reportable if it causes injury ''that requires emergency medical attention'' or property damage that exceeds $25,000 or fair market value in the event of total loss, whichever is less.
- Skycatch, Clayco, AECOM, and DPR Construction said an operation should be reportable if it causes injury ''requiring assistance of trained medical personnel'' or property damage in excess of $20,000.

The California Department of Transportation, Virginia Commonwealth University Honors Students, Southern Company, and a few individual commenters suggested that the accident reporting requirement in this rule should be modeled after the accident reporting requirement for manned aircraft, which, among other things, requires an operator to notify NTSB of an accident resulting in death or ''serious injury'' (see 49 CFR 830.2) or of damage to property, other than the aircraft, estimated to exceed $25,000 for repair (including materials and labor) or fair market value in the event of total loss, whichever is less. (See 49 CFR 830.5(a)(6)).

The Kansas State University UAS Program and Cherokee Nation Technologies said the FAA should follow the NTSB reporting requirement for property damage, but made no comment regarding the injury component of the proposed accident reporting requirement. NTSB also pointed to the manned-aircraft reporting requirement for property damage and suggested the FAA take this, and other criteria included in 49 CFR part 830, into account. An individual commenter pointed out that the NTSB has specific reporting requirements for UAS, and said the FAA's proposed accident reporting requirement should therefore be amended to begin with the phrase: ''In addition to UAS accident/incident reporting requirement of the National Transportation Safety Board. . . .''

Several other commenters also only addressed the property damage component of the accident reporting requirement. An individual commenter said no accident need be reported where the property damage is considered inconsequential by the owner of the property. SkySpecs recommended a reporting requirement for property damage above $100, or if an insurance report is filed. The Center of Innovation-Aerospace, Georgia Department of Economic Development recommended a $500 threshold, which it said is a common deductible amount for property and automobile insurance. The Oklahoma Governor's Unmanned Aerial Systems Council (which explicitly supported the proposed requirement to report all accidents resulting in any injury) expressed concern that a threshold lower than $1,000 would result in unnecessary and burdensome reporting of information and data that would not be beneficial to the FAA, the public, or the industry in general. The American Insurance Association recommended a $5,000 threshold for property damage. The Small UAV Coalition (who also supported the proposed requirement to report accidents causing any injury) said accidents resulting in property damage should only be reportable if the damage caused is to the property of someone not involved in the operation. The commenter did not propose a minimum monetary threshold for this property damage to be reportable.

DJI, which opposed applying the NTSB accident reporting criteria to small UAS, suggested that the FAA look to how other Federal agencies, such as the National Highway Traffic Safety Administration, categorize injury by level of severity. Airport Council International-North America and Clean Gulf Associations said the injury component of the proposed accident reporting requirement should be expanded to include a requirement to report all accidents resulting in death.

Two commenters specifically addressed operations in an industrial setting that may result in injury or property damage. The American Chemistry Council said there should be no reporting requirement for operations in an industrial setting that cause workplace injuries that are covered by OSHA reporting requirements or cause less than $25,000 in damage to private property that is owned and operated by the facility owner. Associated General Contractors of America also encouraged the FAA to exclude any operations resulting in ''OSHA-recordable'' injuries. The commenter further recommended the FAA exclude operations resulting in ''de minimis'' property damage from the reporting requirement.

The FAA agrees with commenters who suggested that injuries and property damage falling below certain thresholds should not be reportable. Requiring remote pilots in command to report minimal injuries (such as a minor bruise from the unmanned aircraft) or minimal property damage (such as chipping a fleck of paint off an object) would impose a significant burden on the remote pilots. This burden would not correspond to a safety/oversight benefit because an operation resulting in minimal injury or minimal property damage may not correspond with a higher likelihood of a regulatory violation.

In determining the threshold at which to set injury reporting, the FAA agrees with commenters who suggested that the threshold should generally be set at serious injury. A serious injury is an injury that qualifies as Level 3 or higher on the Abbreviated Injury Scale (AIS) of the Association for the Advancement of Automotive Medicine. The AIS is an anatomical scoring system that provides a means of ranking the severity of an injury and is widely used by emergency medical personnel. Within the AIS system, injuries are ranked on a scale of 1 to 6, with Level 1 being a minor injury, Level 2 moderate, Level 3

serious, Level 4 severe, Level 5 critical, and Level 6 a non-survivable injury. An AIS Level 3 injury is one that is reversible but usually involves overnight hospitalization.

AIS SEVERITY LEVELS

AIS Level	Severity	Type of injury
1	Minor	Superficial.
2	Moderate ..	Reversible injury; medical attention required.
3	Serious	Reversible injury; hospitalization required.
4	Severe	Life threatening; not fully recoverable without medical care.
5	Critical	Non-reversible injury; unrecoverable even with medical care.
6	Virtually Un-Survivable.	Fatal.

The FAA currently uses serious injury (AIS Level 3) as an injury threshold in other FAA regulations.[154] DOT and FAA guidance also express a preference for AIS methodology in classifying injuries for the purpose of evaluating the costs and benefits of FAA regulations.[155] Additionally, the U.S. National Highway Traffic Safety Administration (NHTSA) uses AIS level 3 injuries as the metric evaluating the effectiveness of occupant safety measures for automobiles [156] and for estimating the costs associated with automobile accidents.[157] The FAA has significant operational experience administering the serious-injury threshold and because the AIS Level 3 standard is widely used and understood, it is the appropriate injury threshold to use in this rule.

In addition to serious injuries, this rule will also require accident reporting for accidents that result in any loss of consciousness because a brief loss of consciousness may not rise to the level of a serious injury. However, the confined-area-of-operation regulations discussed in section III.E.3 of this preamble, such as the general prohibition on flight over people, are designed with the express purpose of preventing accidents in which a small unmanned aircraft hits a person on the head and causes them to lose consciousness or worse. Thus, if there is a loss of consciousness resulting from a small UAS operation, there may be a higher probability of a regulatory violation.

With regard to the threshold for reporting property damage, the FAA agrees with the Center of Innovation-Aerospace, Georgia Department of Economic Development, which suggested a property damage threshold of $500. Property damage below $500 is minimal and may even be part of the remote pilot in command's mitigations to ensure the safety of the operation. For example, a remote pilot in command may mitigate risk of loss of positive control by positioning the small UAS operation such that the small unmanned aircraft will hit uninhabited property in the event of a loss of positive control. However, property damage above $500 is not minimal, and as such, this rule will require reporting of a small UAS accident resulting in property damage exceeding $500.

In calculating the property damage, the FAA notes that sometimes, it may be significantly more cost-effective simply to replace a damaged piece of property rather than repair it. As such, for purposes of the accident-reporting requirement of part 107, property damage will be calculated by the lesser of the repair price or fair market value of the damaged property. For example, assume a small UAS accident that damages a piece of property whose fair market value is $200. Assume also that it would cost $600 to repair the damage caused by the small UAS accident. In this scenario, the remote pilot in command would not be required to report the accident because the fair market value would be lower than the repair cost, and the fair market value would be below $500. The outcome would be the same if the values in the scenario are reversed (repair cost of $200 and fair market value of $600) because the lower value (repair cost) would be below $500.

Transport Canada questioned whether small UAS operators would be permitted to continue operating their UAS after experiencing an accident/incident, or whether they would be expected to cease operations until the accident has been reported and the causal factors addressed. In response, the FAA notes that a remote pilot would need to cease operations only if the FAA revokes or suspends the remote pilot certificate or the unmanned aircraft, as a result of the accident, is no longer in a condition for safe operation in accordance with part 107.

A few commenters recommended changes to the 10-day deadline for reporting operations that result in injury or property damage. The American Insurance Association said the reporting deadline should be changed to 10 business days. The Kansas State University UAS Program recommended a 3-day reporting deadline. The Professional Helicopter Pilots Association and Virginia Department of Aviation recommended a 48-hour reporting deadline, while an individual commenter suggested a 24-hour deadline. The Oregon Department of Aviation also recommended the FAA shorten the proposed 10-day reporting deadline, but did not suggest an alternative deadline. DroneView Technologies suggested a 3-hour reporting deadline.

An accident triggering the reporting requirement of § 107.9 may involve extensive injuries or property damage. The remote pilot in command's first priority should be responding to the accident by, among other things, ensuring that any injured people receive prompt medical attention. Having to immediately draft an accident report for the FAA may interfere with that priority, and as such, the FAA declines to make the reporting deadline shorter than the 10 calendar days proposed in the NPRM. The FAA also declines to extend the reporting deadline beyond 10 calendar days because 10 days should provide a sufficient amount of time to respond to the accident and draft an accident report for the FAA.

Several other commenters, including NBAA, and NAMIC, recommended that the FAA create an online reporting system. NBAA also recommended the FAA work with NASA to determine what modifications if any would be required to the Aviation Safety Reporting System (ASRS) to accommodate small UAS reports. An individual commenter similarly recommended the ASRS be expanded to allow small UAS operators to make reports of unsafe actions on the part of manned aircraft or other small UAS operators. That commenter also suggested the FAA consider creating an online reporting mechanism for operators to voluntarily provide operational data without fear of enforcement actions being taken against them. GAMA requested that the FAA review the agency's Near-Midair Collision System (NMACS) incident

[154] *See Licensing and Safety Requirements for Launch, Supplemental Notice of Proposed Rulemaking,* 67 FR 49456, 49465, July 30, 2002.

[155] *See Economic Values for FAA Investment and Regulatory Decisions,* sec. 2, available at: *https://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/media/econ-value-section-2-tx-values.pdf. See also DOT Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Aviation Analyses,* available at *https://www.transportation.gov/sites/dot.dev/files/docs/VSL%20Guidance.doc.*

[156] Office of Regulatory Analysis and Evaluation, National Center For Statistics And Analysis, *FMVSS No. 214 Amending Side Impact Dynamic Test Adding Oblique Pole Test,* (Aug. 2007).

[157] Blincoe, L. et al, *The Economic Impact of Motor Vehicle Crashes,* DOT HS 809 446 (May 2000).

reporting system to ensure that the existing business rules for reporting NMACs appropriately consider UAS. Texas A & M University-Corpus Christi/LSUASC suggested the COA online portal be used for accident reporting. Virginia Commonwealth University Honors Students also stated that reporting of incident data to the U.S. Department of Interior's SAFECOM system should continue as well.

This rule will allow an accident report to be submitted to the FAA electronically. The part 107 advisory circular provides guidance about how to electronically submit an accident report.

Several commenters recommended that certain incidents other than operations resulting in injury or property damage should also be reportable. The State of Nevada, the Nevada Institute for Autonomous Systems, and the Nevada FAA-designated UAS Test Site, commenting jointly, said the accident reporting requirement should be expanded to include a requirement to report any ''lost platform'' incident. ALPA, AIA, AUVSI, and University of North Carolina System also said the proposed rule should include a reporting requirement for ''lost link'' or ''fly away'' incidents. ALPA asserted that such a reporting requirement will allow the FAA to develop hard data on the reliability of these systems and therefore more accurately evaluate risk.

Modovolate said operations that involve complete loss of control or failure of automated safety systems such as airspace exclusion or return to home should also be reportable. An individual commenter said reports should be filed for operations where there is: Failure of the control device, failure of the flight control system, flyaway (lateral or vertical), loss of control as a result of either electrical failure or radio interference, or a close encounter with a manned aircraft where the manned aircraft was observed to make ''an abrupt avoidance maneuver.'' Airport Council International-North America similarly recommended the accident reporting requirement be expanded to include an operation where an operator was required to take evasive action to avoid manned aircraft, especially in cases where such actions took place within 5 miles of airports. The Professional Helicopter Pilots Association recommended a reporting requirement for all accidents involving other aircraft during flight (whether manned or unmanned), as well as all accidents resulting in substantial damage to the operator's UAS.

CAPA noted that the proposal does not address reporting ''HATR or other incidents that do not rise to the level or property damage or injury.'' The commenter recommended these incidents be reported and tracked ''to ensure this policy is effective and continues to provide safe operating procedures for small UAS operations as they interface with commercial and civil aviation traffic.'' ALPA suggested there would be a potential safety benefit to establishing a process for small UAS owners to report malfunctions, identified defects, and other in-service problems. ALPA noted that this operational data could be used in subsequent risk evaluation.

The purpose of the accident-reporting requirement in this rule is to allow the FAA to more effectively allocate its oversight resources by focusing on potential regulatory violations that resulted in accidents. The FAA declines to mandate reporting of other events, such as the ones suggested by the commenters, because they do not rise to the level of a significant accident. The FAA notes, however, that a regulatory violation can occur without resulting in a serious accident and any regulatory violation may be subject to enforcement action.

The FAA also notes that the Aviation Safety Reporting System (ASRS) is available for voluntary reporting of any aviation safety incident or situation in which aviation safety may have been compromised. The FAA offers ASRS reporters guarantees and incentives to encourage reporting by holding ASRS reports in strict confidence and not using ASRS information against reporters in enforcement actions. Further, the FAA agrees that data collection is a valuable tool for determining a baseline for performance, reliability, and risk assessment. The FAA plans to develop a tool where remote pilots of small UAS can voluntarily share data which may not meet the threshold for accident reporting. This would provide a means for evaluation of operational integrity for small UAS.

NOAA supported the proposed accident reporting requirement, but said it should be expanded to include a requirement to report an operation that results in injury to protected wildlife. NOAA asserted that because many wildlife are also federally regulated, managed, and/or protected species, it is critical that the FAA require reporting of injury to these species, so other Federal agencies and interested parties can assess potential hazards caused by small UAS.

The FAA currently provides a way for all aircraft operators in the NAS to voluntarily report wildlife strikes. Small UAS remote pilots who encounter a wildlife strike may also submit a report. Further, remote pilots may be obligated to report death or injury to wildlife under Federal, State, or local law.

A few commenters opposed the imposition of an accident reporting requirement. Trimble argued that the damage a small UAS can cause is ''sufficiently small'' that operators should not have an obligation to report an accident to the FAA or NTSB. Instead, the commenter said, if an operator is unable to land a small UAS safely and an incident occurs, the operator should only be required to notify local law enforcement. An individual commenter who opposed a reporting requirement recommended ''developing law enforcement relationships to facilitate investigations, insurance claims, etc.''

The FAA disagrees with commenters who suggested that no data should be reported to the FAA. As discussed earlier, the FAA plans to use data collected from these reports to more effectively allocate its oversight resources. In response to the argument that accidents caused by small UAS are small, the FAA notes that reporting for accidents resulting in minor injuries or property damage below $500 will not be required.

The FAA has long-established relationships with law enforcement and values the assistance that law enforcement provides during accident/incident investigations. However, as discussed earlier, the FAA cannot delegate its formal enforcement authority to other entities such as local law enforcement personnel.

J. Statutory Findings

In order to determine whether certain UAS may operate safely in the NAS pursuant to section 333 of Public Law 112–95, the Secretary must find that the operation of the UAS will not: (1) Create a hazard to users of the NAS or the public; or (2) pose a threat to national security.[158] The Secretary must also determine whether small UAS operations subject to this proposed rule pose a safety risk sufficient to require airworthiness certification.[159]

1. Hazard to Users of the NAS or the Public

Pursuant to section 333 of Public Law 112–95, the Secretary proposed to find that small UAS operations subject to part 107 would not create a hazard to users of the NAS or the public. The Secretary proposed this finding after

[158] Sec. 333(b)(1).

[159] Sec. 333(b)(2).

concluding that the two primary safety concerns associated with small UAS operations—the ability to ''see and avoid'' other aircraft with no pilot on board and the operator losing positive control of the small unmanned aircraft—would be mitigated by the other provisions of the proposed rule. The NPRM invited comments on the proposed finding that small UAS operations subject to the proposed rule would not create a hazard to users of the NAS or the public.

NRECA and NBAA supported the proposed finding, without further comment. NetMoby and Planehook, on the other hand, disagreed with the proposed finding. NetMoby argued that ''[s]imply because the UAS is smaller than a manned aircraft does not necessarily mean that it does not pose a risk to the NAS or the public.'' Planehook argued that while operations conducted by ''properly trained and conscientious operators'' may not create a hazard to users of the NAS or the public, an operator may operate his or her small UAS in such a way that the operation does pose a hazard.

One commenter disagreed with the FAA's analysis of public risk, and therefore with the proposed finding that small UAS operations subject to the proposed rule would not create a hazard to users of the NAS or the public.

The FAA acknowledges NetMoby and Planehook's comments that even a small aircraft or a small UAS operated in a careless or reckless manner can cause a hazard to the NAS and the public. However the Secretary's finding is based on small UAS operations subject to the mitigations of part 107. Any operations conducted in a careless or reckless manner would be in violation of part 107. Additionally, although a smaller aircraft may pose a reduced hazard as compared to larger manned aircraft, the Secretary's finding is not based on the size of the aircraft alone. Rather, the combination of mitigations provided by part 107, including requiring operations to be conducted within visual line of sight; limiting maximum gross weight of the small unmanned aircraft to be below 55 pounds; limiting the operating altitude to below 400 feet AGL; requiring remote pilots to be certificated; defining area of operation; and prohibiting operations over any person not directly participating in the operation, support the Secretary's finding that this rule will not create a hazard to users of the NAS or the public.

In response to the individual commenter who disagreed with the Department's analysis of public risk, the agency notes that its hazard determination is based on the mitigations required by part 107, rather than the public risk as determined by calculating the probability of a small UAS harming an individual. Because small UAS come in many different shapes and sizes, and with varied capabilities, the FAA determined what hazards all small unmanned aircraft pose to the NAS and the public, and then put mitigations into part 107 to reduce those hazards. Based on these mitigations, the Secretary finds that operations subject to and compliant with part 107 pose no hazard to the public and the NAS.

2. National Security

Section 333 of Public Law 112–95 also requires the Secretary to determine whether the operation of UAS subject to this rule would pose a threat to national security. Part 107 will expand small UAS operations in the NAS to include non-hobby and non-recreational operations. Under part 107, these operations will be subject to specific requirements, such as being able to operate only during daylight (or civil twilight if there is anti-collision lighting) and only within visual line of sight of the remote pilot in command, the person manipulating the flight controls of the small UAS, and, if applicable, a visual observer.

In addition, the remote pilot in command of the small unmanned aircraft must obtain an FAA-issued remote pilot certificate with a small UAS rating. The process for obtaining this certificate includes the same TSA-review procedures that are currently used under 49 U.S.C. 46111 in order to screen out airman-certificate applicants who pose a security risk. Because the above provisions will limit the security risk that could be posed by small UAS operations subject to this rule, the Secretary proposed to find that these small UAS operations will not pose a threat to national security. The Department invited comments on this finding, and around 45 individuals and organizations commented on this subject.

Several commenters, including Aerius Flight and NRECA, explicitly agreed with the Secretary's proposed finding that small UAS operating under part 107 will not pose a threat to national security.

A number of other commenters identified ways in which small UAS could be used to threaten national security. Numerous commenters, including the International Brotherhood of Teamsters, American Fuel & Petrochemical Manufacturers, and Institute of Makers of Explosives, discussed the potential use of small UAS for criminal or terrorist purposes. The Teamsters noted several recent high-profile security breaches in the United States and Japan involving small UAS, and suggested that allowing package delivery would have the unintended result of facilitating the delivery and deployment of dangerous substances.

The Edison Electrical Institute and the American Petroleum Institute expressed concerns about the potential threat posed by small UAS to the nation's critical energy infrastructure. API suggests that petroleum and natural gas storage and transportation infrastructure (*e.g.,* pipelines) are critical to national security, and therefore the final rule should prohibit the unauthorized use of small UAS ''within appropriate limiting distance'' from such facilities or operations as refineries, distribution terminals, pipelines and similar infrastructure.

The Electronic Privacy Information Center provided great detail on the vulnerability of UAS to hacking, and stated that ''[t]he integration of drones into the NAS will mean that thousands of new, hackable devices will be hovering over our homes and streets without any clear security guidance, despite known vulnerabilities.'' EPIC argued that the weak security of the civil GPS system presents a danger to UAS operators and to the general public, and that the FAA must address and mitigate these vulnerabilities before UAS are integrated into the NAS. One individual argued that because UAS radio frequencies can be jammed, UAS pose a threat to national security.

Other commenters, including Planehook and the Travelers Companies, noted that there is no TSA vetting requirement for hobbyist operations conducted in accordance with section 336 of Public Law 112–95, and suggested that this will serve as a preexisting loophole for remote pilots with nefarious designs who may wish to evade security screening. Planehook further stated that many hobbyists already conduct operations in violation of the provisions of section 336, and that this may be an indication of the level of noncompliance with part 107 that the FAA should expect.

The South Dakota Department of Agriculture connected the issue of national security with those of privacy and personal property. Asserting that our food supply is a matter of national security, the SDDA questioned why the FAA was leaving to the states, rather than addressing nationally, the areas of agricultural intellectual property (*i.e.,* photographic crop monitoring) and

other operations over private agricultural land.

In response to the comments raising various ways in which small UAS may be used to threaten national security, the Department notes that many of the examples provided would be in violation of part 107. For example, hacking or jamming a small UAS and taking over its functions would be in violation of the part 107 provisions prohibiting reckless operations, § 107.23. The provisions of this rule are also not the only legal requirements that may be applicable to small UAS operations; there are additional Federal and State laws and regulations that may criminalize certain UAS activity. For example, 18 U.S.C. 32 criminalizes the willful destruction of an aircraft or aircraft facilities. Hacking a small UAS may also violate Federal anti-hacking statutes such as the Computer Fraud and Abuse Act (18 U.S.C. 1030) as well as State and local anti-hacking laws. The Anti-Terrorism Act also serves as a deterrent for operating small UAS in a manner that threatens national security. A remote pilot willfully using his or her small UAS to, for example, destroy an aircraft or cause death or serious bodily injury, may be subject to the criminal penalties described in such statutes. The FAA notes that these additional laws and regulations would likely apply to hobbyists as well.

With regard to hacking specifically, the FAA notes that the visual line-of-sight requirement in this rule serves as a highly effective detection tool for hacking activities. A skilled hacker may be able to manipulate technological monitoring systems to make it appear that no hacking is taking place. However, because this rule requires a human being to personally maintain visual line of sight of the unmanned aircraft, a hacker will be unable to manipulate human vision to make it appear that a compromised UAS is behaving normally. Thus, a remote pilot in command will be able to quickly notice whether someone else has taken control of their small UAS and alert the appropriate authorities.

In response to the various commenters concerned about surveillance of airports, energy infrastructure, and agricultural intellectual property, the security risk associated with small UAS is far less than that posed by manned aircraft, to the extent such activities are not in violation of existing laws. Small UAS are unable to support the advanced level of surveillance equipment manned aircraft can carry. In addition, because of fuel and power limitations, small unmanned aircraft flight times currently do not exceed one hour, and the average small unmanned aircraft that is available to a consumer has a maximum flight time capability of 30 minutes or less. Unmanned aircraft on the larger side of the small UAS spectrum will generally have even shorter flight times because the heavier small unmanned aircraft require more energy to stay aloft. The provisions of this rule, which include a prohibition on nighttime operations and a requirement for the remote pilot to remain within visual line of sight of the aircraft, also impose restrictions that would severely limit possible nefarious surveillance that could be conducted using a small UAS. As such, the Department finds that small UAS, which are less capable than many other methods of surveillance currently available, are not a threat to national security when operated in accordance with part 107.

A number of commenters argued that, given the ease with which a small UAS can be purchased and deployed, it is unlikely that a bad actor would submit to the remote pilot certification process including TSA security vetting. Commenters, including Matternet, NetMoby, and the UAS America Fund, stated that only well-intentioned and law-abiding remote pilots will submit to the TSA vetting that is included in the remote pilot certification process. CAPA generally agreed with the TSA vetting provision, but worried that the rule will not sufficiently address situations in which a remote pilot is initially cleared by the TSA but later becomes a security threat.

The Department does not agree with the commenters that TSA vetting as required by statute (49 U.S.C. 44903(j)(2)(D)(i)) is an insufficient method to identify bad actors who wish to operate small UAS. The Department agrees that a bad actor may decide not to obtain a remote pilot certificate and submit to TSA security vetting procedures. However such an individual would be in violation of FAA regulations that require a remote pilot certificate and TSA vetting if he or she acts as a remote pilot in command. Adding more regulations for this individual to ignore would not increase the deterrent value of the FAA's regulations but would simply impose an additional burden on individuals who seek to operate lawfully. The FAA notes that after initial vetting, TSA conducts recurrent or daily vetting to ensure that certificate holders do not subsequently become a security threat. All FAA certificate holders are subject to this recurrent vetting, which serves to identify any certificate holder that may later become a security threat.

The Department recognizes that this rule will, in certain circumstances, allow a person without a remote pilot certificate, and therefore not subject to TSA vetting, to manipulate the controls of a small UAS. However, this may only be done under the supervision of a certificated remote pilot in command who must have the ability to immediately take control of the aircraft at any time. Therefore, although there may be circumstances under which a non-certificated, non-TSA-vetted individual is manipulating the controls of a small UAS, under no circumstances will that individual be able to use the small UAS to jeopardize national security because he or she will be supervised by a certificated remote pilot who can wrest control of the vehicle at any time during the operation. This framework is similar to the manned-aircraft framework of part 61, which, in certain circumstances, allows an uncertificated individual to manipulate the controls of an aircraft under the supervision of a certificated airman.

3. Airworthiness Certification

Pursuant to section 333(b)(2) of Public Law 112–95, the NPRM proposed not requiring small UAS to obtain airworthiness certification if the small UAS operation satisfied the provisions of proposed part 107. Proposed part 107 would require that an operator maintain the small UAS in a condition for safe operation, and would prohibit an operator from operating a small UAS unless it was in a condition for safe operation. This condition would be determined during a required pre-flight inspection.

More than 40 commenters supported the Department's proposal not to require an airworthiness certificate for small UAS. Many commenters favored not requiring an airworthiness certificate under this rule because it would be a burdensome process that would stifle technology advancements and delay research.

Several commenters said airworthiness certificates are unnecessary because safety concerns can be mitigated by other means. The Kansas Farm Bureau and Continental Mapping Consultants, for example, said the requirements to maintain a small UAS in condition for safe operation and to conduct a preflight inspection are adequate for maintaining safety.

Two commenters, the Small UAV Coalition and Modovolate Aviation, noted the expense of a type-, production-, or airworthiness certification requirement for small UAS. Modovolate Aviation stated that airworthiness certification ''would

impose unwarranted costs on vendors and operators of small UAS, discouraging their commercial use, and thus blunting their contribution to economic growth and American international competitiveness.'' Modovolate Aviation also asserted that delays caused by an airworthiness certification requirement would render candidate vehicles obsolete by the time they are certificated and would encourage operation of uncertificated vehicles.

Several commenters recommended airworthiness certification in limited circumstances. The City of Phoenix Aviation Department said all UAS operating in airspace adjacent to airports should be ''airworthiness certified.'' One commenter said the FAA should require large UAS (which he defined as ''rotary craft greater than 20 kg and fixed-wing between 12 and 24 kg'') to have an FAA airworthiness certificate, ''which is civilian UAV specific, and not as stringent as the current COA.'' Another individual commenter said small UAS should not be allowed to operate over others' property or persons, and no closer than 500 feet unless they have an airworthiness certificate. Reabe Spraying Service said small UAS that fly over or within 100 feet of a person, vehicle, or occupied building that is not part of the operation should have a manufacturer-provided airworthiness certificate and must come with a manual that outlines all required maintenance and part life limits.

Finally, a number of commenters opposed the Department's decision not to require small UAS to obtain an airworthiness certificate. NAAA and the Colorado Agricultural Aviation Association (CoAA), for example, said such certification is necessary to ensure small UAS can safely operate in the NAS without posing a hazard to persons or property.

One commenter noted that two weeks prior to publication of the NPRM, he presented data from the Army to several FAA engineers at a meeting of the RTCA, and the agreement was that many of the small UAS ''mishap issues'' would be solved through airworthiness certification. The commenter included with his comment files from presentations to the American Society of Safety Engineers and the International System Safety Society, which he said highlight the importance of airworthiness certification of small UAS.

Air Tractor said there should be a set of certification rules addressing the reliability of control systems for small UAS that are similar to the rules for civil certification of aircraft. The commenter stated its belief that the FAA has little knowledge of the quality, environmental performance, and software reliability of today's commercial off-the-shelf small UAS control systems. The commenter said that, at a minimum, these systems should be certified, inspected, and tested to ensure reliable operations.

Unmanned aircraft technologies continue to evolve at a rapid pace. The Department acknowledges that rapidly evolving technologies could face obsolescence by the time the certification process is complete. While the Department does consider such factors, the agency does not believe that this issue alone would warrant its choosing not to require airworthiness certification. Instead, the Secretary finds that operation in accordance with part 107 sufficiently mitigates the safety risk posed by a small unmanned aircraft.

To operate under part 107, a small unmanned aircraft must remain within visual line of sight of the remote pilot in command and may not fly over a person not directly participating in the flight operation. If commercial operation over people is desired, then the remote pilot will have to obtain a waiver by demonstrating that the operation will not decrease safety. The aircraft may be evaluated during the waiver process to ensure it has appropriate safety systems and risk mitigations in place for flight over people.

The final rule also does not permit flight operations in Class B, C, or D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless the remote pilot in command has prior authorization from the air traffic control facility having jurisdiction over that airspace. This operational requirement will mitigate risk and ensure safety around airports without the need for further equipment or certification requirements.

These and other part 107 requirements significantly reduce the risk of a mid-air collision or the likelihood that the unmanned aircraft will fall on top of a person standing underneath it. Additionally, with limited exception, the small unmanned aircraft may not fly higher than 400 feet AGL, which further separates that aircraft operation from most manned-aircraft operations in the NAS.[160] Because of the significant risk mitigation provided by the operating rules of part 107, an airworthiness certification requirement would not provide sufficient additional mitigation to justify the costs of requiring all small UAS operating under part 107 to obtain airworthiness certification.

Some commenters recommended that small UAS vendors and manufacturers be required to aid airworthiness by providing maintenance manual instructions or conducting testing. An individual commenter who supported the FAA's decision not to impose airworthiness certification requirements on small UAS nevertheless urged the FAA to implement regulations that require small UAS vendors to provide maintenance manuals ''such that the operator can indeed comply with the airworthiness requirements in a systematic way to allow 'safe operation.' '' ArgenTech Solutions recommended the FAA require each UAS manufacturer to obtain a limited special purpose certification for small UAS. The commenter suggested the certification include operation and testing at one of the FAA-authorized test sites to certify several minimum attributes. Another commenter, Kansas State University UAS Program, favored self-certification by either the operator or manufacturer using industry consensus standards.

While the FAA will not mandate that manufacturers provide instructions to determine if the aircraft is in a condition for safe operation, the agency encourages this practice. Many aircraft manufacturers, such as DJI, already provide this for their aircraft. Aircraft that are sold with such guidance may benefit from lower insurance rates when compared to equivalent aircraft that do not provide the documentation.

In developing the NPRM, the Department considered using industry consensus standards for airworthiness determination. However, consensus standards are still under development and thus cannot be used as the sole mandatory means of compliance. Additionally, a performance standard requiring the remote pilot to mitigate risk but giving him or her discretion to use non-technological mitigation will afford more flexibility to small UAS operations than airworthiness and technology-dependent requirements.

One commenter suggested that section 333(b)(2) is intended only for temporary use until a ''lasting airworthiness means'' is implemented.

The Department disagrees with the argument that section 333(b)(2) was intended to be temporary. The statutory language in section 333(c) specifically requires the Secretary to ''establish requirements'' for the safe operation of UAS that meet the requirements specified in section 333. Section 333(b)(2) states that the Secretary ''shall

[160] 14 CFR 91.119.

determine . . . whether a certificate of waiver, certificate of authorization, or airworthiness certification under section 44704 of title 49, United States Code, is required for the operation of unmanned aircraft systems. . . .'' [161] There is no language in section 333 indicating that such requirements, if established, must be temporary.

K. Miscellaneous Provisions

1. Mandatory Insurance

Although not specifically discussed or proposed in the NPRM, several commenters raised the issue of liability insurance. For the reasons discussed below, this rule will not include a liability insurance requirement.

Approximately 30 commenters, including NAAA, Property Drone Consortium, and Northrop Grumman Corporation, supported the inclusion of a liability insurance requirement in the final rule. These comments argued that: (1) Other countries require liability insurance for small UAS operations; (2) liability insurance would incentivize safe operations and encourage operators to keep pace with technological developments; and (3) small UAS operations are analogous to automobile operations, which require liability insurance.

This rulemaking is being jointly conducted by the FAA and the Office of the Secretary of Transportation (OST). The FAA statutes applicable to this rulemaking do not authorize the agency to impose mandatory insurance requirements. Thus, the FAA does not have jurisdiction to require small UAS operations subject to this rule to obtain insurance coverage.

Similarly, OST also lacks authority to impose liability insurance requirements on small UAS operations covered by this rule because those operations do not rise to the level of air transportation.[162] However, the Department emphasizes that remote pilots who offer these types of services are responsible for the operation, and could be held liable for any injury or damage that could result. Prudent remote pilots should evaluate their existing insurance policies to determine whether they have appropriate coverage for these operations.

2. Test Sites

To further facilitate the integration of UAS into the NAS, the FAA selected six UAS Test Sites to test UAS technology and operations. The NPRM invited comments on how the FAA can improve or further leverage its UAS Test Site program to encourage innovation, safe development, and UAS integration into the NAS.

The Oklahoma Governor's Unmanned Aerial Systems Council asserted that the legal restrictions imposed on the FAA, prohibiting the agency from ''directing'' the Test Sites under Other Transaction Agreements, leads to an unnecessary level of ambiguity and bureaucratic confusion regarding Test Site missions and objectives. The commenter concluded that it is unlikely that the industry or the FAA will benefit from continued operation of the Test Sites under the current regulatory and OTA structure.

Modovolate Aviation said the FAA should be more explicit about the areas of research, demonstration, and testing that would be most helpful in filling the data void referred to in the NPRM.

Aviation Management recommended the agency do the following: (1) Establish guidance to all academic institutions doing UAS research that defines the project, type, or nature of UAS research that the FAA needs to successfully pursue integration of UAS into the NAS; (2) define the means and methods that will allow defined research to be submitted, categorized, classified and evaluated in a ''national library'' of UAS searchable research; and (3) work with Congress to establish greater levels of UAS research funding.

The New Jersey Institute of Technology claimed that the NPRM does not encourage entities to do business with the FAA-designated Test Sites or other air ranges, and that the development of products or services may be inhibited for some small UAS components or airframes. The commenter claimed that universities and other institutions related to Test Sites may reasonably be concerned that educational, research, and academic potential may be lost due to the prohibitive proposed rules. The commenter also pointed to communication issues between the FAA and the designated Test Sites, and suggested that the FAA elaborate and specify the roles and obligations of all current users, which would enable a reasonable discussion as to the effectiveness of an anticipated FAA UAS Center of Excellence.

NBAA recommended that the FAA ''define parameters that can safely accommodate continued research and development of advanced UAS capabilities'' and provide the future Center of Excellence with authority to approve advanced UAS operational or testing capabilities in coordination with ATC.

AIA said the FAA could make better use of Test Sites by doing the following: (1) Provide a detailed vision of the specific types of data Test Sites should provide to further standards development and overall UAS integration; (2) provide funding mechanisms for operation of Test Sites; (3) provide an opportunity to designate private testing areas within the current sites; (4) expand issuance of COAs to designees at Test Sites and prioritize such COA requests; and (5) address barriers to use that are limiting private enterprise use of the sites, such as ownership and control of intellectual property and data rights.

The FAA has been exercising every effort toward greater facilitation of the Test Sites. To that end, the FAA is working closely with the Test Sites to guide research programs toward specific goals such as System Safety & Data Gathering, Aircraft Certification, Command & Control Link Issues, Control Station Layout & Certification, Ground & Airborne Sense & Avoid, and Environmental Impacts that will help the FAA safely integrate UAS into the national airspace system. In addition, the FAA has worked with the Test Sites, industry, and the general public to quickly discern opportunities, design research challenges, and identify priorities. Many of the research areas suggested in the comments are being addressed in current and planned research sponsored by the FAA, or by one or more of its government or industry partners. The FAA continues an active engagement with the Test Sites, the Center of Excellence, and other research partners to undertake research that will facilitate future flight operations and airspace access.

Lastly, it bears noting that UAS operations in the NAS continue to be developmental. As additional acceptable parameters are demonstrated for safe UAS operations, the FAA may adopt those parameters. With regard to providing the Center of Excellence with authority to approve advanced UAS operational or testing capabilities in coordination with ATC, the FAA remains open to considering various forms of delegated authority where a delegation is legally possible. The FAA is working to expedite the process of authorization of operators and UAS, but faces limitations in terms of manpower

[161] Public Law 112–95, Sec. 333(b)(2).

[162] As discussed in section III.C.1 of this preamble, air carriers (which are not included in this rule) are subject to liability insurance requirements. *See* 49 U.S.C. 41112 (noting that the Secretary may issue a certificate to a citizen of the United States to provide air transportation as an air carrier only if the citizen complies with the Secretary's orders and regulations governing the filing of an insurance policy or self-insurance plan).

and the sheer lack of technological information available.

Many commenters were concerned about lack of funding and an ineffective COA process. UPS discussed two factors it believes have impeded the usefulness of the Test Sites: inadequate funding and the amount of time it takes to obtain the authorizations necessary to fly. UPS noted that in the absence of suitable government funding, the Test Sites look to their ''customers'' for funding, which creates a situation where the fees charged to use the Test Site exceed the economic benefit to the customer. UPS said that as a result, many operators seek a section 333 exemption to allow them to do research and development on their own property. UPS also asserted that the utility of Test Sites has been hampered by the amount of time it takes to obtain the authorizations necessary to fly. To remedy this problem, UPS proposed the FAA grant a blanket authorization to UAS of certain weight and performance standards to operate at Test Sites.

Several other commenters also pointed to increased funding and a better COA process, among other things, as necessary to improve the Test Site program. Like UPS, State of Nevada, the Nevada Institute for Autonomous System, and the Nevada FAA-designated UAS Test Site, commenting jointly, said the effective use of the Test Sites has been hindered by a lack of funding and by the fact that the UAS industry can ''bypass'' the Test Sites by obtaining section 333 exemptions. The commenters said that Congress needs to provide funding for FAA to: (1) Operate the Test Sites; (2) provide Test Sites with ''Broad Area COAs'' that are aircraft-agnostic; and (3) allow the Test Sites to immediately begin testing the small UAS rules proposed in the NPRM to either validate the proposed rules or identify gaps and issues, and to provide standards for small UAS SMS procedures, airworthiness processes, training, and aircrew qualifications. Another commenter said something must be done to relax the regulation preventing Nevada from using its designation as a ''commercial UAS test range.'' The commenter suggested that the COA procedure and approval process be expedited at the Federal level, or that Nevada Test Sites be given autonomy to approve COAs.

Several commenters also discussed the need for additional funding of Test Sites. One commenter said the FAA should provide funding to the Test Sites, as well as develop the organizational architecture needed to facilitate research between the Test Sites and the Center of Excellence. Another commenter said Test Sites should be partnered with funded organizations ''at a level that also allows the pool of Test Sites to handle the demand and to address more complicated operations that exceed the limited proposed rule.'' One commenter said that due to lack of funding, limited support, and process management gaps, very few resources have been directly and solely assigned to the Test Site program. The commenter recommended prioritization, simplification, and a wide research scope be established at the Test Sites. Another commenter said the FAA needs to establish an informed set of research objectives and ensure coordination between emerging UAS manufacturing companies, potential UAS markets, and academic researchers at the Test Sites and the Center of Excellence. The commenter also said that a significant amount of testing will be done by academia and industry outside the Test Sites under COAs and exemptions, and that the FAA should take advantage of those efforts through Cooperative Research and Development Agreements (CRADA) and other agreements.

Texas A&M University-Corpus Christi/LSUASC also recommended the FAA enable Test Sites to conduct operations without having to apply for COAs for every research operation. The commenter also recommended that these ''blanket COA'' operations at Test Sites be permitted at less than 200 feet AGL. In addition, the commenter said the FAA needs to engage the Test Sites' research capacities. The commenter claimed that Test Site proponents have offered significant UAS research capacities to the FAA (*e.g.,* expertise and infrastructure), but the agency has not indicated that these capacities will be used in the development of technologies to enable safe integration of UAS into the NAS. Finally, the commenter said the FAA needs to incorporate applicable portions of the proposed small UAS rule into test-site other transaction agreements (OTAs), which it said would have two residual effects—first, it would assist in the validation of the rules with actual operations, and, second, it would provide the Test Sites some leverage towards being financially sustainable by enabling them to offer services to public- and private-sector entities without burdensome administrative costs (*e.g.,* COA applications).

Regarding the COA process, the FAA has already issued ''blanket COAs'' to the Test Sites which are not aircraft specific. However, the FAA is also responsible for overseeing the operations of the 6 Test Sites, and ensuring each Test Site sets up a safe-testing environment and adheres to strict safety standards. The FAA must exercise every caution to ensure that the introduction of UAS operations into the NAS is executed in a manner that will provide the greatest possible safety protections for manned aircraft as well as people or property on the ground. Thus, part 107, which reflects the safety considerations addressed during the course of this rulemaking, will extend to allowing operations at the Test Sites. Operations that conform to part 107 will require no additional authorization, obviating additional blanket COAs. Operations that are outside the scope of part 107 will require waivers to portions of part 107; this requirement is necessary to ensure that UAS vehicles are evaluated for safety on a case-by-case basis.

Regarding the costs associated with UAS development and other related issues, the FAA cannot interfere with market pricing. The UAS industry, like any other, is subject to the economic structure of the United States and prices are typically controlled by supply and demand. With regard to the Test Sites and what they charge for services they provide, the FAA cannot interfere because the FAA is not charged with subsidizing the cost of operations at the Test Sites. The sites must be allowed to obtain funding for their continued operation.

In regards to funding, Congress has not appropriated Federal funds for Test Site operations or research. If the FAA obtains funding specific to UAS, it will make those funds available to operators in accordance with the legislative language appropriating the funds.

Several commenters proposed specific areas of testing for the FAA-designated Test Sites to undertake. Modovolate said energy dissipation tests should be conducted to obtain data on energy dissipation in collisions between small UAS and manned aircraft, particularly helicopters. The commenter said these collision energy dissipation tests should focus on collecting data on the effects of a collision with small UAS that are made of various types of frangible materials.

The University of North Dakota's John D. Odegard School of Aerospace Sciences—which is part of one of the six established Test Sites—said the FAA and academic institutions should work together to study 13 areas of UAS operations, including extended VLOS and BVLOS operations, operations over persons, and nighttime operations. The commenter urged all parties to work with Congress to establish levels of funding for this research, which it said

will lead to future integration of UAS into the NAS.

Exelis said the FAA should use the designated Test Sites to prove and demonstrate the safety and operations of technology that enables beyond-visual-line-of-sight UAS operations. To that end, the commenter said the Test Sites should be granted COAs that allow for BVLOS operations. The commenter also said the Test Site program can be further leveraged by undertaking testing of BLVOS operations in real-world environments.

The State of Nevada, the Nevada Institute for Autonomous System, and the Nevada FAA-designated UAS Test Site, commenting jointly, stated that the FAA should enable specific research and development at the designated Test Sites ''to identify operating limitations that could be relaxed based on technological advancements.'' More specifically, the commenters said the Test Sites and future FAA UAS Center of Excellence can provide assistance in developing standards which delineate the acceptable performance of sensor technologies to satisfy ''see and avoid'' or ''sense and avoid'' requirements.

The National Association of Broadcasters, National Cable & Telecommunications Association, and Radio Television Digital News Association, commenting jointly, urged the FAA to increase its efforts to facilitate and encourage use of the existing UAS Test Sites to expedite UAS research and development and to develop data and safety records for unmanned aircraft to support their expanded use for breaking news coverage, sports coverage, and video production, including over populated areas. The commenters also pointed to research that is currently being conducted by universities on the use of small UAS for newsgathering and reporting purposes, and encouraged the FAA to use the results of that research to further refine the small UAS rule.

CTIA—The Wireless Association said the FAA should expeditiously grant any requests from the commercial wireless industry to test its technologies with small UAS at any of the FAA's six designated UAS Test Sites, as well as in various geographic locations pursuant to the FAA's section 333 exemptions and experimental aircraft certification processes. The commenter asserted that researchers can collect data on the networks' reliability and robustness of signal and submit their findings to the FAA and its supporting committees. The commenter further asserted that the FAA should incorporate the results of this testing when considering spectrum to support small UAS operating within and beyond the visual line of sight.

The Air Medical Operators Association said the UAS Test Sites are an excellent area to test the ability of UAS to avoid approaching aircraft. The commenter asserted that UAS must be tested to ensure to the flying public that the required separation is sufficient to allow the UAS operator to maneuver away from manned aircraft.

One commenter recommended the Test Sites conduct testing on the visibility to manned aircraft of small UAS of various sizes and speeds and with various visibility treatments under a variety of conditions. The commenter also recommended testing various see-and-avoid technologies under a variety of test conditions and testing to help determine anti-collision lighting requirements. Another individual commenter said the use of UAS to transport property should be tested at one of the designated Test Sites.

The FAA welcomes the commenters' suggestions for UAS research, and encourages the Test Site sponsors to consider these recommendations as further testing parameters. Several of the comments coincide with ideas that the FAA has, or currently is in the process of adopting. The speed at which advanced technologies can be adopted is an issue that must be addressed step by step. Wireless operations and collection of data are both subjects that the FAA is examining. Wireless operations, however, must first be able to demonstrate the capability to operate under control and safely. Additionally, data collection is subject to a variety of laws. On occasion, additional limitations are imposed by desire of the operators.

NetMoby suggested that one method to improve the Test Site program is to increase the number of Test Sites. Specifically, the commenter urged the FAA to establish a minimum of one Test Site per State (with no maximum). Travelers United similarly said the designation of only six Test Sites is ''unnecessarily limiting,'' although it did not propose an alternative number of sites. The commenter did say that Test Sites should be able to expand their airspace further into Class G airspace within their region, to allow for more operations in different geographies and population densities.

The number of Test Sites established by the FAA was specifically designated by Congress. Section 332 of the FAA Modernization and Reform Act of 2012 (Pub. L. 112–95) directed the FAA to ''establish a program to integrate unmanned aircraft systems into the national airspace system at 6 test ranges.'' The FAA therefore does not have the authority to establish additional Test Sites and also conform to its Congressional mandate.

One commenter said the FAA can make better use of its six designated Test Sites by designating them as ''Qualified Entities,'' as is done in Europe. NetMoby recommended the FAA establish standards for accredited academic institutions to apply for authority to operate as a Test Site, with stringent qualifications and reporting requirements for each test-site. The University of Illinois at Urbana-Champaign similarly suggested that universities and others should be permitted to conduct research on their own properties, so long as the institutions are willing and able to implement adequate safety measures. Another commenter said private individuals and corporations should be allowed to set up private Test Sites for developing UAS.

In the United Kingdom, the government has established ''national qualified entities'' that conduct assessments of UAS operators and make recommendations to the Civil Aviation Authority whether to approve those operators. In the United States, Congress has mandated the FAA under 49 U.S.C. 44701 to prescribe standards in the interest of aviation safety. In response to comments suggesting that entities outside of the six selected Test Sites should be permitted to conduct research on their properties, the FAA notes that nothing prevents other entities from conducting small UAS testing within the confines of part 107. For UAS operations in which the small unmanned aircraft weighs less than 55 pounds that are not permitted under part 107, an entity may seek a waiver, provided the entity intending to conduct testing provides evidence that that the proposed operation can safely be conducted under the terms of a certificate of waiver.

Additionally, the FAA developed a process under FAA Order 8000.732A to appoint UAS Designated Airworthiness Representatives (DARs) for UAS Certification at UAS Test Sites. These DARs are specifically authorized to issue special airworthiness certificates in the experimental category for research and development, market survey, and crew training, at UAS Test Sites. Where UAS Test Sites are focused on public aircraft operations, this additional flexibility provides UAS Test Sites with the ability to conduct specific civil operations under a special airworthiness certificate/experimental category.

Although it did not mention UAS Test Sites, specifically, the Washington Aviation Group recommended that the FAA gather information on the frequency with which small UAS can be expected to fail, and on the prevalence of return-to-home technology. The Washington State Department of Transportation, Aviation Division—which also did not specifically mention UAS Test Sites—recommended the FAA initiate a study to examine hobbyist UAS activities in an effort to determine whether registration of some hobby UAS aircraft may now be appropriate. Event 38 Unmanned Systems said the FAA must secure appropriate research and development funding, and conduct research on any proposed rule implementation, in an open and transparent manner with particular attention paid to non-biased review and quality assurance.

The FAA has established requirements (in the Registration Rule) for registration of all unmanned aircraft and aircraft classified as model aircraft. As mentioned previously in regards to funding, Congress must appropriate Federal funds to the FAA for specific types of research and development.

3. Noise and Environmental

a. The National Environmental Policy Act

The Department of Transportation has determined that this proposed action qualifies for categorical exclusion pursuant to Paragraph 4.c.5 of DOT Order 5610.1C, Procedures for Considering Environmental Impacts (44 FR 56420, Oct. 1, 1979) and FAA Order 1050.1F, paragraph 5–6.6(f).[163] Paragraph 4.c.5 of DOT Order 5610.1C incorporates by reference actions identified by FAA as categorical exclusions.

Categorical exclusions are actions identified in an agency's NEPA implementing procedures that do not normally have a significant impact on the environment and therefore do not require either an environmental assessment (EA) or environmental impact statement (EIS). *See* 40 CFR 1508.4. In analyzing the applicability of a categorical exclusion (CATEX), the agency must also consider whether extraordinary circumstances are present that would warrant the preparation of an EA or EIS. *Id.* A number of commenters expressed concern that there may be noise and environmental impacts as a result of this rule. Based on the information known at this time and what is reasonably foreseeable, FAA does not find any extraordinary circumstances that preclude use of a CATEX for implementation of this rule. For the reasons discussed below, the FAA will not make any changes to the rule based on these comments.

b. Noise

Approximately 60 commenters expressed some concern about the noise produced by small UAS. The comments ranged from very general to specific. One commenter specified the need for a noise metric to measure or control the noise from UAS. Another requested noise certification and operating limits to be established. Many of the comments regarding noise expressed concern over the potential effect on wildlife, such as startling nesting birds. One commenter described the potential for human noise exposure as ''considerable'' since a person in New York City could be exposed to ''dozens'' of flights a day, and concluded that small UAS noise posed a greater problem than noise from airports. Another commenter indicated that the rerouting of manned aircraft for safety reasons when small UAS are operating in the same area might force the noise of larger manned aircraft to be unfairly concentrated on certain people.

The Professional Helicopter Pilots Association stated that noise emissions from small UAS operations should be below 65 DBE under all operating conditions (we believe the commenter meant ''dBA (A-weighted decibels'')). The CAFE Foundation stated that the NPRM omitted limits for noise at a measured sideline distance, and stated that noise is ''the principal source of the public's complaints about aircraft.'' The commenter concluded that ''[t]he rules of operation for UAVs need to include certification standards for their noise emissions at a prescribed distance,'' giving an example of 48 dBA at a 20-meter sideline distance that would result in a day-night level (DNL) of 54.7.

Turning first to the potential environmental impacts of the proposed rule, based upon FAA's forecasts and the best available science and information, the FAA has determined that this rulemaking qualifies for the CATEX in FAA Order 1050.1F, Paragraph 5–6.6(f). The FAA examined the potential noise impacts considering the projected amount and type of Small UAS operations. The FAA has documented the categorical exclusion, including the potential for extraordinary circumstances and review of the potential for extraordinary circumstances, and has placed a copy of it in the docket for the final rule.

The NPRM did not propose noise certification standards or operating limitations for small UAS. As to the comments concerning noise limitations, there are two aspects—the formally tested limits of noise that are established when an aircraft is certificated by the FAA, and noise operating limits that apply to certain aircraft. Operators of UAS seeking type certification are subject to the limits for smaller non-jet aircraft listed in 14 CFR part 36 Appendix G (fixed-wing) and Appendix J (helicopters). Appendix G imposes a noise limit of 70 dBA for takeoff noise from a single engine airplane weighing no more than 1,257 pounds that was manufactured on or after February 3, 2006.[164] The small UAS to which part 107 will apply are considerably smaller, less than 55 pounds. The commenters requesting noise certification standards as part of this rule did not provide any evidence to show that the noise emitted by the Small UAS subject to this rule would exceed the current limits of part 36 Appendix G or J. The FAA recently used Appendix G to certificate two small unmanned aircraft, one with a takeoff weight of 44 pounds and the other 13.4 pounds. These aircraft were subject to the full noise test procedures specified in part 36, Appendix G. The resulting noise levels (53.2 dBA and 27.0 dBA) were substantially lower than the 70 dBA limit in Appendix G, by margins of 16.8 dBA and 43 dBA, respectively.

While the FAA has chosen not to require type certification of small UAS subject to this rule, the FAA is gathering data for all UAS on which it may base future certification standards, especially for those UAS that exceed the 55-pound weight limit of part 107 or that use more advanced propulsion systems that would affect their noise profiles. The FAA may apply the requirements of part 36 separately to UAS under the FAA's authority to regulate noise in the future. At this time, however, the FAA does not believe there is sufficient evidence to warrant such a standard. If full type and airworthiness certification for a UAS is applied for as a means to operate outside part 107 restrictions, the noise certification standards of part 36 already apply as they would to any manned aircraft, including the required noise tests.

For similar reasons, the FAA lacks sufficient evidence at this time to justify imposing operating noise limits on small UAS. The only operating noise

[163] FAA has determined that this final rulemaking is covered by the CATEX described in paragraph 5–6.6(f) of FAA Order 1050.1F. In the NPRM, the FAA relied upon the categorical exclusion in section 312(f) of FAA Order 1050.1E the NPRM the FAA has updated the order and the corollary provision in the new order is paragraph 5–6.6(f).

[164] 14 CFR part 36, Appendix G, Sec. G36.301(c).

rules in the United States apply to turbojet aircraft and supersonic operations.[165]

The FAA considered the potential for noise impacts based on the projected amount and type of small UAS operations operating under this rule. Pursuant to 14 CFR part 150 land use compatibility guidelines incorporated by reference in FAA Order 1050.1F, Environmental Impacts: Policies and Procedures (July 16, 2015), noise-sensitive areas such as residential, educational, health, and religious structures and sites are considered compatible land uses when the yearly day-night average sound level (DNL) is below 65. DNL is a cumulative noise metric, calculated by adding up the noise produced by individual aircraft, however, and does not directly correspond to the noise produced by an individual aircraft of any weight or size. To illustrate how the noise of an individual UAS affects the land use compatibility threshold, at 200 feet altitude over the measurement point, it would take 6,000 flights of the noisier of the two certificated UAS (at 53.2 dBA) over one 24-hour period to exceed the 65 DNL land use compatibility threshold; at 400 feet altitude over the measurement point, there would need to be 25,000 flights in one 24-hour period to exceed the land use compatibility threshold. The FAA does not anticipate this level of small UAS operations at any location in the United States, nor would the airspace over a particular location support such levels of activity. The FAA may revisit the issue of noise from small UAS in light of future operational experience and more noise data for all UAS.

c. Other Environmental Comments

A number of commenters raised air quality concerns with regard to small UAS operations that would be conducted under the proposed rule. Green Vegans and five individual commenters asserted that the aggregate number of small UAS operations that would be conducted under part 107 will result in a significant impact on air quality. In support of their claim, these commenters cited a report released by Volpe in 2013,[166] which projects a total number of UAS vehicles approaching approximately 250,000 by 2035, of which approximately 175,000 vehicles would be available for purchase from the commercial marketplace.

The individual commenters argued that the collective number of projected UAS in the report indicates that there are significant environmental impacts and/or extraordinary circumstances that require a more extensive NEPA review process. The commenters further suggested that the aggregate number of UAS would cause an impact on air quality. On the other hand, Kapture Digital Media suggested that the substitution of small UAS for manned aircraft in various applications would have a positive effect on air quality, since most small UAS use electrical power rather than fossil fuels. Two individual commenters also opined that small UAS operations would not adversely impact air quality.

The Clean Air Act established the National Ambient Air Quality Standards (NAAQS) for six pollutants (''criteria pollutants'') that are the most common types of pollutants that can cause damage to humans and the environment. Those pollutants are: Carbon monoxide (CO), nitrogen dioxide (the most common of oxides of nitrogen gas), (NO2), ozone (O3), particulate matter ($PM_{2.5}$ and PM_{10}), sulfur dioxide (SO_2), and lead (Pb). Under the Clean Air Act, the FAA must determine whether promulgation of this rule has the potential to cause or contribute to any new violation of any standard in any area, increase the frequency or severity of any existing violation of any standard in any area, or delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

The FAA currently allows small UAS operations comparable to the ones that will be enabled by this rule through an exemption process utilizing Public Law 112–95, section 333. As of this writing, the FAA has issued exemptions to allow over 3,385 small UAS operations. The majority of these operations used small UAS that were powered by electricity (*i.e.* through battery-powered electric motors) which generally do not produce the pollutants covered by NAAQS. Indeed, as noted by Kapture Digital Media and the individual commenters, the replacement of fossil-fuel-powered manned aircraft with electrically powered small UAS that promulgation of this rule will enable may even have a positive impact on air quality.

Based on information available about the type of equipment likely to be used (*i.e.,* battery-powered electric motors), emissions attributable to UAS operating subject to this regulation will not cause significant air quality impacts, and would not violate air quality standards. The FAA has no evidence that would change this conclusion. Therefore FAA has determined that air quality impacts from the small UAS rule are not extraordinary circumstances precluding the use of a CATEX.

Green Vegans stated that ''the use and numbers of UASs/drones by industry, government agencies, and critically, hobbyists, who do not need permission to operate their drones, have increased dramatically.'' The commenter added that the ''potential environmental and social impacts [of UAS use] are enormous.'' Green Vegans further asserted that the FAA cannot rely on a CATEX to comply with NEPA and stated that the FAA must prepare an Environmental Impact Statement (EIS) before proceeding further.

The Department of Transportation has adopted policies and procedures for compliance with the National Environmental Policy Act (NEPA), as implemented by Council on Environmental Quality (CEQ) regulations, in FAA Order 1050.1F, Environmental Impacts: Policies and Procedures. Among other things, DOT Order 5610.1C, paragraph 4.c.5, lists DOT actions that are normally subject to a CATEX, and incorporates by reference the actions identified by the FAA. FAA Order 1050.1F lists FAA actions that are normally subject to a CATEX. FAA Order 1050.1F, Paragraph 5–6.6(f) covers rulemaking actions (excluding those that if implemented may cause a significant impact on the human environment). Based upon its forecasts and the best available information, the FAA has determined that this rulemaking is covered by the CATEX in FAA Order 1050.1F, Paragraph 5–6.6(f), and will be documented pursuant to FAA Order 1050.1F, Paragraph 5–3. FAA does not find any extraordinary circumstances that would preclude the use of a CATEX.

The FAA also notes that this rulemaking has limited applicability to two types of UAS use cited by Green Vegans. First, as discussed in section III.C.4 of this preamble, Public Law 112–95, section 336 prohibits the FAA from conducting a rulemaking with regard to hobby/recreational operations that meet the statutory criteria specified in section 336. Section 336 provides an exception only for model aircraft that endanger the safety of the NAS, and this rule will codify that exception in part 101. Second, as discussed in section III.C.3 of this preamble, this rule will also not apply to public aircraft operations of small UAS that are not operated as civil aircraft.

Green Vegans and several individual commenters also argued that the ''flood'' of UAS predicted to fly in the NAS constitute extraordinary circumstances under paragraph 304 of FAA Order

[165] *See* 14 CFR part 91, subpart I.

[166] *Technical Report, Version 0.1—September 2013* DOT–VNTSC–DoD–13–01 (February 2014).

1050.1E.[167] The commenters asserted that the high numbers of UAS will have an environmental impact on ecosystems and the human environment and this constitutes extraordinary circumstances.

In response, the FAA notes that, because electrically powered small UAS could replace fossil-fuel-powered manned aircraft, the environmental impact of small UAS operations could be a positive improvement in air quality and noise. At this time, the FAA has no information indicating that the implementation of this rule will result in any significant impacts, cumulative or otherwise. As such, the FAA has determined that there are no extraordinary circumstances that preclude categorical exclusion of this rule.

Green Vegans expressed concern that the FAA is ignoring the large numbers of hobby/recreational small UAS that would not be covered by part 107. The commenter suggested that community-based organizations would be unlikely to issue guidelines that include provisions for operating model aircraft in an environmentally responsible way. In response, the FAA considered the effects of small UAS operating under this rule in light of other UAS operations, and did not find any evidence that this rule was likely to directly, indirectly, or cumulatively create a significant environmental impact. The FAA also emphasizes that section 336(a) of Public Law 112–95 prohibits the agency from addressing in this rule model aircraft that are operated in accordance with section 336.

Approximately 20 commenters discussed the use of UAS in wildlife conservation and monitoring efforts. Most commenters expressed support for adopting UAS technology. NOAA stated that high-quality UAS operations could be very beneficial and offer significant cost savings and increase safety for endangered, threatened and trust species. The Nez Perce Tribe stated that it sees enormous benefits in the use of small UAS for management of salmon fisheries and other wildlife. The Nature Conservancy discussed the benefits of using UAS for monitoring sand hill cranes and other wildlife, and the increased safety that small UAS use would provide for wildlife biologists. Shell Exploration and Production Company described the potential use of UAS to monitor and observe endangered species and marine mammals.

On the other hand, several commenters, including Green Vegans, remarked on the danger that a small UAS traveling at up to 100 mph would present to migratory birds, mallard ducks, and other wildlife because birds might not be visible to small UAS operators. The Ventura Audubon Society expressed concern about the negative impacts the use of small UAS could have on nesting shorebirds. An individual commenter asserted that small UAS use can affect wildlife and manned aircraft in an unsafe manner, as evidenced by the aggregate number of bird and wildlife strikes every year. The commenter expressed concern that small UAS operations conducted under part 107 may interfere with birds and relied on the FAA Strike Report 1990–2012 in support of her comments.

The FAA agrees with the commenters that wildlife surveying and monitoring operations conducted under part 107 can have benefits for wildlife conservation. The RIA accompanying this rule contains a discussion of the many societal benefits that will be enabled by this rule, including wildlife conservation and monitoring efforts.

In response to commenters who expressed concerns about negative impacts to birds and other wildlife, the FAA emphasizes that this rule does not authorize the harassment, harming, or killing of birds, mammals, or ocean-dwelling animals. These types of actions are prohibited by other laws and regulations such as the Migratory Bird Treaty Act (see 16 U.S.C. 703; 50 CFR part 21), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). The FAA emphasizes that in addition to satisfying the provisions of this rule, remote pilots of a small UAS will remain subject to all applicable laws, including environmental and wildlife laws.

The Nature Conservancy and several individual commenters expressed concern with wetlands and other ecosystems that provide habitat for water fowl.

Executive Order 11990, DOT Order 5660.1A, the Rivers and Harbors Act of 1899, and the Federal Water Pollution Control Act, as amended (commonly referred to as the Clean Water Act), address activities in wetlands. Executive Order 11990 requires Federal agencies to ensure their actions minimize the destruction, loss, or degradation of wetlands. It also assures the protection, preservation, and enhancement of the Nation's wetlands to the fullest extent practicable during the planning, construction, funding, and operation of transportation facilities and projects. The Clean Water Act provides the authority to establish water quality standards, control discharges, develop waste treatment management plans and practices, prevent or minimize the loss of wetlands, determine location with regard to an aquifer or sensitive ecological area such as a wetlands area, and regulate other issues concerning water quality.

It is not anticipated that this rule will involve land acquisition or ground disturbing activities that would affect coastal resources or wetlands. In regards to impacts to habitat, the rule is not intended to authorize encroachment into any habitats for waterfowl and FAA does not anticipate this rule causing significant impacts to such habitats.

The Nature Conservancy asked for less restrictive daytime-operations and visual-line-of-sight requirements, asserting that changes to these proposed provisions would improve their conservation efforts. ''In sum, The Nature Conservancy views UAS as a critical conservation tool.'' Further, ''[t]he Conservancy's envisioned use for UAS in California provides just one example of why the daytime operations requirement would limit the effectiveness of UAS as a conservation tool.''

As discussed in section III.E.2.c.i of this preamble, the daylight-operations provision of this rule has been expanded to allow operations during civil twilight hours. This change will further enable small UAS operations under part 107, including operations conducted for positive environmental management. This change will also allow greater utilization of small UAS as a conservation tool in Alaska where, in the northern parts of that State, the sun does not rise for as many as 64 days a year.

With regard to visual line of sight, as discussed in section III.E.2.a of this preamble, this rule will generally implement the visual-line-of-sight provision as proposed. However, the FAA will consider waiving that restriction if an applicant seeking extended operational flexibility can demonstrate that his or her operation will have at least the same level of safety as an operation conducted within visual line of sight.

One individual commenter raised concerns about adverse visual impacts that could result from small unmanned aircraft flight. The commenter stated that the visual impact of seeing ''. . . a drone rather than the natural scape is unfortunate.'' The commenter compared unmanned aircraft regulations to land use controls such as building heights being limited when feasible to reduce visual impacts to natural scenic corridors. The commenter also complained that at the commenter's

[167] Since the NPRM the FAA has updated the order and the corollary provision in the new order is paragraph 5–2.

local school yard, ''teenagers are their (sic) learning to fly their drones.''

Pursuant to FAA Order 1050.1F, (Paragraph 4–3, Exhibit 4–1) the FAA generally considers visual impacts that could:

(i) Affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources, (ii) Contrast with the visual resources and/or visual character in the study area, and (iii) Block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations.

The FAA does not have evidence or data that the operation of small UAS under this rule would significantly affect the nature of visual character of an area, contrast with visual resources, or significantly block or obstruct the views of visual resources.

The FAA notes that the provisions of this rule (such as the visual-line-of-sight requirement, the maximum altitude limitation, and the restriction on operations in controlled airspace) limit the areas where a small UAS could be operated under part 107. Additionally, as discussed in section III.J.2 of this preamble, because of the limitations of current fuel and power-source technology, small UAS currently available to consumers have an average flight time of only 30 minutes or less. Some small UAS have maximum flight time of less than 10 minutes. Because of the regulatory and practical limitations on small UAS operations that will be conducted under part 107, promulgation of this rule will not result in significant visual impacts.

Berkey Williams asked the FAA to initiate formal government-to-government consultation with Indian Tribes, and the Green Vegans noted the need for Tribal participation under NEPA. Berkey Williams stated that formal government-to-government consultation with Indian Tribes is needed to properly identify and mitigate the impacts that small UAS may have on Tribal interests in Tribal territory. The Nez Perce Tribe and the Northern Arapaho Tribe filed comments indicating their interest in using small UAS for fish and wildlife management and agricultural purposes. The Northern Arapaho Tribe restated their previous request to initiate government-to-government consultation regarding the development and implementation of UAS on the Wind River Indian Reservation, and submitted comments on the NPRM concerning: (1) Waivers to the visual-line-of-sight requirement; and (2) recognition of Tribal authority to regulate or prohibit UAS use to protect against interference with traditional ceremonies and other activities.

Consistent with Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments,* and FAA Order 1210.20, *American Indian and Alaska Native Tribal Consultation Policy and Procedures,* the FAA ensures that Federally Recognized Tribes (Tribes) are given the opportunity to provide meaningful and timely input regarding proposed Federal actions that have the potential to uniquely or significantly affect their respective Tribes. At this point, the FAA has not identified any unique or significant effects, environmental or otherwise, on tribes resulting from this rule. However, the FAA has entered into government-to-government consultation with the Northern Arapaho Nation on its general use of UAS. In addition, the Nez Pierce tribe has contacted FAA to discuss obtaining a section 333 exemption to operate small UAS under existing rules.

With regard to the specific issues raised by the Northern Arapahoe Tribe and the Nez Perce Tribe, the FAA notes that the requirements concerning airman certification and visual line of sight in this rule are not unique and significant environmental impacts on the Tribes. The FAA also notes the Northern Arapahoe Tribe's concerns about Tribal authority to regulate or prohibit UAS flights, but, as discussed in section III.K.6 of this preamble, this rule does not address preemption issues because those issues necessitate a case-specific analysis that is not appropriate in a rule of general applicability. The FAA notes, however, that state governments have historically been able to regulate the takeoffs and landings of aircraft within their state boundaries. The FAA anticipates that the Tribes would be able to exercise similar internal sovereignty with regard to the takeoffs and landings of small UAS within their territories. Thus, while preemption is beyond the scope of this rule, the FAA will conduct outreach to tribes seeking information about their ability to regulate small UAS operations conducted within their territory to see how their concerns could be addressed within the broader UAS integration effort.

NOAA asked the FAA to add a regulatory provision that would require the operator to ensure that a small UAS would not pose a danger to protected wildlife in the event of a loss of aircraft control. NOAA noted that it addresses this issue in its current guidance, such as the NMFS Marine Wildlife Viewing Guidelines. These guidelines recommend, in general, that the public keep a safe distance of 50 yards (150 feet) from dolphins, seals, and sea lions on the water or land and 100 yards (300 feet) from large whales on water or land. For all marine mammals, the recommended viewing guideline for aerial observations is 1,000 feet.

To the extent NOAA seeks compliance with applicable environmental statutes, such as the Marine Mammal Protection Act (MMPA), the FAA agrees that the pertinent NOAA regulations and guidance provide an excellent overview of the applicable requirements that must be followed by individuals who seek to operate in germane areas. These regulations and guidance may be found at: *http://uas.noaa.gov/policy/*. Further, since NOAA administers the applicable environmental statutes, the FAA defers to NOAA regarding the requirements imposed by specific regulations that protect marine wildlife.

NOAA also expressed concern that the rule would overlap and conflict with several statutes and regulations that prohibit the approach of endangered marine species. NOAA cited the National Marine Sanctuaries Act (NMSA) and the Endangered Species Act (ESA). NOAA asked the FAA to include wildlife-specific language in the rule so that the public is made aware of regulations and guidelines, including the NMFS Marine Wildlife Viewing Guidelines, which recommend, in general, that the public keep a safe distance of 50 yards (150 feet) from dolphins, seals, and sea lions on the water or land and 100 yards (300 feet) from large whales on water or land, and recommends viewing guideline for aerial observations of all marine mammals of 1,000 feet. Green Vegans also cited the same statutes as potentially being implicated by operation of small UAS.

The FAA agrees with NOAA that remote pilots operating a small UAS are responsible for complying with all applicable laws and regulations, not just the requirements of this rule. This rule does not authorize the harassment, harming, or killing of wildlife, and remote pilots of small UAS remain subject to environmental and wildlife laws such as the ones cited by the commenters as well as any other laws applicable to the small UAS operation. With regard to marine wildlife, as discussed earlier, the FAA strongly recommends that remote pilots conducting operations near marine wildlife familiarize themselves with NOAA regulations and guidance, which can be found at: *http://uas.noaa.gov/policy/*. However, with regard to the contents of this rule, the FAA defers to NOAA for the regulations and guidance

regarding matters within NOAA's jurisdiction.

Several individual commenters expressed concern that small UAS could be used to deliver hazardous materials to public and private citizens endangering the lives of people, wildlife, and property. In response, the FAA notes that, as discussed in section III.C.1 of this preamble, the provisions of this rule do not authorize the use of small UAS to transport or deliver hazardous materials.

4. Privacy

In the NPRM, the FAA acknowledged that privacy concerns have been raised regarding the integration of UAS into the NAS. Although proposed regulations to address privacy concerns were deemed beyond the scope of this rulemaking, the FAA emphasized its intended participation in the multi-stakeholder engagement process led by the National Telecommunications and Information Administration (NTIA) pursuant to the Presidential Memorandum, Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems (February 15, 2015). Pursuant to the Presidential Memorandum, NTIA and its interagency partners, including the FAA, are working with stakeholders to develop best practices concerning privacy, transparency, and accountability for the broad range of possible UAS platforms and commercial practices.

In addition, the FAA conducted a privacy impact assessment (PIA) of the proposed rule in accordance with section 522(a)(5) of division H of the FY 2005 Omnibus Appropriations Act, Public Law 108–447, 118 Stat. 3268 (Dec. 8, 2004) and section 208 of the E-Government Act of 2002, Public Law 107–347, 116 Stat. 2889 (Dec. 17, 2002). As part of the PIA, the FAA analyzed the impact the proposed rule might have on collecting, storing, and disseminating personally identifiable information (PII) of airmen and UAS operators, and the FAA examined and evaluated protections and alternative information handling processes in developing the proposed rule in order to mitigate potential privacy risks. The PIA has been updated to reflect the provisions of this final rule and can be found at: *http://www.transportation.gov/individuals/privacy/privacy-impact-assessments*.

The FAA intends to continue addressing privacy concerns through engagement and collaboration with the public, stakeholders and other agencies with authority and subject matter expertise in privacy law and policy. The FAA considered whether to include privacy provisions in this rulemaking. However, for the reasons explained in the discussion that follows, this rule does not include privacy regulations.

The FAA received about 180 comments on the NPRM raising concerns about the potential impacts of small UAS operations on privacy. Most commenters expressed support for UAS integration and recognized the many benefits of this technology across diverse industries, but commenters discussed concerns regarding personal privacy, data privacy, private property rights and intellectual property rights. Several commenters, including the Illinois Farm Bureau, Colorado Cattlemen's Association, and the International Association of Amusement Parks and Attractions (IAAPA), raised concerns regarding small UAS operations over private property and several asserted that UAS operations should not be permitted over private property without advance authorization given by the business, institution or property owner.

Some commenters, including Colorado Ski Country USA, the National Association of State Departments of Agriculture (NASDA), and the Electronic Privacy Information Center (EPIC), asserted that the FAA should include provisions to protect privacy as part of this rulemaking, while the Center for Democracy and Technology (CDT) asserted the FAA should address privacy in a future rulemaking. The CDT and EPIC included specific regulatory proposals for consideration. The National Farmers Union asked the FAA to be mindful of its concerns regarding the collection of data by industry and government, which might be used against a farm owner.

However, several commenters, including the Colorado Cattlemen's Association, National Farmers Union, and the Florida Department of Agriculture and Consumer Services, recognized that privacy regulations are beyond the scope of this rulemaking and FAA authority. Several commenters, including the Professional Photographers of America and the Law Office of Debbie Weecks, asserted that existing law already addresses the issue of privacy. The News Media Coalition asserted that privacy concerns are best addressed at the State level. The University of North Georgia commented that privacy concerns are minimal provided flights are operated in accordance with FAA rules, and images are acquired from 300 feet or above and are not obtained using facial recognition technology.

The Colorado Cattlemen's Association encouraged the FAA to continue its participation in NTIA's multi-stakeholder engagement efforts consistent with the February 15, 2015 Presidential Memorandum. On the other hand, AeroMarine recommended a federally commissioned review of the technological neutrality of FAA UAS proposed rules led by the Department of Commerce. Aeromarine also recommended a federally commissioned review of the adequacy of comparative technology-neutral privacy regulations (like the EU), led by the Department of Justice. One individual commented on the PIA and asserted it did not raise any strong concerns for the privacy of pilots.

Overall, the comments demonstrate a lack of consensus regarding the extent to which UAS integration poses potential risks for privacy intrusions, how privacy concerns should be addressed, and the FAA's role in efforts to address these concerns. In response, the FAA notes that its mission is to provide the safest, most efficient aerospace system in the world, and does not include regulating privacy. The FAA recognizes that unique characteristics and capabilities of UAS may pose risks to individual privacy. However, these concerns are generally related to technology and equipment, which may be installed on an unmanned (or manned) aircraft, but are unrelated to the safe flight of the aircraft. There is a long history of pilots placing cameras and other sensors on aircraft for a variety of purposes (*e.g.,* news helicopters, aerial surveys, film/television production, law enforcement, etc.).

Although the FAA regulates the safe and efficient operation of all aircraft within the NAS, the FAA has never extended its administrative reach to regulate the use of cameras and other sensors extraneous to the airworthiness or safe operation of the aircraft in order to protect individual privacy. Moreover, there is substantial, ongoing debate among policymakers, industry, advocacy groups and members of the public regarding the extent to which UAS operations pose novel privacy issues, whether those issues are addressed by existing legal frameworks, and the means by which privacy risks should be further mitigated. Recognizing the importance of addressing privacy concerns in the proper forum, the FAA has partnered with other Federal agencies with the mandate and expertise to identify, develop, and implement appropriate mitigation strategies to address privacy concerns.

Turning to specific concerns raised by the commenters, EPIC asserted that

privacy is a necessary component of the Comprehensive Plan for civil UAS required by Public Law 112–95, section 332(a), the FAA is required to establish privacy regulations prior to the integration of UAS into the NAS, and the FAA must therefore reissue the NPRM to fulfill the Congressional mandate. EPIC believes the FAA should propose privacy regulations that include provisions for use and data limitations, transparency, and public accountability. The CDT proposed that the FAA consider a future rulemaking to establish (1) limits on UAS collection and analysis of data; (2) limits on UAS retention of data; (3) standardized methods to disclose data collection practices by non-hobbyist UAS operators and technical capacity to identify those operators; and (4) methods to honor requests to opt-out certain areas entirely or partially from UAS data collection. The NASDA and the South Dakota Department of Agriculture also asserted that privacy issues need to be addressed before UAS are integrated into the airspace.

In section 332(a) of Public Law 112–95, Congress required the Secretary of Transportation to develop, in consultation with representatives of the aviation industry, Federal agencies that employ UAS technology in the NAS, and the UAS industry, a comprehensive plan to safely accelerate the integration of civil UAS into the NAS. The mandate included specific direction regarding the contents of the plan, which addressed the safe and efficient integration of UAS into the airspace, but did not require the consideration of privacy implications.[168] Moreover, in section 332(b) of Public Law 112–95, Congress directed the FAA to issue a final rule on small unmanned aircraft systems that will allow for civil operations of such systems in the NAS. Section 333 of Public Law 112–95 directed the Secretary to determine whether UAS operations posing the least amount of public risk could safely be operated in the NAS and, if so, to establish requirements for the safe operation of these systems in the NAS, prior to completion of the UAS Comprehensive Plan and rulemaking required by section 332.

None of the UAS-related provisions of Public Law 112–95 directed the FAA to consider privacy issues when addressing the integration of small UAS into the airspace, or mandated the inclusion of privacy considerations in the UAS Comprehensive Plan. Reading such a mandate into Public Law 112–95 would be a significant expansion beyond the FAA's long-standing statutory authority as a safety agency. Nonetheless, the FAA has consistently recognized the importance of stakeholder engagement regarding the concerns raised regarding privacy implications associated with UAS integration and incorporated privacy considerations into the UAS Test Site Program, under its contracting authority, as discussed further in response to the following comment.

Moreover, consistent with the February 15, 2015 Presidential Memorandum, the FAA has been working closely with the privacy experts at NTIA by participating in public engagement sessions and educating both its governmental partners and privacy stakeholders regarding the safety issues associated with integrating UAS into the NAS. In March 2015, the NTIA invited comment on the issues that should be addressed as part of the stakeholder engagement process, and in July 2015, the NTIA announced further plans to hold a series of public engagement sessions in an open and transparent forum to develop consensus best practices for utilization by civil UAS operators.[169] The FAA will continue to participate in these public engagement sessions and any resulting working group to lend its insight and expertise regarding aviation safety issues as relevant to the development of consensus best practices for civil use of UAS.

EPIC asserted that the FAA has acknowledged that privacy needs to be addressed as part of UAS integration by addressing privacy as part of its test site program.

Section 332(c) of Public Law 112–95 directed the FAA, in coordination with NASA and DOD, to develop a UAS test site program for purposes of gathering safety and technical information relevant to the safe and efficient integration of UAS into the NAS. The UAS test site program is expected to help the FAA gain a better understanding of operational issues, such as training requirements, operational specifications, and technology considerations, which are essential to the FAA's chief mission to ensuring the safety and efficiency of the entire aviation system. Although not a required component of the test site program, the FAA recognized the test site program as an opportunity to further the dialogue with regard to privacy concerns raised concerning UAS integration.

The FAA implemented privacy requirements for the UAS test sites pursuant to its broad authority in 49 U.S.C. 106(l)(6), which allows the Administrator to enter into contracts under ''such terms and conditions as the Administrator may consider appropriate.'' Under this broad contracting authority, the FAA included certain terms and conditions for operating the test sites in the ''other transaction agreement'' (OTA) for each chosen test site operator, which included requirements that each test site operator establish, and make publicly available, a privacy policy governing all activities and that test sites must be operated in accordance with all applicable privacy laws.[170] The FAA did not specify the contents of any test site operator's privacy policy and noted its expectation that the public entities operating the test sites and their respective State and local oversight bodies would monitor and enforce a test site's compliance with its own policies.[171]

To develop these privacy requirements, the FAA engaged the public and enlisted assistance from subject matter experts outside the agency specializing in privacy law and policy. While the test sites were established in fulfillment of the requirements in Public Law 112–95, the privacy requirements were ultimately included in the OTAs pursuant to the FAA's contracting authority in order to further the dialogue regarding which privacy issues are raised by UAS operations and how law, public policy, and industry practices should respond to those issues in the long run. The FAA consistently emphasized that the privacy requirements for the UAS test sites ''are not intended to predetermine the long-term policy and regulatory framework under which UAS would operate.'' [172]

Contrary to the FAA's general contracting authority in § 106(l)(6), the FAA's rulemaking authority is specifically tied to its critical safety mission. While the FAA must comply with the Privacy Act of 1974, 5 U.S.C. 552a, and other applicable legal requirements related to privacy when the FAA is collecting, maintaining, and using information about individuals, the FAA's rulemaking authority neither mandates nor permits the FAA to issue or enforce regulations specifically aimed at protecting privacy interests between

[168] *See id.* at section 332(a)(2).

[169] 80 FR 11978, Mar. 5, 2015; 80 FR 41013, July 14, 2015.

[170] *See* 78 FR 68360, 68364, Nov. 14, 2013.

[171] *Id.* at 68363.

[172] *See* Civil UAS Roadmap at 1.4.4; 78 FR 18932, Mar. 28, 2013; 78 FR 12259, Feb. 22, 2013; and 78 FR 68360, Nov. 14, 2013.

third parties. Specifically, this rulemaking is being conducted under 49 U.S.C. 40103(b), 44701(a)(5), and Public Law 112–95, section 333, which focus on the safe operation of aircraft in the NAS. Thus, the functions of the Administrator and the FAA in this rulemaking do not include the protection of privacy interests between third parties. However, as discussed earlier, the FAA recognizes the importance of addressing privacy concerns and will continue to participate in the NTIA process to lend its insight and expertise regarding aviation safety issues to the development of consensus best practices for civil use of UAS.

EPIC asserted that UAS cannot be safely integrated into the NAS without privacy regulations and if the FAA does not address privacy it will create safety risks, because individuals will turn to self-help measures (*e.g.* by using technology such as geo-fencing, which could lead to the loss of positive control of a UAS) to protect their privacy. In response, the FAA notes that there could be many different motivations (not just privacy concerns) for an individual to engage in unsafe conduct. That is why the regulations of this rule require that a small UAS be safely operated. If a person engages in conduct that creates an unsafe small UAS operation, then that person will be in violation of this rule regardless of the specific motivation for that conduct.

The FAA also notes that, with regard to EPIC's example of geo-fencing as potentially dangerous self-help, a number of commenters on this rule specifically requested the FAA to mandate geo-fencing, asserting that this would increase the safety of a small UAS operation. As discussed in section III.E.3.b.vii.1 of this preamble, while this rule will not require geo-fencing equipage, the FAA may consider such equipage as a positive safety mitigation in evaluating waiver requests for individual operations.

Several commenters, including the Illinois Farm Bureau, Colorado Cattlemen's Association, and the IAAPA, raised concerns regarding small UAS operations over private property and asserted that UAS operations should not be permitted over private property without advance authorization given by the business or property owner. In addition, the IAAPA asserted that UAS could pose a threat to intellectual property and other business interests of amusement parks, and other commenters raised concerns regarding the use of UAS to collect proprietary data over privately owned farms and businesses. However, the Wisconsin Society of Land Surveyors commented that aerial geospatial data acquisition practices using UAS provide significant societal benefit, are not a threat to individual citizen privacy and therefore Federal efforts to impose limits on UAS should exempt surveying and aerial mapping.

As indicated in the NPRM and by some commenters, State law and other legal protections may already provide recourse for a person whose individual privacy, data privacy, private property rights, or intellectual property rights may be impacted by a remote pilot's civil or public use of a UAS. Moreover, as the New Jersey Institute of Technology, pointed out, established Fourth Amendment legal precedent may already ''serve as guiding boundaries or thresholds'' for law enforcement use of UAS. However, in light of the FAA's long-standing mission and authority as a safety agency, it would be overreaching for the FAA to enact regulations concerning privacy rights.[173]

5. First Amendment

The FAA also received comments concerning the First Amendment implications of this rulemaking. In the NPRM, the FAA proposed a number of restrictions on small UAS flight in the interest of aviation safety, which some commenters have asserted incidentally burden the First Amendment. Many commenters, including the International Center for Law and Economics and TechFreedom, the Student Press Law Center, and the News Media Coalition, encouraged the FAA to consider how the proposed rules may infringe on First Amendment rights.

After describing the applicable standards of review, the International Center for Law and Economics and TechFreedom asserted that various aspects of the rule are likely unconstitutional because they are not sufficiently narrowly drawn and adequately tailored to respond to the government interest for which they were created to address. This commenter went on to argue that the following NPRM provisions would have particular difficulty meeting the First Amendment burdens for time, place, and manner restrictions: (1) Ban on UAS flights over populated areas; (2) the specific airspace restrictions proposed in the NPRM; (3) the licensing regime for UAS operators; (4) the prohibition on nighttime operations; (5) the proposed visual line-of-sight requirements; (6) the ban on operating a small UAS from a moving vehicle; and (7) the ban on simultaneous operation of multiple UAS. Another commenter added that self-employed media photographers and videographers should be exempt from paying fees for operating UAS that may apply to larger news organizations, because such fees unduly would infringe upon their First Amendment rights.

The Student Press Law Center asserted that a failure to carve out an appropriate exemption for student journalism, similar to the one provided for ''hobbyists,'' could leave the final rule susceptible to a First Amendment challenge. The commenter argued that denying a journalist access to the skies on the basis of his intent to engage in protected speech unfairly punishes the would-be speaker, and stated that the intent to engage in a protected activity cannot be used as a basis for more burdensome regulation.

Additionally, one individual asserted that citizens engaged in constitutionally protected First Amendment activity could be subject to increased policing as a result of widespread small UAS usage. Another individual was concerned about the distinction between hobbyists and commercial use because, according to this individual, this distinction could result in the demise of model aviation magazines by muzzling hobbyists who are also paid.

a. First Amendment Law in the United States

In the United States, there is a right to freedom of speech, except under certain circumstances where the government is permitted to restrict speech. Whether the speech can constitutionally be restricted depends on the forum in which the speech is made, the content of the speech, or the manner in which it is regulated.[174] Government limitations on speech in a nonpublic forum receive a lower level of scrutiny than restrictions on speech in a public forum.[175]

In the public forum context, non-content-based restrictions on speech, such as the provisions in this rule, are analyzed using an intermediate scrutiny framework. Under intermediate scrutiny, a restriction on speech must advance a ''significant,'' ''substantial,'' or ''important,'' (but not necessarily ''compelling'') government interest, and the restriction must be narrowly tailored to achieve that interest. The restriction does not have to be the least restrictive

[173] *Nat'l Ass'n for Advancement of Colored People* v. *Fed. Power Comm'n,* 425 U.S. 662 (1976).

[174] U.S. Congressional Research Service. Freedom of Speech and Press: Exceptions to the First Amendment (7–5700, September 8, 2014) by Kathleen Ann Ruane. *https://www.fas.org/sgp/crs/misc/95-815.pdf* at 9.

[175] *Ctr. for Bio-Ethical Reform, Inc.* v. *City & Cnty. of Honolulu,* 455 F.3d 910, 920 (9th Cir. 2006).

means to advance the governmental interest.[176] There are two categories of non-content-based speech restrictions: (1) Incidental restrictions, which are restrictions aimed at conduct other than speech, but which incidentally restrict speech; and (2) time, place, or manner restrictions on speech.[177]

As discussed below, this rule regulates activity in a nonpublic forum: The NAS. However, even if we assume, for the sake of discussion, that the NAS is a public forum, the proper framework in which to view the provisions of this rule is not under the category of time, place, or manner restrictions, but under the category of incidental restrictions on speech. The flight of a small UAS is not speech—it is conduct other than speech which may incidentally restrict speech (*e.g.,* news reporting, commercial speech, or aerial photography). However, for the reasons discussed below, even if this rule were to be analyzed using the more stringent time, place, manner framework, the provisions of this rule would still be consistent with the First Amendment.

b. Restrictions on Speech in a Non-Public Forum

First, the location in which an activity occurs determines the level of scrutiny the courts will apply to a restriction placed on the activity. Restrictions placed on activities that occur in a non-public forum receive the lowest level of First Amendment scrutiny. Airspace is a nonpublic forum. As discussed in *Center for Bio-Ethical Reform, Inc.* v. *City and County of Honolulu,* ''one would be hard pressed to find another forum that has had its access as historically restricted as U.S. airspace.'' [178] Thus, FAA regulation of the NAS may impose restrictions in this forum that are ''reasonable and viewpoint neutral.'' [179] ''The reasonableness analysis focuses on whether the limitation is consistent with preserving the property for the purpose to which it is dedicated.'' [180] This rule is reasonable because it directly addresses the FAA's interest in preserving the safety of manned aircraft flying in the NAS, as well as the safety of people on the ground. This rule is also viewpoint neutral because it does not specifically target a certain opinion or stance.[181] As such, the provisions of this rule are consistent with the First Amendment.

c. Incidental Restrictions on Speech

If we were to assume, for the sake of discussion, that the NAS is a public forum, then the appropriate category in which to evaluate the provisions of this rule would be as an incidental restriction on speech. The activity actually regulated by this rule—flying a small unmanned aircraft—is not speech or an expressive activity. Rather, the flight of a small unmanned aircraft has only an incidental relationship to expressive conduct because it could be used to assist an expressive activity, such as recording something via camera. However, the provisions of this rule regulate only the flight of small unmanned aircraft; the use of a camera or other method of recording something near the aircraft is not directly regulated by part 107. In other words, attaching a camera to a small unmanned aircraft does not transform flying that aircraft into expressive conduct any more than attaching a camera to a car would transform driving that car into expressive conduct. In both cases, any restrictions on expressive conduct that occur as a result of regulating the operation of the small unmanned aircraft or car are incidental restrictions.

The Supreme Court has noted that the standard for determining the constitutionality of an incidental restriction is ''little, if any, different from the standard applied to a time, place, or manner restriction.'' [182] As long as the regulation is content-neutral and narrowly focused on a substantial government interest, an incidental restriction need not be the least restrictive or least intrusive means of furthering that government interest.[183] As discussed in the previous section, this regulation is content-neutral and is narrowly focused on the substantial government interest of regulating aviation safety.[184] Therefore, it need not be the least restrictive or least intrusive means of furthering aviation safety.

In *Arcara* v. *Cloud Books,* the defendant challenged a New York State law under which an adult bookstore was closed because it was found to be a public health nuisance. Respondents argued that the effect of the statutory closure remedy impermissibly burdened its bookselling activities protected under the First Amendment. The Supreme Court observed that ''[t]he severity of this burden is dubious at best, and is mitigated by the fact that respondents remain free to sell the same materials at another location.'' [185] The Court continued:

> In any event, this argument proves too much, since every civil and criminal remedy imposes some conceivable burden on First Amendment protected activities. One liable for a civil damages award has less money to spend on paid political announcements or to contribute to political causes, yet no one would suggest that such liability gives rise to a valid First Amendment claim. Similarly, a thief who is sent to prison might complain that his First Amendment right to speak in public places has been infringed because of the confinement, but we have explicitly rejected a prisoner's claim to a prison environment least restrictive of his desire to speak to outsiders.[186]

Ultimately, the Court concluded that absent any basis for heightened scrutiny, ''the First Amendment is not implicated by the enforcement of a public health regulation of general application against the physical premises in which respondents happen to sell books.'' [187]

Similarly, this rule is directed at aviation safety and does not directly regulate reporting or other expressive activity. Anyone seeking to use a small UAS for photography or videography in a manner not permitted under this rule is free to utilize another method of photography or videography by, for example, using a manned aircraft, filming from a tall structure or landmark, filming from the ground, or using specialized equipment. Thus, the provisions of this rule meet the constitutional standard for an incidental restriction on speech, and enforcement would not implicate the First Amendment.

d. Time, Place, Manner Restrictions on Speech

Finally, even if we were to assume that this rule directly regulates expressive activity in a public forum, the provisions of this rule would still be consistent with the First Amendment as a permissible time, place, or manner restriction on speech. A constitutionally permitted time, place, or manner restriction on speech occurs when the regulation is content-neutral, narrowly tailored to serve a significant

[176] CRS at 9.

[177] CRS at 9.

[178] *Ctr. for Bio-Ethical Reform, Inc.* v. *City & Cnty. of Honolulu,* 455 F.3d 910, 920 (9th Cir. 2006).

[179] *Ctr. for Bio-Ethical Reform* at 915.

[180] *Ctr. for Bio-Ethical Reform* at 922, citing *Brown* v. *California Dept. of Transp.*321 F.3d 1217, 1222 (9th Cir. 2003).

[181] *Ctr. for Bio-Ethical Reform* at 921.

[182] *Clark,* 468 U.S. at 294.

[183] *S.F. Arts & Athletics, Inc.* v. *U.S. Olympic Comm.,* 483 U.S. 522, 537 (1987).

[184] *See Minneapolis Star & Tribune Co.* v. *Minnesota Comm'r of Revenue,* 460 U.S. 575 (1983). In that case, the Supreme Court struck down a tax imposed on the sale of large quantities of newsprint and ink because the tax had the effect of singling out newspapers to shoulder its burden. Here there is no such disproportionate effect—there are many small UAS operators who are not newsgathering organizations.

[185] *Arcara* v. *Cloud Books, Inc.,* 478 U.S. 697, 705 (1986).

[186] *Id.* at 705–06.

[187] *Id.* at 707.

government interest, and leaves open ample alternative channels of communication.

First, the requirement that the regulation be content-neutral is satisfied in this rule. The rule applies equally to all remote pilots of small UAS subject to FAA regulation, regardless of content.[188] The regulation ''is not being applied because of disagreement with the message presented.'' [189] There is no question as to the content-neutrality of the regulation in this rule.

Second, this rule is narrowly focused on the FAA's substantial interest in protecting the navigable airspace of the United States, in addition to people on the ground. An example of a restriction that was considered unconstitutional was a ban on displaying flags or banners on public sidewalks surrounding the Supreme Court because there was not sufficient justification for the ban and it was not narrowly tailored.[190] Conversely, with respect to the regulation at issue, to discard the provisions with which the commenters have taken issue would be at odds with the FAA's stated mission of providing the safest airspace system in the world. The safety rationale for the provisions specifically designated by commenters as posing First Amendment issues is discussed in those provisions' respective sections of this preamble.

Lastly, there are adequate alternative channels of communication available for operations that are not allowed under the provisions of this rule. The First Amendment analysis does not require that a regulation be the least restrictive means of achieving the government interest, only that there not be a less restrictive alternative that serves the government's interest as efficiently as the regulation at issue. A variety of other reporting, photography, and videography tactics that have been used prior to the existence of small UAS continue to be available to this day—the provisions of this rule apply only to small UAS, and not to other methods of conducting photography or videography. For example, as mentioned previously, the capability to conduct aerial photography and videography using manned aircraft remains unaffected by this rule.

This rule fulfills several legitimate needs, the most important of which is providing the safest, most efficient aerospace system in the world. The provisions at issue all align with that principle. As such, this rule (which does not discriminate based on the time, place or manner of any expressive conduct) is narrowly tailored to achieve a significant, substantial, and important government interest.

6. Preemption

Although the NPRM did not mention preemption, the FAA received some comments on Federal preemption over State and local regulations. The FAA has reviewed the comments and, as discussed below, decided that specific regulatory text addressing preemption is not required in the final rule.

The Associated General Contractors of America, Consumers Energy Company, and National Association of Mutual Insurance Companies raised concerns about the proposed rule's lack of a preemption provision. Consumer Energy Company pointed out that without a preemption provision, State and local governments may attempt to regulate small UAS operations, resulting in potentially conflicting rules. Commenters argued that conflicting rules may lead to confusion, litigation costs, increased operational limitations, burden on UAS users, and delay in the adoption of UAS technology.

Additionally, the Stadium Managers Association commented that states and local jurisdictions may react to the lack of Federal regulations for model aircraft ''with a flood of legislation that might very well be more restrictive and controlling than that of the § 336 community-based organizations.'' [191] The Stadium Managers Association questioned how Federal preemption would apply to model aircraft and stated generally its concern about the potential conflict between State and Federal laws.

The FAA is not persuaded that including a preemption provision in the final rule is warranted at this time. Preemption issues involving small UAS necessitate a case-specific analysis that is not appropriate in a rule of general applicability. Additionally, certain legal aspects concerning small UAS use may be best addressed at the State or local level. For example, State law and other legal protections for individual privacy may provide recourse for a person whose privacy may be affected through another person's use of a UAS.[192]

On December 17, 2015, the FAA Chief Counsel and the Director of the FAA's UAS Integration Office issued a Fact Sheet on State and Local Regulation of Unmanned Aircraft Systems (UAS). The Fact Sheet is intended to serve as a guide for State and local governments as they respond to the increased use of UAS in the national airspace. It summarizes well-established legal principles as to the Federal responsibility for regulating the operation or flight of aircraft, which includes, as a matter of law, UAS. The Fact Sheet also summarizes the Federal responsibility for ensuring the safety of flight as well as the safety of people and property on the ground as a result of the operation of aircraft. Substantial air safety issues are implicated when State or local governments attempt to regulate the operation of aircraft in the national airspace. The Fact Sheet provides examples of State and local laws affecting UAS for which consultation with the FAA is recommended and those that are likely to fall within State and local government authority. For example, consultation with FAA is recommended when State or local governments enact operational UAS restrictions on flight altitude, flight paths; operational bans; or any regulation of the navigable airspace. The Fact Sheet also notes that laws traditionally related to State and local police power—including land use, zoning, privacy, trespass, and law enforcement operations—generally are not subject to Federal regulation. Finally, the Fact Sheet includes a list of relevant legal authorities in an appendix. The Fact Sheet is available at *http://www.faa.gov/uas/regulations_policies/media/UAS_Fact_Sheet_Final.pdf.*

7. Agricultural Operations

Several commenters stated that any aerial application work conducted with small UAS must comply with 14 CFR

[188] Any disparities in operation between pilots of small UAS who are hobbyists and those who are using small UAS for commercial purposes are beyond the control of the FAA—the ''carve-out'' for hobbyists was not instituted with FAA authority. As stated in the rule, section 336 of Public Law 112–95 specifically prohibits the FAA from promulgating rules regarding model aircraft that meet all of the following statutory criteria:

- The aircraft is flown strictly for hobby or recreational use;
- The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;
- The aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;
- The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and
- When flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport) with prior notice of the operation.

Therefore, the FAA can only promulgate rules regarding commercial uses of small UAS that are outside the scope of section 336, such as commercial uses.

[189] *Clark,* 468 U.S. at 294.

[190] *United States* v. *Grace,* 461 U.S. 171 (1983).

[191] Stadium Managers Association Comment at 5.

[192] NPRM at 9552.

part 137, ''Agricultural Aircraft Operations.'' The FAA agrees, and emphasizes that under the current regulations (which remain unchanged by this rule) a remote pilot must comply with part 137 if he or she is engaging in dispensing activities that meet the definition of ''agricultural aircraft operation'' in 14 CFR 137.3.

Part 137 applies to ''agricultural aircraft operations'' conducted within the United States. Section 137.3 defines ''agricultural aircraft operation'' as ''the operation of an aircraft for the purpose of (1) dispensing any economic poison, (2) dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life, or pest control, or (3) engaging in dispensing activities directly affecting agriculture, horticulture, or forest preservation, but not including the dispensing of live insects.''

Any small UAS remote pilot conducting operations under part 107 that constitute an ''agricultural aircraft operation'' within the meaning of part 137 is required to comply with part 137, in addition to part 107, and hold an agricultural aircraft operator certificate. A remote pilot of a small UAS conducting agricultural aircraft operations may pose a contamination danger to himself or people in the area of operation, either through the exposure to or ingestion of the dispensed substance, or through the contamination of water or food supplies. Part 137 addresses this safety concern by levying requirements on agricultural aircraft operations, including certification, knowledge, and skill requirements. Therefore, any small UAS operation that meets the applicability requirements of part 137 must comply with part 137 in addition to part 107; these regulations are independent requirements. The FAA recognizes that remote pilots may not be able to meet all of the part 137 requirements because these regulations did not contemplate the unique characteristics of unmanned aircraft. As with other regulatory provisions, those remote pilots may seek an exemption from the part 137 requirements they are unable to meet.

The FAA notes that not all operations related to agricultural uses of a small UAS will be subject to part 137. Small UAS operations that are related to agriculture (*i.e.,* crop monitoring, crop photography) but do not constitute an ''agricultural aircraft operation'' under part 137 are not required to comply with part 137.

8. Miscellaneous Comments

Several individual commenters urged the FAA to focus on education. A few commenters, for example, recommended the FAA require that all UAS sold in the United States include information about applicable UAS regulations. Another commenter recommended a televised or magazine ad campaign ''to educate and steer people.''

The FAA will conduct an outreach effort, including publishing an advisory circular providing guidance on safe small UAS operations, and will continue to develop guidance for the public at *http://www.faa.gov/uas/*.

The North Dakota Department of Agriculture raised concerns related to data gathering, storing and ownership of UAS technology and the fact that UAS operations can take place across State borders.

These issues are beyond the scope of this rulemaking.

IV. Regulatory Notices and Analyses

A. Regulatory Evaluation

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 direct that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Public Law 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Public Law 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Public Law 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or Tribal governments, in the aggregate, or by the private sector, of $155 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this final rule. We suggest readers seeking greater detail read the full regulatory evaluation, a copy of which we have placed in the docket for this rulemaking.

In conducting these analyses, FAA has determined that this final rule: (1) Has benefits that justify its costs; (2) is an economically ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866; (3) is ''significant'' as defined in DOT's Regulatory Policies and Procedures; (4) will have a significant positive economic impact on a substantial number of small entities; (5) will not create unnecessary obstacles to the foreign commerce of the United States; and (6) is subject to the Unfunded Mandates Reform Act of 1995 (Public Law 104–4). These analyses are summarized below.

Assumptions and Data

The FAA's estimated benefits and costs are based on assessments of the small UAS Aviation Rulemaking Committee (ARC), commenters to the NPRM, and the opinions of FAA and industry subject matter experts. We remind the reader that since legal operation of non-recreational/non-hobby small UAS in the NAS constitutes a new market, available data for these operations is sparse. The benefit and cost analysis for the regulatory evaluation is based on the following assumptions:

- Because the commercial small UAS industry is not yet established and may evolve differently from current expectations, the FAA determines that a five-year time frame of analysis is appropriate.
- The base year is 2016.
- We use a three percent and seven percent discount rate for the costs, as prescribed by OMB in Circular A–4.[193]
- Costs of the rule are estimated using two separate fleet forecasts. Based on these forecasts, a low case and a high case are developed.
  - *Low Case:* For this scenario, the small UAS fleet is separated into two different categories, professional-grade and consumer-grade, as discussed in the low case fleet forecast below. The FAA assumes professional vehicles are replaced every three years and the consumer vehicles are replaced every 1.5 years.[194]
  - Small UAS remote pilots flying ''Professional'' vehicles are assumed to remain part of the pilot stock for the five-year analysis period. Pilots flying ''Consumer'' vehicles are assumed to attrite at a rate of 20 percent annually.[195]

[193] *http://www.whitehouse.gov/omb/circulars_a004_a-4.*

[194] Commercial sUAS Market Forecast, Prepared for GRA Incorporated by Teal Group Corporation. December 31, 2015.

[195] We note that the Small Business Administration (SBA) reports new firms with employees tend to have an annual failure rate of 10 to 12 percent where new firms without employees have failure rates about 30 to 36 percent. As this is an entirely new industry, the failure rate may be towards the higher end of the range. We find that the FAA's forecast of 20 percent is consistent with the SBA's failure rate of new business. *http://www.sba.gov/sites/default/files/FAQ_Sept_2012.pdf.*

○ *High Case:* The high case does not distinguish between small UAS types and it is assumed that all vehicles have a life-span of one year.

■ All pilots are assumed to attrite at a rate of 20 percent annually.[196]

• We estimate that there is one qualified FAA-approved remote pilot in command for every two small UAS registered [197] and that both small UAS are of the same type (*i.e.* professional or consumer). This is a simplifying assumption.

• The FAA estimates that a small UAS remote pilot applicant will expend 20 hours of self-study in preparation for taking the initial knowledge test and ten hours for the recurrent test.[198] For individuals that fail the initial or recurrent test on their first attempt, the self-study-time to retake the test is reduced by 50 percent.

• The FAA assumes that it will take an applicant 3 hours to take the initial or recurrent knowledge test. This time may be over-estimated for the purpose of the recurrent knowledge test, given that it covers fewer topics than other pilot tests.

• The FAA determines that holders of Public COAs for activities may choose to operate under part 107.

• The FAA assumes that the failure rate of applicants [199] taking the small UAS initial and recurrent knowledge based test is 10% percent.[200] However, applicants that fail are assumed to pass the knowledge test on their second attempt.

• The cost to administer an FAA approved small UAS knowledge test to a small UAS applicant or operator is $150.[201]

• The FAA estimates that a small UAS operator applicant will need to travel an average of 19 miles one way to reach their closest KTC location (38 miles round trip).[202]

• The FAA estimates that pilots operating small UAS under a 333 exemption will need to travel an average of 19 miles one way to reach their sport pilot license (38 miles round trip).[203]

• The 2016 published IRS variable cost mileage rate of $0.19 per mile is used to estimate the cost of vehicle usage.[204]

• The FAA assigns the hourly value of time and hourly values of travel time savings as to equal $25.14 for Year 1.[205]

• The FAA cost to issue an airman certificate is $25.

• The FAA assumes a $50 fee to validate the identity of a remote pilot applicant who holds a part 61 pilot certificate with a current flight review and who has opted to take the online training course instead of the initial knowledge test.[206]

• The FAA assumes that those remote pilots flying small UAS under a 333 exemption will operate under Part 107 rules upon expiration of their exemption.

• The FAA determines that the cost to for an applicant to be granted a 333 exemption is $1,500.[207]

• The FAA estimates that the cost for sport pilot school is $3,000.[208]

• The FAA estimates that the flight training time for a sport pilot certificate is 33 hours.[209]

• The FAA estimates that a sport pilot applicant will spend 20 hours of self-study in preparation for taking the sport-pilot initial knowledge test.[210]

• The FAA estimates that an applicant for a sport pilot license will make 22 round trips to the training center.[211]

Benefits Summary

The net benefit of a regulatory action can be expressed by the change in economic welfare that it generates for society. These welfare impacts are reflected by changes in ''consumer surplus.'' [212] Consumer surplus is an economic concept reflecting the idea that individuals and businesses demonstrate a willingness to pay for various goods and services, which reflects the value they receive from consuming or using those goods and services. Of course, not all consumers and business will receive the same value from a good or service, and this is reflected in the fact that there is usually wide variation in their willingness to pay to acquire it. The demand curve for that good or service reflects the continuum of values that different businesses and consumers receive from using it, and the consequent variation in their willingness to pay to purchase it.

Businesses and consumers to whom this value exceeds the price of purchasing a good or service will do so, and as a result will experience benefits equal to the difference between the value they receive from that good or service and the price they pay to purchase it. This difference represents the consumer surplus they experiencing from purchasing and using it.

A government action that reduces the price of a good or service increases the difference between the value its original buyers attach to it and the price they pay for it, thereby increasing the consumer surplus they receive. At the same time, the reduction in its price leads some consumers or businesses that were previously unwilling to purchase it—because its value to them was below its price—will now find it worthwhile to do so. Like those who purchased it at its initially higher price, they now also experience consumer surplus equal to the difference between the value they receive from having it and the (lower) price they now pay to purchase it.

The benefit resulting from such an action includes the increases in consumer surplus to both groups: The savings experienced by those who formerly purchased the affected good or service at its initially higher price, and the new or additional consumer surplus experienced by those who decide to purchase it at its now lower price. Again, because the demand curve for that good or service reflects the distribution of values that businesses and consumers receive from using it, this total benefit can be quantified by estimating the area under the demand curve between the old price and the new price.

This Part 107 small UAS rule is an ''enabling rule,'' which effectively reduces the cost of entry into the non-recreational, non-hobby (or ''commercial'') market for UAS services. Benefits are quantified in terms of changes in consumer surplus for both existing 333 exemption holders, who have incurred significant costs to enable

[196] Small UAS Registration and Marking interim final rule (Registry IFR), published on December 16, 2015.

[197] Based on the FAA Civil Aircraft Registry as of December 2015.

[198] The FAA does not require a small UAS remote pilot applicant to attend ground school to be eligible to take the initial knowledge test. However, the FAA acknowledges that applicants may need self-study to pass the exam.

[199] The FAA notes that a person first must apply to become a small UAS remote pilot. During the application process, this analysis will refer to a person applying to become a small UAS remote pilot as an applicant. After the applicant has successfully passed the application process, this analysis will refer to the person as a small UAS remote pilot.

[200] Since the small UAS knowledge test has yet to be administered, statistics are not yet available to estimate the failure rate of applicants. However, the weighted average failure rate for all categories of airman taking knowledge tests in 2014 was 10%.

[201] *http://www.catstest.com/airman-testing-exams/recreational-private-pilot.php.*

[202] See ''Travel Expense'' section of the regulatory evaluation for methodology and source information.

[203] See ''Travel Expense'' section of the regulatory evaluation for methodology and source information.

[204] *https://www.irs.gov/uac/Newsroom/2016-Standard-Mileage-Rates-for-Business-Medical-and-Moving-Announced.*

[205] Source: Economic Values for Evaluation of FAA Investment and Regulatory Decisions (*http://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/*) Table 1–1 Recommended Hourly Values of Travel Time Savings. P. 1–2. Increased by 1.1 percent annually per U.S. Department of Transportation Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis. (*https://www.transportation.gov/administrations/office-policy/2015-value-travel-time-guidance.* p.6).

[206] The FAA considers this to be a conservative estimate since there are no overhead costs associated with positive identification. Since the FAA did not receive a comment providing a better basis for this estimate, the FAA will continue to use $50 as the positive identification fee for the final rule.

[207] *http://antonelli-law.com/Drone_UAS_Practice_Group.php* (Checked on 3/16/2016).

[208] *http://www.aopa.org/letsgoflying/ready/time/options.html.*

[209] Ibid.

[210] To determine the amount of self-study an individual would need to prep for the knowledge test, we examined two different sport pilot ground schools that claimed attendance at one of their sessions over the course of a weekend would be adequate preparation to pass the sport pilot written knowledge test. We then used these hours as a proxy for the self-study time a remote pilot applicant would need to pass the initial knowledge test. One of the pilot schools we examined offered a two-day sport pilot course which included 19 hours of instruction, and the other school offered a three-day course that lasted for a period of 23 hours. Based upon these two estimates, the FAA assumes that 20 hours of self-study is adequate to pass the initial knowledge test.

[211] Federal Aviation Administration—Flight Standards Service

[212] The impact of regulatory actions on economic welfare also includes any resulting changes in ''producer surplus.'' In this case, however, a government agency (FAA) is the ''producer'' of UAS pilot certifications, and its marginal or incremental costs for certifying additional pilots are assumed to be constant. Because the agency thus receives no producer surplus, the welfare impacts of this regulatory action consist entirely of changes in consumer surplus to the two categories of small UAS pilots.

them to operate small UASs (and would continue to do so in the absence of this rule), and new small UAS pilots certified under the streamlined procedures it establishes. The consumer surplus for new pilots is measured by the traditional consumer surplus triangle while the consumer surplus for the 333 exemption holders is measured as a cost savings. For new pilots, initial costs to obtain the remote pilot certificate were subtracted from consumer surplus to obtain an estimate of net benefits to pilots. For existing 333 exemption holders, the costs of maintaining their remote pilot certificates and other costs, such as TSA vetting, were subtracted from the consumer surplus to obtain estimates of the net benefits to pilots.

PART 107 FINAL RULE QUANTIFIED BENEFITS TO PILOTS—LOW CASE

[$ Millions]

Year	Cost savings 333 pilots	Consumer surplus remote pilots	Total consumer surplus
2016	.....	$33.7	$33.7
2017	$1.5	104.2	105.8
2018	2.6	159.8	162.6
2019	1.1	275.6	276.7
2020	1.8	371.4	373.3
Total	*7.2*	*944.9*	*952.0*
Discounted 3%	.....	.....	*874.4*
Discounted 7%	.....	.....	*785.1*

PART 107 FINAL RULE QUANTIFIED BENEFITS TO PILOTS—HIGH CASE

[$ Millions]

Year	Cost savings 333 pilots	Consumer surplus remote pilots	Total consumer surplus
2016	.....	$1,700	$1,700.0
2017	$1.5	5,226	5,227.5
2018	2.6	521	523.6
2019	1.1	1,507	1,508.1
2020	1.8	1,352	1,353.8
Total	*7.2*	10,306	*10,313.2*
Discounted 3%	.....	.....	*9,852*
Discounted 7%	.....	.....	*9,307*

Note: The benefits for existing 333 exemption holders are the same under both the high and low fleet forecasts.

Cost Summary

In addition to those costs subtracted from consumer surplus to calculate benefits, there are other costs which include renewal costs for new pilots, small UAS lighting costs, change of name costs, and government costs. In the Regulatory Evaluation, we estimate these costs by provision. In the following tables, we provide the estimated total cost for both the low case and high case of the final rule for the five year period of analysis.

SMALL UAS PART 107 FINAL RULE COSTS—LOW CASE

[Millions of dollars]

	2016	2017	2018	2019	2020	2016–20
Owner/Operator Costs						
Costs Netted Out of Consumer Surplus						
Initial "New" Pilot Costs	$9.83	$30.52	$47.10	$81.66	$110.76	$279.87
333 Pilot Costs	.....	0.1	0.24	0.04	0.07	0.49
Total	9.83	30.66	47.34	81.70	110.83	280.36
Other Costs						
Pt 107 "New" Pilots—Recurrent Tests	.....	.....	4.37	13.84	24.52	42.73
Change of Name or Address Form	0.02	0.05	0.09	0.17	0.27	0.59
Anti-Collision Lighting	1.05	2.72	4.80	8.54	12.50	29.61
Total	1.07	2.77	9.27	22.55	37.28	72.93
Total Owner/Operator Costs	10.90	33.43	56.61	104.25	148.11	353.29
Government Costs						
TSA Security Vetting	0.12	0.39	0.59	0.99	1.32	3.41

SMALL UAS PART 107 FINAL RULE COSTS—LOW CASE—Continued

[Millions of dollars]

	2016	2017	2018	2019	2020	2016–20
FAA—Develop Knowledge Tests	0.25					0.25
FAA—Develop Part 61 Training	0.12					0.12
FAA—sUAS Operating Certificate	0.30	0.96	1.48	2.46	3.31	8.52
FAA—Develop ATC Training	0.03					0.03
FAA—Train ATC Employees	0.93					0.93
FAA—Develop Flight Standards Training	0.03					0.03
FAA—Train Flight Standards Employees	0.13					0.13
FAA—Hiring Additional Employees	13.07	18.33	24.69	33.02	43.81	132.93
Total Government Costs	14.98	19.68	26.76	36.47	48.45	146.34
Total Gov't and Owner/Operator Costs	25.87	53.11	83.37	140.72	196.56	499.63
7% Present Value	25.87	49.64	72.82	114.87	149.96	413.15
3% Present Value	25.87	51.57	78.59	128.77	174.65	459.44

Note: Initial "New" Pilot Costs and 333 Pilot Costs were already subtracted to compute the estimates of the benefits to pilots presented above and should not be included when calculating total net benefits.

SMALL UAS PART 107 FINAL RULE COSTS—HIGH CASE

[Millions of dollars]

Owner/Operator costs	2016	2017	2018	2019	2020	2016–20
Costs Netted Out of Consumer Surplus						
Initial "New" Pilot Costs	$248.00	$765.00	$77.00	$223.00	$202.00	$1,515.00
333 Pilot Costs		0.14	0.24	0.04	0.07	0.49
Total	248.00	765.14	77.24	223.04	202.07	1,515.49
Other Costs						
Pt 107 "New" Pilots—Recurrent Tests			$135.28	$417.90	$129.61	$682.79
Change of Name or Address Form	0.29	1.19	1.23	1.27	1.32	5.30
Anti-Collision Lighting	19.74	79.74	81.76	83.84	85.95	351.04
Total	20.03	80.93	218.27	503.01	216.88	1,039.13
Total Owner/Operator Costs	268.03	846.07	295.51	726.05	418.95	2,554.62
Government Costs						
TSA Security Vetting	$3.09	$9.38	$0.93	$2.69	$2.41	$18.50
FAA—Develop Knowledge Tests	0.25					0.25
FAA—Develop Part 61 Training	0.12					0.12
FAA—sUAS Operating Certificate	7.71	23.44	2.33	6.73	6.03	46.24
FAA—Develop ATC Training	0.03					0.03
FAA—Train ATC Employees	0.93					0.93
FAA—Develop Flight Standards Training	0.03					0.03
FAA—Train Flight Standards Employees	0.13					0.13
FAA—Hiring Additional Employees	22.40	35.21	34.76	35.95	45.97	174.29
Total Government Costs	$34.69	$68.02	$38.02	$45.38	$54.41	$240.52
Total Gov't and Owner/Operator Costs	$302.72	$914.09	$333.53	$771.43	$473.36	$2,795.14
7% Present Value	302.72	854.29	291.31	629.72	361.13	2,439.17
3% Present Value	302.72	887.49	314.38	705.94	420.58	2,631.12

Note: Initial "New" Pilot Costs and 333 Pilot Costs were already subtracted to compute the estimates of the benefits to pilots presented above and should not be included when calculating total net benefits.

Net Benefits Summary

This rulemaking responds to Congressional direction to allow commercial operation of small UAS in the national airspace system (NAS). Currently the FAA has issued over 4,000 exemptions allowing for commercial operations. This rule will lower the costs of entry for small UAS commercial operations. Once issued, future operators will decide whether their benefits exceed their costs. The FAA has quantified these benefits by estimating consumer surplus resulting from future commercial operations.

The final rule's major costs are activities associated with recurrent knowledge test requirements for the airman certification of small UAS remote pilots. Also, there are

costs associated with the security vetting that TSA is required to conduct. The FAA incurs costs to issue operator certificates with a small UAS rating; costs for developing knowledge tests and on-line training for remote pilot applicants; and costs for training FAA personnel. Additional costs will also accrue from time it takes to complete the paperwork for airman certification and airman name or address change.

The estimated out-of-pocket cash outlay for a remote pilot applicant to be FAA-certificated is $150. As this rulemaking enables new businesses and a new market, each remote pilot will decide to voluntarily enter the market and incur these compliance costs because they expect their benefits to exceed costs. As profitable opportunities increase, so will the social benefits. The net social benefits of this rulemaking over the 5-year analysis period are presented below.

SMALL UAS PART 107 FINAL RULE NET SOCIAL BENEFITS: 2016–2020

	Millions $	7% PV Millions $	3% PV Millions $
Net Benefits to Pilots: 333 Pilots and Pt 107 Pilots	$952	$785	$874
FAA and Other Costs*	219	182	202
Net Social Benefit	733	603	672
HIGH CASE			
Net Benefits to Pilots: 333 Pilots and Pt 107 Pilots	$10,313	$9,307	$9,852
FAA and Other Costs*	1,280	1,072	1,184
Net Social Benefit	9,034	8,235	8,668

*Other costs include TSA vetting costs, anti-collision lights, and part 107 recurrent costs. Details may not add to column totals due to rounding.

B. Final Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Public Law 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA. Section 604 of the Act requires agencies to prepare a final regulatory flexibility analysis (FRFA) describing the impact of final rules on small entities. When issuing a final rule, section 604(a) of the Act specifies that each FRFA contain:

- A statement of the need for and objectives of the rule;
- a statement of the significant issues raised by the public comments in response to the initial regulatory flexibility analysis, a statement of the assessment of the agency of such issues, and a statement of any changes made in the proposed rule as a result of such comments;
- the response of the agency to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA) in response to the proposed rule, and a detailed statement of any change made to the proposed rule in the final rule as a result of the comments;
- a description of and an estimate of the number of small entities to which the rule will apply or an explanation of why no such estimate is available;
- a description of the projected reporting, recordkeeping and other compliance requirements of the rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record; and
- a description of the steps the agency has taken to minimize the significant economic impact on small entities consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each one of the other significant alternatives to the rule considered by the agency which affect the impact on small entities was rejected

1. A Statement of the Need for and Objectives of the Rule

The FAA is amending its regulations to adopt specific rules to allow the operation of small unmanned aircraft system (small UAS) operations in the National Airspace System (NAS). These changes will address the operation of small UAS and the certification of their operators. The requirements will allow small UAS to operate in the NAS while minimizing the risk they may pose to manned aviation operations and the general public.

Currently commercial activity using a small UAS is prohibited by Federal regulation unless the civil aircraft has an airworthiness certificate in effect or operations are approved by the FAA on a case-by-case basis via an exemption from the pertinent regulations. Once this final rule is adopted, operators will be permitted to participate in certain non-hobbyist activities from which they are currently prohibited without a more costly exemption. The final rule requirements are intended to enable the opportunity for the private sector to develop commercial small UAS businesses and facilitate legal and safe operations.

2. A Statement of the Significant Issues Raised by the Public Comments in Response to the Initial Regulatory Flexibility Analysis, a Statement of the Assessment of the Agency of such Issues, and a Statement of any Changes Made in the Proposed Rule as a Result of Such Comments

One individual commented that the regulatory evaluation did not differentiate the economic impact between large operators of small UAS and small operators of small UAS, and that the regulatory flexibility analysis describing the impact to small operators was not available. The Initial Regulatory Flexibility Determination (IRFD) was included as Section IV.B of the NPRM. In that regulatory flexibility determination, the FAA states that most, if not all, new commercial activities will be conducted by operators that would be small entities. Because the commercial small UAS industry is not yet established and legal operation of commercial small UAS in the NAS constitutes a new market, available data is sparse. Accordingly, the FAA has not quantified the number of small entities to which the final rule will apply because while the FAA believes most would be small entities, some may evolve quickly to become large firms.

One individual commented that the proposed cost for the knowledge test fees, and TSA security vetting and related costs are too high, and that the high cost will be burdensome for small startup businesses and negatively affect new innovative small UAS businesses in the U.S. The commenter stated that the total cost at the beginning should be no more than $1,000. The FAA

disagrees that the compliance costs of this rule are too high. As shown in the regulatory evaluation, the only initial out-of-pocket cost for an owner/operator is $150 to take the initial knowledge test. For part 61 pilot certificate holders with a current flight review, the cost is even less and consists of $50 for airman certificate application verification by a DPE, CFI or ACR. This rulemaking only requires that an applicant for a remote pilot certificate with a small UAS rating demonstrate aeronautical knowledge by passing an initial knowledge test, or, for those eligible, completing on-line training.

One individual commented that he had been looking into starting a small business for monitoring pipelines and right of ways for oil and gas companies using UAV's, but that the blanket visual-line-of-sight requirement makes his business plan impossible. The commenter states that the rule essentially protects all current aviation companies from competition, and shuts down many small business startups. The FAA disagrees with this belief. The final rule will integrate small UAS operations posing the least amount of risk to the NAS. The operational limitations are imposed to keep the NAS safe. In the meantime, the FAA will continue working on integrating UAS operations that pose greater amounts of risk and will issue notices of proposed rulemaking for those operations once the pertinent issues have been addressed. Once the entire integration process is complete, the FAA envisions the NAS populated with UAS that operate well beyond the operational limits of this rule. The FAA has selected this approach because it will allow lower-risk small UAS operations to be incorporated into the NAS immediately as opposed to waiting until the issues associated with higher-risk UAS operations are resolved.

The NBAA and an individual commented positively on the NPRM. The NBAA commented that they believe the NPRM could have a positive impact on small entities. An individual commented that he is a small business owner for whom UAS are an integral part of his business plan, and these rules will help him grow his business, while ensuring a safe operating environment for UAS.

3. The Response of the Agency to any Comments Filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA) in Response to the Proposed Rule, and a Detailed Statement of any Change Made to the Proposed Rule in the Final Rule as a Result of the Comments

The SBA Office of Advocacy commented that the FAA should articulate and quantify the framework or parameters for assessing risk, reassess its consideration of alternatives in the proposed rule, and release any safety data it has in order to facilitate the public's evaluation of the FAA's assessment of risk. With regard to data, the supporting documents available in the docket for this rulemaking contain everything that the FAA relied on in issuing this rule. At this time, the FAA does not have data that would allow it to quantify the risk posed by small UAS operations conducted under part 107. The FAA notes, however, that many of the operating restrictions of part 107 are waivable, and the agency anticipates gaining a significant amount of data and operational experience as a result of its administration of the waiver process.

The FAA also emphasizes that this rule is simply one step in the integration of small UAS into the NAS. Both the FAA and the private sector currently have a number of initiatives to obtain more data on small UAS operations, and the FAA anticipates using this data in future agency actions to further integrate UAS operations into the NAS.

In response to the SBA Office of Advocacy comment regarding alternatives, the FAA responds that the initial regulatory evaluation discussed 9 separate alternatives in its regulatory analysis. The alternatives were rejected due to policy considerations and the undue burden that would be imposed on small UAS operators.

4. A Description and an Estimate of the Number of Small Entities to Which the Rule Will Apply, or an Explanation of Why No Such Estimate Is Available

Because the commercial small UAS industry is not yet established and legal operation of commercial small UAS in the NAS constitutes a new market, available data for these operations is sparse. However, this industry is ideal for a small entity since start-up costs are lower than many other industries.[213] Based on analysis by AUVSI, over 90 percent of exemption holders are small businesses. If this trend continues over the 5-year analysis period, the FAA forecasts a 90 percent of the vehicle owners in both the low case and the high case will be small entities.[214] The FAA believes that the final rule will enable numerous new industries, while maintaining a safe operating environment in the NAS.

5. A Description of the Projected Reporting, Recordkeeping and Other Compliance Requirements of the Rule, Including an Estimate of the Classes of Small Entities Which Will Be Subject to the Requirement and the Type of Professional Skills Necessary for Preparation of the Report or Record

This rule has two reporting requirements for small UAS remote pilots: Accident reporting and, upon request of the Administrator, reporting of deviations from the rules of Part 107 during an emergency. The remote pilot in command is required to report any accident that results in at least serious injury to any person or any loss of consciousness; or damage to any property, other than the small unmanned aircraft. The remote pilot in command is also required to send a written report of any deviation from the rules of Part 107 during an emergency requiring immediate action, upon request of the Administrator. Both reports will be short and limited to capturing basic information. As such, completion of these reports will not require professional skills beyond basic literacy.

Below is a summary of the major compliance requirements of the final rule.

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107

Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer.

[213] Based on analysis by AUVSI of the 3,136 exemptions filed through January 2016, over 90% of the exemptions are held by small businesses *http://www.auvsi.org/auvsiresources/exemptions.*

[214] See the ''Commercial (Non Modeler) small UAS Fleet Forecasts: Reconciling Differences in the Registry IFR and Part 107 Final Rule'' section of the regulatory evaluation for more detail to the low case and high case ranges.

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107—Continued

	• At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle. • Daylight-only operations (30 minutes before official sunrise to 30 minutes after official sunset, local time). • Must yield right of way to other aircraft. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy ''see-and-avoid'' requirement but can be used as long as requirement is satisfied in other ways. • Maximum groundspeed of 100 mph (87 knots). • Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission. • No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving aircraft. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No careless or reckless operations. • No carriage of hazardous materials. • Requires preflight inspection by the remote pilot in command. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375. • External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. • Transportation of property for compensation or hire allowed provided that— ○ The aircraft, including its attached systems, payload and cargo weigh less than 55 pounds total; ○ The flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and ○ The flight occurs wholly within the bounds of a State and does not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession. • Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.
Remote Pilot in Command Certification and Responsibilities.	• Establishes a remote pilot in command position. • A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). • To qualify for a remote pilot certificate, a person must: ○ Demonstrate aeronautical knowledge by either: ■ Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or ■ Hold a part 61 pilot certificate, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA. ○ Be vetted by the Transportation Security Administration. ○ Be at least 16 years old. • Part 61 pilot certificate holders will obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon successful completion of TSA security vetting. The FAA anticipates that it will be able to issue a temporary remote pilot certificate within 10 business days after receiving a completed remote pilot certificate application. • Until international standards are developed, foreign-certificated UAS pilots will be required to obtain an FAA-issued remote pilot certificate with a small UAS rating. A remote pilot in command must: • Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the rule. • Report to the FAA within 10 days of any operation that results in at least serious injury, loss of consciousness, or property damage of at least $500. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation. • Ensure that the small unmanned aircraft complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency.
Aircraft Requirements	• FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation.

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107—Continued

Model Aircraft	• Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112–95. • The rule codifies the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.
Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle. • Daylight-only operations (30 minutes before official sunrise to 30 minutes after official sunset, local time). • Must yield right of way to other aircraft, manned or unmanned. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy ''see-and-avoid'' requirement but can be used as long as requirement is satisfied in other ways. • Maximum groundspeed of 100 mph (87 knots). • Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission. • No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving aircraft. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No careless or reckless operations. • No carriage of hazardous materials. • Requires preflight inspection by the remote pilot in command. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375. • External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. • Transportation of property for compensation or hire allowed provided that— ○ The aircraft, including its attached systems, payload and cargo weigh less than 55 pounds total; ○ The flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and ○ The flight occurs wholly within the bounds of a State and does not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession. • Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.
Remote Pilot in Command Certification and Responsibilities.	• Establishes a remote pilot in command position. • A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). • To qualify for a remote pilot certificate, a person must: ○ Demonstrate aeronautical knowledge by either: ▪ Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or ▪ Hold a part 61 pilot certificate, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA. ○ Be vetted by the Transportation Security Administration. ○ Be at least 16 years old. • Part 61 pilot certificate holders can obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. • Until international standards are developed, foreign-certificated UAS pilots will be required to obtain a remote pilot certificate with a small UAS rating. A remote pilot in command must: • Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the rule. • Report to the FAA within 10 days of any operation that results in serious or fatal injury , loss of consciousness, or property damage of at least $500. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation.

TABLE 1—SUMMARY OF THE MAJOR PROVISIONS OF PART 107—Continued

Model Aircraft	• Ensure that the small unmanned aircraft complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency. • FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation. • Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112–95. • The rule codifies the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

6. A Description of the Steps the Agency Has Taken To Minimize the Significant Economic Impact on Small Entities Consistent With the Stated Objectives of Applicable Statutes, Including a Statement of the Factual, Policy, and Legal Reasons for Selecting the Alternative Adopted in the Final Rule and Why Each One of the Other Significant Alternatives to the Rule Considered by the Agency Which Affect The Impact on Small Entities Was Rejected

With respect to the potential operator costs, we assume that each operator will be a new entrant into the commercial market and that each operator will have two small UAS. The following table shows the final rule's estimated out-of-pocket startup and recurrent direct compliance costs for a new small UAS operator or owner.

SMALL UAS OPERATOR STARTUP AND RECURRENT COSTS REMOTE PILOT APPLICANT/REMOTE PILOT OUT-OF-POCKET COSTS

Type of cost	Cost	
	Initial	Recurrent
Remote Pilot Applicant/Remote Pilot:		
Knowledge Test Fees ...	$150.00	$150.00
Owner:		
Anti-Collision Lighting	32.00	32.00
Current Part 61 Remote Pilot Applicant:		
Positive Identification of the Applicant Fee	50.00	

*Details may not add to row or column totals due to rounding.

The estimated out-of-pocket cost for an individual to become FAA certificated as a remote pilot with a small UAS rating is $150, which is less than the cost of any other airmen certification that allows non-recreational operations in the NAS.[215] The FAA does not believe this amount on a per operator basis to be a significant negative economic impact to small entity operators because $150 is relatively inexpensive to be licensed for operation of a commercial vehicle.

The FAA expects this final rule will have a significant positive economic impact because it enables new businesses to operate small UAS for hire and will stimulate a manufacturing support industry. The FAA believes that most, if not all, of these new commercial activities will be conducted by operators of small UAS who are small business entities. Therefore, the FAA believes that this final rule will have a positive significant impact on a substantial number of entities.

The FAA considered both more costly and less costly alternatives as part of its final rule. The FAA rejected the more costly alternatives due to policy considerations and undue burden that will be imposed on small UAS operators. The less costly alternatives and the FAA's reasons for rejecting or accepting those alternatives in the NPRM are discussed below.

The NPRM noted that the FAA considered an online test-taking option. Ultimately, this option was rejected due to concerns about cheating and the protection of personally identifiable information (PII). Because an applicant for a remote pilot certificate with small UAS rating is not required to pass a practical test, knowledge testing is the only way for the FAA to determine that a remote pilot has the requisite aeronautical knowledge to operate safely in the NAS. Therefore, it is imperative that the testing methodology being used assures that knowledge is demonstrated. Online testing cannot yet provide adequate proctoring of a test to ensure, among other things, that the test-taker is not taking the test for someone else or using reference material or other unapproved aids to help answer the test questions. Concerns with online testing are not limited to cheating. Because the knowledge test questions are pulled from a test bank with a finite number of questions, limiting access to that database to knowledge testing centers ensures the continued security and integrity of the test questions.

The next alternative the FAA considered was to proceed on with the provisions proposed in the notice of proposed rulemaking (NPRM). Due to the large number of comments, we have decided to incorporate some of the additional types of operations received from commenters to this final rule. The FAA discusses the comments we received on the proposed rule and their resolutions earlier in the preamble.

Also, in the NPRM, the FAA considered creating a separate micro UAS classification for UAS weighing no more than 4.4 pounds (2 kilograms). The NPRM went on to list the following restrictions that the FAA was considering for such a micro UAS classification:

- Require that the micro UAS be made out of frangible materials that break, distort, or yield on impact.
- Require that the unmanned aircraft weigh no more than 4.4 pounds.
- Impose a maximum airspeed of 30 knots.
- Impose a maximum altitude of 400 feet AGL.
- Restrict flight distance to 1,500 feet from, and within the visual line of sight of, the operator
- Ban the use of first person view during operations.
- Require the operator to maintain manual control of the flight path of the micro UAS and, therefore, ban the use of automation to control the flight path.
- Limit operations to Class G airspace.
- Require the micro UAS to maintain a distance of at least 5 nautical miles from any airport.

With these additional operating restrictions, the NPRM also proposed to: (1) Allow micro UAS to fly over people not involved with the operation; and (2) create a separate airman certificate with a micro UAS rating.

[215] To become certificated as remote pilot with a small UAS rating, an individual is only required to pass a knowledge test. The certification does not require an individual to attend ground school or to pass a practical skills exam, both of which are required to receive an airmen's certification for sport pilot and above.

After consideration of the comments that the proposed micro UAS restrictions would limit the utility of such operations and safety concerns that remain even with the operating limitations proposed in the NPRM, the FAA has determined that a different framework to regulate micro UAS is needed. Because the public has not yet been given an opportunity to comment on an alternate framework for micro UAS operations, the FAA has determined that a new comment period should be provided for the micro UAS operation requirements. Accordingly, the FAA will move to expeditiously issue a new rule detailing a new more performance-based framework to integrate micro UAS into the NAS while addressing the safety concerns raised by the stakeholders. In the meantime, the FAA will finalize the remainder of this rule to immediately integrate all other small UAS operations into the NAS.

The FAA also considered allowing all small UAS to fly over people not involved with the operation. Manned aircraft are generally permitted to fly over people because manned aircraft are formally evaluated for airworthiness through the airworthiness certification process, which could have significant costs to both the small UAS manufacturer and operator. Because of the high risk of injury, almost all other countries that currently regulate UAS generally do not allow small unmanned aircraft to fly over people or congested areas.[216] The risk associated with flight over people is due to mechanical reliability issues that a remote pilot in command may have a limited opportunity to evaluate without airworthiness certification or a more extensive maintenance process. At this time, the FAA has no data establishing how that risk could be mitigated through operational constraints (whether performance-based or otherwise), other than a prohibition on flight over people.

Accordingly, this rule will retain the general prohibition on flight over people, but with two changes. First, this rule will allow a small unmanned aircraft to be operated over a person who is inside a stationary covered vehicle. Second, this rule will make the restriction on operating a small unmanned aircraft over people waivable. This will allow the FAA to consider, on a case-by-case basis, any additional mitigations that are incorporated into a small UAS operation. The FAA will grant a waiver request allowing small unmanned aircraft flight over people if the applicant establishes that his or her operation can safely be conducted under the terms of a certificate of waiver.

In section 333 of Public Law 112–95, Congress also directed the Secretary to determine whether ''certain unmanned aircraft systems may operate safely in the national airspace system.'' The FAA currently accommodates non-recreational small UAS use through various mechanisms, such as special airworthiness certificates, exemptions, and certificates of authorizations (COA). As an alternative to this final rule, the FAA considered continuing to issue special airworthiness certificates, exemptions, and COAs to all non-recreational small UAS users. We anticipate that many of the operations that would previously require exemptions and COAs will now fall under the purview of part 107, which generally does not require an exemption or a COA prior to operation.

The FAA expects this final rule will have a significant positive economic impact because it enables new businesses to operate small UAS for hire and will stimulate a manufacturing support industry. The FAA believes that most, if not all, of these new commercial activities will be conducted by operators of small UAS who are small business entities. Therefore, the FAA believes that this final rule will have a positive significant impact on a substantial number of entities.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. Under this rule's requirements, additional access to United States airspace is permitted, so the rule does not create an obstacle to foreign commerce.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and Tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $155.0 million in lieu of $100 million. The assessment may be included in conjunction with other assessments, as it is here.

This final rule is unlikely to result in expenditure by State, local or Tribal governments of more than $150 million annually. The final rule will potentially result in an expenditure of much more than that magnitude by pilots seeking remote pilot certificates. We have considered alternatives to this rulemaking, which are discussed above in the ''*Describe alternatives considered*'' section of the regulatory flexibility analysis.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. According to the 1995 amendments to the Paperwork Reduction Act (5 CFR 1320.8(b)(2)(vi)), an agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement unless it displays a currently valid Office of Management and Budget (OMB) control number.

This action contains the following information collection requirements:

- Submission of an application for a remote pilot certificate with a small UAS rating;
- reporting any accident that results in at least serious injury to any person or any loss of consciousness; or damage to any property, other than the small unmanned aircraft, for which the cost of repair (including materials and labor) exceeds $500; or the fair market value of the property exceeds $500 in the event of total loss.
- application for certificate of waiver or authorization to allow a small UAS operation to deviate from certain operating provisions of part 107.
- during an emergency requiring immediate action, each remote pilot in command who deviates from any rule in part 107 shall, upon request of the Administrator, send a written report of that deviation to the Administrator.

[216] Some countries, such as the United Kingdom, allow approval for flight in congested areas on a case-by-case basis. *See* GAO, *Unmanned Aerial Systems: FAA Continues Progress toward Integration into the National Airspace* at 32 (July 2015).

Below, we discuss each of these information-collection requirements in more detail. As required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)), the FAA has submitted these proposed information collection amendments to OMB for its review.

1. Obtaining a Remote Pilot Certificate With a Small UAS Rating

Summary: The FAA's statute [217] prohibits a person from serving as an airman without an airman certificate. This final rule will create a new airman certificate for remote pilots to satisfy the statutory requirement. The airman certificate will be called a remote pilot certificate with a small UAS rating, and in order to obtain it, the applicant will have to either: (1) Take and pass an aeronautical knowledge test; or (2) for those part 61 pilots that have completed a flight review within the previous 24 months, take an on-line training course. Upon successful completion of either the aeronautical knowledge test or online training, the applicant will submit an application for the certificate.

To take and pass an aeronautical knowledge test, a person will have to: (1) Apply to take the test at an FAA-approved Knowledge Testing Center; (2) take the test; and (3) obtain an airman knowledge test report showing that he or she passed the test. After passing a knowledge test, the person will then apply for the certificate by: (1) Filling out and submitting an application for the certificate; and (2) attaching evidence showing that the person passed the airman knowledge test.

For a flight review current part 61 pilot certificate holders seeking to substitute the initial training course for the initial aeronautical knowledge test, the applicant will first set up an account with the FAA by providing their email address, first name, last name, suffix, and zip code. Once the applicant receives an email from the FAA to finish creating their profile, the applicant will be able to log-on, complete the course, and obtain a course completion certificate. The applicant will then (1) fill out and submit an application for the remote pilot certificate with small UAS rating; (2) present a copy of the on-line training course completion certificate and his or her logbook upon application to demonstrate that he or she has satisfied the flight review requirement within the preceding 24 months. The on-line training course is available to anyone who sets up an account with the FAA.

The above requirements do not result in a new collection of information, but instead expand an existing collection of information that is approved under OMB control number 2120–0021. This collection of information governs information that the FAA collects to certificate pilots and flight instructors. The above requirements will increase the burden of this already-existing collection of information.

Use: The above requirements will be used by the FAA to issue airman certificates to remote pilots in command in order to satisfy the statutory requirement that an airman must possess an airman certificate.

Estimate of Increase in Annual Burden:

Low Case Scenario
2016-2018

Final Rule Requirement	Pages Per Application	Applicant Time (Hours)	Total # of Pages	Total Time (Hours)	Total Cost ($Mil)	Annual # of Pages	Annual Time (Hours)	Annual Cost ($Mil)
Application for Remote Pilot Certificate	1	0.25	117,686	29,421	$0.85	39,229	9,807	$0.28
Knowledge Test Application	3	0.25	378,397	31,533	$0.80	126,132	10,511	$0.27
Knowledge Test Exam Time	70	3	8,829,260	378,397	$9.65	2,943,087	126,132	$3.22
On-line Training for Current pt 61 pilots	60	2	181,217	6,041	$0.15	60,406	2,014	$0.05
Create Account for On-Line Training	1	0.25	117,686	29,421	$0.85	39,229	9,807	$0.28
On-line Training for Knowledge Test Applicants	60	2	7,567,938	252,265	$6.43	2,522,646	84,088	$2.14
Airman Knowledge Test Report	1	0.25	126,132	31,533	$0.65	42,044	10,511	$0.22

*Details may not add to row or column totals due to rounding

High Case Scenario
2016-2018

Final Rule Requirement	Pages Per Application	Applicant Time (Hours)	Total # of Pages	Total Time (Hours)	Total Cost ($Mil)	Annual # of Pages	Annual Time (Hours)	Annual Cost ($Mil)
Application for Remote Pilot Certificate	1	0.25	1,583,766	395,942	$10.19	527,922	131,981	$3.40
Knowledge Test Application	3	0.25	5,216,461	434,705	$11.04	1,738,820	144,902	$3.68
Knowledge Test Exam Time	70	3	121,717,427	5,216,461	$132.47	40,572,476	1,738,820	$44.16
On-line Training for Current pt 61 pilots	60	2	181,217	6,041	$0.15	60,406	2,014	$0.05
Create Account for On-Line Training	1	0.25	1,583,766	395,942	$10.19	527,922	131,981	$3.40
On-line Training for Knowledge Test Applicants	60	2	104,329,223	3,477,641	$88.31	34,776,408	1,159,214	$29.44
Airman Knowledge Test Report	1	0.25	1,738,820	434,705	$8.93	579,607	144,902	$2.98

*Details may not add to row or column totals due to rounding

2. Accident Reporting

Summary: To ensure proper oversight of small UAS operations, this rule will require a remote pilot in command to report to the FAA any small UAS operation that results in: (1) At least serious injury to any person or any loss of consciousness; or (2) damage to any property, other than the small unmanned aircraft, unless the cost of repair (including materials and labor) or fair market value in the event of total loss does not exceed $500.

After receiving this report, the FAA may conduct further investigation to determine whether any FAA regulations were violated. The report must be made to the nearest Federal Aviation Administration Flight Standards District Office, or one of the Regional Operations Centers or the Washington Operations Center, in a manner acceptable to the Administrator. The

[217] 49 U.S.C. 44711(a)(2)(A).

FAA emphasizes that this reporting requirement will be triggered only during operations that result in the conditions specified above.

This requirement will constitute a new collection of information, and the FAA has submitted it to OMB for review and a control number. Notice of OMB approval for this information collection will be published in a future **Federal Register** document.

Use: The above requirements will be used by the FAA to ensure proper oversight of small UAS operations. A report of an accident that results in an injury to a person or property damage may serve to initiate an FAA investigation into whether FAA regulations were violated.

Annual Burden Estimate

There is one page of paperwork associated with reporting an accident and it will take an applicant 0.25 hours to complete. The FAA does not have the data needed to quantify the paperwork burden imposed by this requirement.

3. Emergency Powers

Summary: The remote pilot in command must, upon FAA request, submit a report to the FAA if he or she has exercises his or her emergency powers. This report must provide a detailed explanation of what happened.

Use: The above requirements will be used by the FAA to ensure proper oversight of small UAS operations. A report will help the FAA to better understand the reasons for a pilot deviating from part 107.

Annual Burden Estimate

There is one page of paperwork associated with reporting the use of emergency powers that will take an applicant 0.3 hours to complete. The FAA does not have the data needed to quantify the paperwork burden imposed by this requirement.

The above requirements do not result in a new collection of information, but instead expand an existing collection of information that is approved under OMB control number 2120–0005. This collection of information governs, among other things, reports that are provided to the FAA by pilots in command who have exercised emergency powers. The above requirements will increase the burden of this already-existing collection of information.

4. Certificate of Waiver

The certificate of waiver will allow a remote pilot in command conducting a small UAS operation to deviate from certain provisions of part 107. To obtain a certificate of waiver, an applicant will submit a request containing a complete description of the proposed operation and a justification, including supporting data and documentation as necessary, that establishes that the proposed operation can safely be conducted under the terms of a certificate of waiver.

The FAA expects that the amount of data and analysis required as part of the application will be proportional to the specific relief that is requested. Similarly, the FAA anticipates that the time required to make a determination regarding waiver requests will vary based on the complexity of the request. For example, a request for a major deviation from part 107 for an operation that takes place in a congested metropolitan area with heavy air traffic will likely require more data and analysis than a request for a minor deviation for an operation that takes place in a sparsely populated area with minimal air traffic. If a certificate of waiver is granted, that certificate may include additional conditions and limitations designed to ensure that the small UAS operation can safely be conducted under the terms of a certificate of waiver.

Use

This collection of information by the FAA governs applicants requesting a certificate of waiver for an aviation event. The above requirements will increase the burden of this already-existing collection of information.

Annual Burden Estimate

The above requirements will not result in a new collection of information, but will instead expand an existing OMB-approved collection of information that is approved under OMB control number 2120–0027. We cannot quantify total costs, over the 5-year analysis period for waiver activities because The FAA does not have the information to estimate the number of waiver requests it will receive, but expects that individuals would apply for waivers only in instances in which the benefits exceed the costs. The application for certificate of waiver is a minimum of three pages and it is estimated to take at least 0.75 hours to complete.

5. Total Annual Burden Estimate

The total annualized burden estimate of the information-collection requirements associated with this rule is as follows:

Final rule requirement	Total no. of pages (millions)	Total cost (millions)	Annual cost (millions)
Low Case:			
Remote Pilot Certificate	17.3	$19.4	$6.5
Accident Reporting	Unknown	Unknown	Unknown
Emergency Powers	Unknown	Unknown	Unknown
Certificate of Waiver	Unknown	Unknown	Unknown
High Case:			
Remote Pilot Certificate	236.4	$261.3	$87.1
Accident Reporting	Unknown	Unknown	Unknown
Emergency Powers	Unknown	Unknown	Unknown
Certificate of Waiver	Unknown	Unknown	Unknown

F. International Compatibility and Cooperation

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these regulations.

G. Environmental Analysis

FAA Order 1050.1F identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the

absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 5–6.6f and involves no extraordinary circumstances. The FAA has documented the categorical exclusion, including its noise analysis and review of the potential for extraordinary circumstances, and has placed a copy of it in the docket for this rule.

H. Regulations Affecting Intrastate Aviation in Alaska

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the FAA, when modifying its regulations in a manner affecting intrastate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish appropriate regulatory distinctions. In the NPRM, the FAA requested comments on whether the proposed rule should apply differently to intrastate operations in Alaska. The agency did not receive any comments, and has determined, based on the administrative record of this rulemaking, that there is no need to make any regulatory distinctions applicable to intrastate aviation in Alaska.

V. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this final rule under the principles and criteria of Executive Order 13132, Federalism. The agency determined that this action will not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, does not have Federalism implications.

B. Executive Order 13211, Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this final rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it is not a ''significant energy action'' under the executive order and it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

C. Executive Order 13609, Promoting International Regulatory Cooperation

Executive Order 13609, Promoting International Regulatory Cooperation, promotes international regulatory cooperation to meet shared challenges involving health, safety, labor, security, environmental, and other issues and to reduce, eliminate, or prevent unnecessary differences in regulatory requirements. The FAA has analyzed this action under the policies and agency responsibilities of Executive Order 13609, and has determined that this action would have no effect on international regulatory cooperation. The Department continues to participate in the evaluation of ICAO's SARPs and any recommended updates to reflect amendments necessary to address issues unique to the operation of remotely piloted aircraft.

VI. Additional Information

A. Availability of Rulemaking Documents

An electronic copy of rulemaking documents may be obtained from the Internet by—

- Searching the Federal eRulemaking Portal (*http://www.regulations.gov*);
- Visiting the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies* or
- Accessing the Government Publishing Office's Web page at *http://www.gpo.gov/fdsys/*.

Copies may also be obtained by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9677. Commenters must identify the docket or amendment number of this rulemaking.

All documents the FAA considered in developing this rule, including economic analyses and technical reports, may be accessed from the Internet through the Federal eRulemaking Portal referenced previously.

B. Comments Submitted to the Docket

Comments received may be viewed by going to *http://www.regulations.gov* and following the online instructions to search the docket number for this action. Anyone is able to search the electronic form of all comments received into any of the FAA's dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

C. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document may contact its local FAA official, or the person listed under the **FOR FURTHER INFORMATION CONTACT** heading at the beginning of the preamble. To find out more about SBREFA on the Internet, visit *http://www.faa.gov/regulations_policies/rulemaking/sbre_act/*.

List of Subjects

14 CFR Part 21

Aircraft, Aviation safety, Recording and recordkeeping requirements.

14 CFR Part 43

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

14 CFR Part 61

Aircraft, Airmen, Alcohol abuse, Aviation safety, Drug abuse, Recreation and recreation areas, Reporting and recordkeeping requirements, Security measures, Teachers.

14 CFR Part 91

Air traffic control, Aircraft, Airmen, Airports, Aviation safety, Reporting and recordkeeping requirements.

14 CFR Part 101

Aircraft, Aviation Safety.

14 CFR Part 107

Aircraft, Airmen, Aviation safety, Reporting and recordkeeping requirements, Security measures, Signs and symbols, Small unmanned aircraft, Unmanned aircraft.

14 CFR Part 119

Air carriers, Aircraft, Aviation safety.

14 CFR Part 133

Aircraft, Aviation safety.

14 CFR Part 183

Airmen, Authority delegations (Government agencies).

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends chapter I of title 14, Code of Federal Regulations as follows:

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

■ 1. The authority citation for part 21 is revised to read as follows:

Authority: 42 U.S.C. 7572; 49 U.S.C. 106(f), 106(g), 40101 note, 40105, 40113, 44701–44702, 44704, 44707, 44709, 44711, 44713, 44715, 45303; Sec. 333 of Public Law 112–95, 126 Stat. 75.

■ 2. In § 21.1, revise paragraph (a) introductory text to read as follows:

§ 21.1 Applicability and definitions.

(a) Except for aircraft subject to the provisions of part 107 of this chapter, this part prescribes—

* * * * *

PART 43—MAINTENANCE, PREVENTIVE MAINTENANCE, REBUILDING, AND ALTERATION

■ 3. The authority citation for part 43 is revised to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701, 44703, 44705, 44707, 44711, 44713, 44717, 44725.

■ 4. In § 43.1, revise paragraph (b) to read as follows:

§ 43.1 Applicability.

* * * * *

(b) This part does not apply to—

(1) Any aircraft for which the FAA has issued an experimental certificate, unless the FAA has previously issued a different kind of airworthiness certificate for that aircraft;

(2) Any aircraft for which the FAA has issued an experimental certificate under the provisions of § 21.191(i)(3) of this chapter, and the aircraft was previously issued a special airworthiness certificate in the light-sport category under the provisions of § 21.190 of this chapter; or

(3) Any aircraft subject to the provisions of part 107 of this chapter.

* * * * *

PART 61—CERTIFICATION: PILOTS, FLIGHT INSTRUCTORS, AND GROUND INSTRUCTORS

■ 5. The authority citation for part 61 continues to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701–44703, 44707, 44709–44711, 44729, 44903, 45102–45103, 45301–45302.

■ 6. In § 61.1, revise paragraph (a) introductory text to read as follows:

§ 61.1 Applicability and definitions.

(a) Except as provided in part 107 of this chapter, this part prescribes:

* * * * *

■ 7. Add § 61.8 to read as follows:

§ 61.8 Inapplicability of unmanned aircraft operations.

Any action conducted pursuant to part 107 of this chapter or Subpart E of part 101 of this chapter cannot be used to meet the requirements of this part.

■ 8. In § 61.193, revise paragraph (b) to read as follows:

§ 61.193 Flight instructor privileges.

* * * * *

(b) A person who holds a flight instructor certificate is authorized, in a form and manner acceptable to the Administrator, to:

(1) Accept an application for a student pilot certificate or, for an applicant who holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, a remote pilot certificate with a small UAS rating;

(2) Verify the identity of the applicant; and

(3) Verify that an applicant for a student pilot certificate meets the eligibility requirements in § 61.83 or an applicant for a remote pilot certificate with a small UAS rating meets the eligibility requirements in § 107.61 of this chapter.

■ 9. In § 61.413, revise paragraph (b) to read as follows:

§ 61.413 What are the privileges of my flight instructor certificate with a sport pilot rating?

* * * * *

(b) A person who holds a flight instructor certificate with a sport pilot rating is authorized, in a form and manner acceptable to the Administrator, to:

(1) Accept an application for a student pilot certificate or, for an applicant who holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, a remote pilot certificate with a small UAS rating;

(2) Verify the identity of the applicant; and

(3) Verify that an applicant for a student pilot certificate meets the eligibility requirements in § 61.83.

PART 91—GENERAL OPERATING AND FLIGHT RULES

■ 10. The authority citation for part 91 continues to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 1155, 40101, 40103, 40105, 40113, 40120, 44101, 44111, 44701, 44704, 44709, 44711, 44712, 44715, 44716, 44717, 44722, 46306, 46315, 46316, 46504, 46506–46507, 47122, 47508, 47528–47531, 47534, articles 12 and 29 of the Convention on International Civil Aviation (61 Stat. 1180), (126 Stat. 11).

■ 11. In § 91.1, revise paragraph (a) introductory text and add paragraphs (e) and (f) to read as follows:

§ 91.1 Applicability.

(a) Except as provided in paragraphs (b), (c), (e), and (f) of this section and §§ 91.701 and 91.703, this part prescribes rules governing the operation of aircraft within the United States, including the waters within 3 nautical miles of the U.S. coast.

* * * * *

(e) This part does not apply to any aircraft or vehicle governed by part 103 of this chapter, or subparts B, C, or D of part 101 of this chapter.

(f) Except as provided in §§ 107.13, 107.27, 107.47, 107.57, and 107.59 of this chapter, this part does not apply to any aircraft governed by part 107 of this chapter.

PART 101—MOORED BALLOONS, KITES, AMATEUR ROCKETS, UNMANNED FREE BALLOONS, AND CERTAIN MODEL AIRCRAFT

■ 12. The authority citation for part 101 is revised to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40101 note, 40103, 40113–40114, 45302, 44502, 44514, 44701–44702, 44721, 46308, Sec. 336(b), Pub. L. 112–95, 126 Stat. 77.

■ 13. The heading for part 101 is revised to read as set forth above.

■ 14. In § 101.1, add paragraph (a)(5) to read as follows:

§ 101.1 Applicability.

(a) * * *

(5) Any model aircraft that meets the conditions specified in § 101.41. For purposes of this part, a model aircraft is an unmanned aircraft that is:

(i) Capable of sustained flight in the atmosphere;

(ii) Flown within visual line of sight of the person operating the aircraft; and

(iii) Flown for hobby or recreational purposes.

* * * * *

■ 15. Add subpart E, consisting of §§ 101.41 and 101.43, to read as follows:

Subpart E—Special Rule for Model Aircraft

§ 101.41 Applicability.

This subpart prescribes rules governing the operation of a model aircraft (or an aircraft being developed as a model aircraft) that meets all of the following conditions as set forth in section 336 of Public Law 112–95:

(a) The aircraft is flown strictly for hobby or recreational use;

(b) The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;

(c) The aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;

(d) The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and

(e) When flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport) with prior notice of the operation.

§ 101.43 Endangering the safety of the National Airspace System.

No person may operate model aircraft so as to endanger the safety of the national airspace system.

■ 16. Add part 107 to read as follows:

PART 107—SMALL UNMANNED AIRCRAFT SYSTEMS

Sec.

Authority: 49 U.S.C. 106(f), 40101 note, 40103(b), 44701(a)(5); Sec. 333 of Pub. L. 112–95, 126 Stat. 75.

Subpart A—General

§ 107.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this part applies to the registration, airman certification, and operation of civil small unmanned aircraft systems within the United States.

(b) This part does not apply to the following:

(1) Air carrier operations;

(2) Any aircraft subject to the provisions of part 101 of this chapter; or

(3) Any operation that a remote pilot in command elects to conduct pursuant to an exemption issued under section 333 of Public Law 112–95, unless otherwise specified in the exemption.

§ 107.3 Definitions.

The following definitions apply to this part. If there is a conflict between the definitions of this part and definitions specified in § 1.1 of this chapter, the definitions in this part control for purposes of this part:

Control station means an interface used by the remote pilot to control the flight path of the small unmanned aircraft.

Corrective lenses means spectacles or contact lenses.

Small unmanned aircraft means an unmanned aircraft weighing less than 55 pounds on takeoff, including everything that is on board or otherwise attached to the aircraft.

Small unmanned aircraft system (small UAS) means a small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) that are required for the safe and efficient operation of the small unmanned aircraft in the national airspace system.

Unmanned aircraft means an aircraft operated without the possibility of direct human intervention from within or on the aircraft.

Visual observer means a person who is designated by the remote pilot in command to assist the remote pilot in command and the person manipulating the flight controls of the small UAS to see and avoid other air traffic or objects aloft or on the ground.

§ 107.5 Falsification, reproduction or alteration.

(a) No person may make or cause to be made—

(1) Any fraudulent or intentionally false record or report that is required to be made, kept, or used to show compliance with any requirement under this part.

(2) Any reproduction or alteration, for fraudulent purpose, of any certificate, rating, authorization, record or report under this part.

(b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for any of the following:

(1) Denial of an application for a remote pilot certificate or a certificate of waiver,

(2) Suspension or revocation of any certificate or waiver issued by the Administrator under this part and held by that person; or

(3) A civil penalty.

§ 107.7 Inspection, testing, and demonstration of compliance.

(a) A remote pilot in command, owner, or person manipulating the flight controls of a small unmanned aircraft system must, upon request, make available to the Administrator:

(1) The remote pilot certificate with a small UAS rating; and

(2) Any other document, record, or report required to be kept under the regulations of this chapter.

(b) The remote pilot in command, visual observer, owner, operator, or person manipulating the flight controls of a small unmanned aircraft system must, upon request, allow the Administrator to make any test or inspection of the small unmanned aircraft system, the remote pilot in command, the person manipulating the flight controls of a small unmanned aircraft system, and, if applicable, the visual observer to determine compliance with this part.

§ 107.9 Accident reporting.

No later than 10 calendar days after an operation that meets the criteria of either paragraph (a) or (b) of this section, a remote pilot in command must report to the FAA, in a manner acceptable to the Administrator, any

operation of the small unmanned aircraft involving at least:

(a) Serious injury to any person or any loss of consciousness; or

(b) Damage to any property, other than the small unmanned aircraft, unless one of the following conditions is satisfied:

(1) The cost of repair (including materials and labor) does not exceed $500; or

(2) The fair market value of the property does not exceed $500 in the event of total loss.

Subpart B—Operating Rules

§ 107.11 Applicability.

This subpart applies to the operation of all civil small unmanned aircraft systems subject to this part.

§ 107.12 Requirement for a remote pilot certificate with a small UAS rating.

(a) Except as provided in paragraph (c) of this section, no person may manipulate the flight controls of a small unmanned aircraft system unless:

(1) That person has a remote pilot certificate with a small UAS rating issued pursuant to subpart C of this part and satisfies the requirements of § 107.65; or

(2) That person is under the direct supervision of a remote pilot in command and the remote pilot in command has the ability to immediately take direct control of the flight of the small unmanned aircraft.

(b) Except as provided in paragraph (c) of this section, no person may act as a remote pilot in command unless that person has a remote pilot certificate with a small UAS rating issued pursuant to Subpart C of this part and satisfies the requirements of § 107.65.

(c) The Administrator may, consistent with international standards, authorize an airman to operate a civil foreign-registered small unmanned aircraft without an FAA-issued remote pilot certificate with a small UAS rating.

§ 107.13 Registration.

A person operating a civil small unmanned aircraft system for purposes of flight must comply with the provisions of § 91.203(a)(2) of this chapter.

§ 107.15 Condition for safe operation.

(a) No person may operate a civil small unmanned aircraft system unless it is in a condition for safe operation. Prior to each flight, the remote pilot in command must check the small unmanned aircraft system to determine whether it is in a condition for safe operation.

(b) No person may continue flight of the small unmanned aircraft when he or she knows or has reason to know that the small unmanned aircraft system is no longer in a condition for safe operation.

§ 107.17 Medical condition.

No person may manipulate the flight controls of a small unmanned aircraft system or act as a remote pilot in command, visual observer, or direct participant in the operation of the small unmanned aircraft if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of the small unmanned aircraft system.

§ 107.19 Remote pilot in command.

(a) A remote pilot in command must be designated before or during the flight of the small unmanned aircraft.

(b) The remote pilot in command is directly responsible for and is the final authority as to the operation of the small unmanned aircraft system.

(c) The remote pilot in command must ensure that the small unmanned aircraft will pose no undue hazard to other people, other aircraft, or other property in the event of a loss of control of the aircraft for any reason.

(d) The remote pilot in command must ensure that the small UAS operation complies with all applicable regulations of this chapter.

(e) The remote pilot in command must have the ability to direct the small unmanned aircraft to ensure compliance with the applicable provisions of this chapter.

§ 107.21 In-flight emergency.

(a) In an in-flight emergency requiring immediate action, the remote pilot in command may deviate from any rule of this part to the extent necessary to meet that emergency.

(b) Each remote pilot in command who deviates from a rule under paragraph (a) of this section must, upon request of the Administrator, send a written report of that deviation to the Administrator.

§ 107.23 Hazardous operation.

No person may:

(a) Operate a small unmanned aircraft system in a careless or reckless manner so as to endanger the life or property of another; or

(b) Allow an object to be dropped from a small unmanned aircraft in a manner that creates an undue hazard to persons or property.

§ 107.25 Operation from a moving vehicle or aircraft.

No person may operate a small unmanned aircraft system—

(a) From a moving aircraft; or

(b) From a moving land or water-borne vehicle unless the small unmanned aircraft is flown over a sparsely populated area and is not transporting another person's property for compensation or hire.

§ 107.27 Alcohol or drugs.

A person manipulating the flight controls of a small unmanned aircraft system or acting as a remote pilot in command or visual observer must comply with the provisions of §§ 91.17 and 91.19 of this chapter.

§ 107.29 Daylight operation.

(a) No person may operate a small unmanned aircraft system during night.

(b) No person may operate a small unmanned aircraft system during periods of civil twilight unless the small unmanned aircraft has lighted anti-collision lighting visible for at least 3 statute miles. The remote pilot in command may reduce the intensity of the anti-collision lighting if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.

(c) For purposes of paragraph (b) of this section, civil twilight refers to the following:

(1) Except for Alaska, a period of time that begins 30 minutes before official sunrise and ends at official sunrise;

(2) Except for Alaska, a period of time that begins at official sunset and ends 30 minutes after official sunset; and

(3) In Alaska, the period of civil twilight as defined in the Air Almanac.

§ 107.31 Visual line of sight aircraft operation.

(a) With vision that is unaided by any device other than corrective lenses, the remote pilot in command, the visual observer (if one is used), and the person manipulating the flight control of the small unmanned aircraft system must be able to see the unmanned aircraft throughout the entire flight in order to:

(1) Know the unmanned aircraft's location;

(2) Determine the unmanned aircraft's attitude, altitude, and direction of flight;

(3) Observe the airspace for other air traffic or hazards; and

(4) Determine that the unmanned aircraft does not endanger the life or property of another.

(b) Throughout the entire flight of the small unmanned aircraft, the ability described in paragraph (a) of this section must be exercised by either:

(1) The remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system; or

(2) A visual observer.

§ 107.33 Visual observer.

If a visual observer is used during the aircraft operation, all of the following requirements must be met:

(a) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must maintain effective communication with each other at all times.

(b) The remote pilot in command must ensure that the visual observer is able to see the unmanned aircraft in the manner specified in § 107.31.

(c) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must coordinate to do the following:

(1) Scan the airspace where the small unmanned aircraft is operating for any potential collision hazard; and

(2) Maintain awareness of the position of the small unmanned aircraft through direct visual observation.

§ 107.35 Operation of multiple small unmanned aircraft.

A person may not operate or act as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time.

§ 107.36 Carriage of hazardous material.

A small unmanned aircraft may not carry hazardous material. For purposes of this section, the term hazardous material is defined in 49 CFR 171.8.

§ 107.37 Operation near aircraft; right-of-way rules.

(a) Each small unmanned aircraft must yield the right of way to all aircraft, airborne vehicles, and launch and reentry vehicles. Yielding the right of way means that the small unmanned aircraft must give way to the aircraft or vehicle and may not pass over, under, or ahead of it unless well clear.

(b) No person may operate a small unmanned aircraft so close to another aircraft as to create a collision hazard.

§ 107.39 Operation over human beings.

No person may operate a small unmanned aircraft over a human being unless that human being is:

(a) Directly participating in the operation of the small unmanned aircraft; or

(b) Located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft.

§ 107.41 Operation in certain airspace.

No person may operate a small unmanned aircraft in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from Air Traffic Control (ATC).

§ 107.43 Operation in the vicinity of airports.

No person may operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns at any airport, heliport, or seaplane base.

§ 107.45 Operation in prohibited or restricted areas.

No person may operate a small unmanned aircraft in prohibited or restricted areas unless that person has permission from the using or controlling agency, as appropriate.

§ 107.47 Flight restrictions in the proximity of certain areas designated by notice to airmen.

A person acting as a remote pilot in command must comply with the provisions of §§ 91.137 through 91.145 and 99.7 of this chapter.

§ 107.49 Preflight familiarization, inspection, and actions for aircraft operation.

Prior to flight, the remote pilot in command must:

(a) Assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. This assessment must include:

(1) Local weather conditions;

(2) Local airspace and any flight restrictions;

(3) The location of persons and property on the surface; and

(4) Other ground hazards.

(b) Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards;

(c) Ensure that all control links between ground control station and the small unmanned aircraft are working properly;

(d) If the small unmanned aircraft is powered, ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time; and

(e) Ensure that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft.

§ 107.51 Operating limitations for small unmanned aircraft.

A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with all of the following operating limitations when operating a small unmanned aircraft system:

(a) The groundspeed of the small unmanned aircraft may not exceed 87 knots (100 miles per hour).

(b) The altitude of the small unmanned aircraft cannot be higher than 400 feet above ground level, unless the small unmanned aircraft:

(1) Is flown within a 400-foot radius of a structure; and

(2) Does not fly higher than 400 feet above the structure's immediate uppermost limit.

(c) The minimum flight visibility, as observed from the location of the control station must be no less than 3 statute miles. For purposes of this section, flight visibility means the average slant distance from the control station at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

(d) The minimum distance of the small unmanned aircraft from clouds must be no less than:

(1) 500 feet below the cloud; and

(2) 2,000 feet horizontally from the cloud.

Subpart C—Remote Pilot Certification

§ 107.53 Applicability.

This subpart prescribes the requirements for issuing a remote pilot certificate with a small UAS rating.

§ 107.57 Offenses involving alcohol or drugs.

(a) A conviction for the violation of any Federal or State statute relating to the growing, processing, manufacture, sale, disposition, possession, transportation, or importation of narcotic drugs, marijuana, or depressant or stimulant drugs or substances is grounds for:

(1) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of final conviction; or

(2) Suspension or revocation of a remote pilot certificate with a small UAS rating.

(b) Committing an act prohibited by § 91.17(a) or § 91.19(a) of this chapter is grounds for:

(1) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of that act; or

(2) Suspension or revocation of a remote pilot certificate with a small UAS rating.

§ 107.59 Refusal to submit to an alcohol test or to furnish test results.

A refusal to submit to a test to indicate the percentage by weight of alcohol in the blood, when requested by a law enforcement officer in accordance with § 91.17(c) of this chapter, or a refusal to furnish or authorize the release of the test results requested by the Administrator in accordance with § 91.17(c) or (d) of this chapter, is grounds for:

(a) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of that refusal; or

(b) Suspension or revocation of a remote pilot certificate with a small UAS rating.

§ 107.61 Eligibility.

Subject to the provisions of §§ 107.57 and 107.59, in order to be eligible for a remote pilot certificate with a small UAS rating under this subpart, a person must:

(a) Be at least 16 years of age;

(b) Be able to read, speak, write, and understand the English language. If the applicant is unable to meet one of these requirements due to medical reasons, the FAA may place such operating limitations on that applicant's certificate as are necessary for the safe operation of the small unmanned aircraft;

(c) Not know or have reason to know that he or she has a physical or mental condition that would interfere with the safe operation of a small unmanned aircraft system; and

(d) Demonstrate aeronautical knowledge by satisfying one of the following conditions:

(1) Pass an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73(a); or

(2) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, complete an initial training course covering the areas of knowledge specified in § 107.74(a) in a manner acceptable to the Administrator.

§ 107.63 Issuance of a remote pilot certificate with a small UAS rating.

An applicant for a remote pilot certificate with a small UAS rating under this subpart must make the application in a form and manner acceptable to the Administrator.

(a) The application must include either:

(1) Evidence showing that the applicant passed an initial aeronautical knowledge test. If applying using a paper application, this evidence must be an airman knowledge test report showing passage of the knowledge test; or

(2) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, a certificate of completion of a part 107 initial training course.

(b) If the application is being made pursuant to paragraph (a)(2) of this section:

(1) The application must be submitted to a Flight Standards District Office, a designated pilot examiner, an airman certification representative for a pilot school, a certificated flight instructor, or other person authorized by the Administrator;

(2) The person accepting the application submission must verify the identity of the applicant in a manner acceptable to the Administrator; and

(3) The person making the application must, by logbook endorsement or other manner acceptable to the Administrator, show the applicant meets the flight review requirements specified in § 61.56 of this chapter.

§ 107.64 Temporary certificate.

(a) A temporary remote pilot certificate with a small UAS rating is issued for up to 120 calendar days, at which time a permanent certificate will be issued to a person whom the Administrator finds qualified under this part.

(b) A temporary remote pilot certificate with a small UAS rating expires:

(1) On the expiration date shown on the certificate;

(2) Upon receipt of the permanent certificate; or

(3) Upon receipt of a notice that the certificate sought is denied or revoked.

§ 107.65 Aeronautical knowledge recency.

A person may not operate a small unmanned aircraft system unless that person has completed one of the following, within the previous 24 calendar months:

(a) Passed an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73(a);

(b) Passed a recurrent aeronautical knowledge test covering the areas of knowledge specified in § 107.73(b); or

(c) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § § 61.56, passed either an initial or recurrent training course covering the areas of knowledge specified in § 107.74(a) or (b) in a manner acceptable to the Administrator.

§ 107.67 Knowledge tests: General procedures and passing grades.

(a) Knowledge tests prescribed by or under this part are given by persons and in the manner designated by the Administrator.

(b) An applicant for a knowledge test must have proper identification at the time of application that contains the applicant's:

(1) Photograph;

(2) Signature;

(3) Date of birth, which shows the applicant meets or will meet the age requirements of this part for the certificate and rating sought before the expiration date of the airman knowledge test report; and

(4) Permanent mailing address. If the applicant's permanent mailing address is a post office box number, then the applicant must also provide a current residential address.

(c) The minimum passing grade for the knowledge test will be specified by the Administrator.

§ 107.69 Knowledge tests: Cheating or other unauthorized conduct.

(a) An applicant for a knowledge test may not:

(1) Copy or intentionally remove any knowledge test;

(2) Give to another applicant or receive from another applicant any part or copy of a knowledge test;

(3) Give or receive assistance on a knowledge test during the period that test is being given;

(4) Take any part of a knowledge test on behalf of another person;

(5) Be represented by, or represent, another person for a knowledge test;

(6) Use any material or aid during the period that the test is being given, unless specifically authorized to do so by the Administrator; and

(7) Intentionally cause, assist, or participate in any act prohibited by this paragraph.

(b) An applicant who the Administrator finds has committed an act prohibited by paragraph (a) of this section is prohibited, for 1 year after the date of committing that act, from:

(1) Applying for any certificate, rating, or authorization issued under this chapter; and

(2) Applying for and taking any test under this chapter.

(c) Any certificate or rating held by an applicant may be suspended or revoked if the Administrator finds that person has committed an act prohibited by paragraph (a) of this section.

§ 107.71 Retesting after failure.

An applicant for a knowledge test who fails that test may not reapply for the test for 14 calendar days after failing the test.

§ 107.73 Initial and recurrent knowledge tests.

(a) An initial aeronautical knowledge test covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation;

(3) Aviation weather sources and effects of weather on small unmanned aircraft performance;

(4) Small unmanned aircraft loading;

(5) Emergency procedures;

(6) Crew resource management;

(7) Radio communication procedures;

(8) Determining the performance of small unmanned aircraft;

(9) Physiological effects of drugs and alcohol;

(10) Aeronautical decision-making and judgment;

(11) Airport operations; and

(12) Maintenance and preflight inspection procedures.

(b) A recurrent aeronautical knowledge test covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Airspace classification and operating requirements and flight restrictions affecting small unmanned aircraft operation;

(3) Emergency procedures;

(4) Crew resource management;

(5) Aeronautical decision-making and judgment;

(6) Airport operations; and

(7) Maintenance and preflight inspection procedures.

§ 107.74 Initial and recurrent training courses.

(a) An initial training course covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Effects of weather on small unmanned aircraft performance;

(3) Small unmanned aircraft loading;

(4) Emergency procedures;

(5) Crew resource management;

(6) Determining the performance of small unmanned aircraft; and

(7) Maintenance and preflight inspection procedures.

(b) A recurrent training course covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Emergency procedures;

(3) Crew resource management; and

(4) Maintenance and preflight inspection procedures.

§ 107.77 Change of name or address.

(a) *Change of name.* An application to change the name on a certificate issued under this subpart must be accompanied by the applicant's:

(1) Remote pilot certificate with small UAS rating; and

(2) A copy of the marriage license, court order, or other document verifying the name change.

(b) The documents in paragraph (a) of this section will be returned to the applicant after inspection.

(c) *Change of address.* The holder of a remote pilot certificate with small UAS rating issued under this subpart who has made a change in permanent mailing address may not, after 30 days from that date, exercise the privileges of the certificate unless the holder has notified the FAA of the change in address using one of the following methods:

(1) By letter to the FAA Airman Certification Branch, P.O. Box 25082, Oklahoma City, OK 73125 providing the new permanent mailing address, or if the permanent mailing address includes a post office box number, then the holder's current residential address; or

(2) By using the FAA Web site portal at *www.faa.gov* providing the new permanent mailing address, or if the permanent mailing address includes a post office box number, then the holder's current residential address.

§ 107.79 Voluntary surrender of certificate.

(a) The holder of a certificate issued under this subpart may voluntarily surrender it for cancellation.

(b) Any request made under paragraph (a) of this section must include the following signed statement or its equivalent: ''I voluntarily surrender my remote pilot certificate with a small UAS rating for cancellation. This request is made for my own reasons, with full knowledge that my certificate will not be reissued to me unless I again complete the requirements specified in §§ 107.61 and 107.63.''

Subpart D—Waivers

§ 107.200 Waiver policy and requirements.

(a) The Administrator may issue a certificate of waiver authorizing a deviation from any regulation specified in § 107.205 if the Administrator finds that a proposed small UAS operation can safely be conducted under the terms of that certificate of waiver.

(b) A request for a certificate of waiver must contain a complete description of the proposed operation and justification that establishes that the operation can safely be conducted under the terms of a certificate of waiver.

(c) The Administrator may prescribe additional limitations that the Administrator considers necessary.

(d) A person who receives a certificate of waiver issued under this section:

(1) May deviate from the regulations of this part to the extent specified in the certificate of waiver; and

(2) Must comply with any conditions or limitations that are specified in the certificate of waiver.

§ 107.205 List of regulations subject to waiver.

A certificate of waiver issued pursuant to § 107.200 may authorize a deviation from the following regulations of this part:

(a) Section 107.25—Operation from a moving vehicle or aircraft. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.

(b) Section 107.29—Daylight operation.

(c) Section 107.31—Visual line of sight aircraft operation. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.

(d) Section 107.33—Visual observer.

(e) Section 107.35—Operation of multiple small unmanned aircraft systems.

(f) Section 107.37(a)—Yielding the right of way.

(g) Section 107.39—Operation over people.

(h) Section 107.41—Operation in certain airspace.

(i) Section 107.51—Operating limitations for small unmanned aircraft.

PART 119—CERTIFICATION: AIR CARRIERS AND COMMERCIAL OPERATORS

■ 17. The authority citation for part 119 continues to read as follows:

Authority: 49 U.S.C. 106(g), 1153, 40101, 40102, 40103, 40113, 44105, 44106, 44111,

44701–44717, 44722, 44901, 44903, 44904, 44906, 44912, 44914, 44936, 44938, 46103, 46105.

■ 18. In § 119.1, revise paragraphs (e)(9) and (10) and add paragraph (e)(11) to read as follows:

§ 119.1 Applicability.

* * * * *

(e) * * *

(9) Emergency mail service conducted under 49 U.S.C. 41906;

(10) Operations conducted under the provisions of § 91.321 of this chapter; or

(11) Small UAS operations conducted under part 107 of this chapter.

PART 133—ROTORCRAFT EXTERNAL-LOAD OPERATIONS

■ 19. The authority citation for part 133 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701–44702.

■ 20. In § 133.1, revise the introductory text to read as follows:

§ 133.1 Applicability.

Except for aircraft subject to part 107 of this chapter, this part prescribes—

* * * * *

PART 183—REPRESENTATIVES OF THE ADMINISTRATOR

■ 21. The authority citation for part 183 continues to read as follows:

Authority: 31 U.S.C. 9701; 49 U.S.C. 106(f), 106(g), 40113, 44702, 45303.

■ 22. In § 183.23, revise paragraphs (b) and (c) and ad paragraph (d) to read as follows:

§ 183.23 Pilot examiners.

* * * * *

(b) Under the general supervision of the appropriate local Flight Standards Inspector, conduct those tests;

(c) In the discretion of the appropriate local Flight Standards Inspector, issue temporary pilot certificates and ratings to qualified applicants; and

(d) Accept an application for a remote pilot certificate with a small UAS rating and verify the identity of the applicant in a form and manner acceptable to the Administrator.

Issued under the authority provided by 49 U.S.C. 106(f), 40101 note; and Sec. 333 of Pub. L. 112–95, in Washington, DC, on June 21, 2016.

Anthony R. Foxx,

Secretary, Department of Transportation.

Michael P. Huerta,

Administrator, Federal Aviation Administration.

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