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DEPARTMENT OF TRANSPORTATION

Office of the Secretary

Federal Aviation Administration

14 CFR Part 107

[Docket No.; Notice No.]

RIN 2120-AK85

Operation of Small Unmanned Aircraft Systems over People

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking.

SUMMARY: The FAA proposes to amend its rules applicable to the operation of small unmanned aircraft systems (UAS). This rulemaking would allow operations of small unmanned aircraft over people in certain conditions and operations of small UAS at night without obtaining a waiver. It would also require remote pilots in command to present their remote pilot in command certificate as well as identification to certain federal, state, or local officials, upon request, and proposes to amend the knowledge testing requirements in the rules that apply to small UAS operations to require training every 24 calendar months. This proposal would be the next phase in integrating small UAS using a risk-based approach. These amendments would allow expanded small UAS operations and reduce the knowledge testing burden on remote pilot in command certificate holders.

DATES: *TO BE ANNOUNCED.*

ADDRESSES: *TO BE ANNOUNCED.*

FOR FURTHER INFORMATION CONTACT: *TO BE ANNOUNCED.*

SUPPLEMENTARY INFORMATION:

I. Executive Summary

A. Background

On June 28, 2016, the FAA published the much-anticipated rules that allowed people to begin conducting routine, civil small UAS operations.[1] That rule established a new part in the Code of Federal Regulations, 14 CFR part 107 (part 107), containing remote pilot certification and operating rules for small UAS weighing less than 55 pounds. Under those rules, anyone operating a small UAS must either hold a remote pilot certificate or be under the direct supervision of a remote pilot in command.[2] Throughout this document the FAA uses the term "remote pilot" to mean a person authorized to conduct operations under part 107. Part 107 specifically excludes operations by any UAS weighing 55 pounds or greater; by air carriers, regardless of size; and by any UAS, regardless of size that operates pursuant to an exemption issued under Section 333 of Public Law 112-95[3] (or 49 U.S.C. 44807).[4] In addition, as a result of Public Law 115-254, part 107 also does not apply to limited recreational UAS operations under 49 U.S.C. 44809.[5]

This proposal is the next step in the FAA's incremental approach to integrating UAS into the national airspace system (NAS), based on demands for increased operational flexibility and the experience FAA has gained since part 107 was first published.[6] Specifically, this proposal

[1] Operation and Certification of Small Unmanned Aircraft Systems, 81 FR 42064 (June 28, 2016).
[2] 14 CFR 107.12.
[3] Signed into law February 14, 2012.
[4] Section 347(b) of Public Law 115-254 (Oct. 5, 2018) repealed Section 333.
[5] Section 349 of Public Law 115-254 repealed section 336 of Public Law 112-95.
[6] Operation and Certification of Small Unmanned Aircraft Systems, 81 FR 42064 (June 28, 2016). In the 2016 rule, the FAA noted that it would continue to work on expanding the types of small UAS operations that would be permitted as it gained more experience with the risks UAS pose to the NAS.

would expand the activities permitted under part 107 to allow operations over people and at night under certain conditions. As such, it builds on the framework established when the FAA first published part 107. For example, this proposal applies to the same universe of UAS operations identified in the 2016 rule. The FAA will continue to build on this framework as it develops future proposals to allow increasingly more complex operations in the NAS.

This proposal also builds on the performance-based regulatory philosophy established in the 2016 part 107 rule. In that rule, the FAA recognized that the possibilities for innovation in unmanned aircraft technology are virtually boundless and that the industry can move in directions no one can predict. Today, there are even more applications and opportunities for small UAS that either did not exist or were only in their nascent stages in 2016. The FAA's challenge in developing this proposal, therefore, is to balance the need to mitigate the risk small unmanned aircraft pose to other aircraft and to people and property on the ground without inhibiting innovation.

One aspect of the FAA's challenge is that technology moves at the speed of innovation while the administrative rulemaking process, by design, does not. To address this challenge, this proposal is technologically neutral, with the understanding that technology and applications will evolve in the time between the publication of this proposal and the final rule, and beyond. As a result, this proposal incorporates performance-based requirements to achieve the agency's safety objectives while simultaneously encouraging the development of solutions in this dynamic environment.

Taking into account this challenge and these competing considerations, the FAA proposes to relax the prohibition on operations over people and at night under certain

circumstances. While this step may have a significant effect on stakeholders, it represents a small change to the regulatory structure for small UAS. The FAA expects all operators to continue to comply with the existing provisions of part 107. The consequences of noncompliance that currently apply to part 107 remain in effect and would be extended to any new provisions implemented following this proposal. Section I.D. discusses the consequences of noncompliance.

B. Overview of the Proposal

1. Night Operations

Current FAA regulations do not permit small UAS operations at night (§ 107.29). An operation at night is defined as an operation conducted between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time.[7] Part 107 permits operators to request a waiver from these provisions, however. (§ 107.200). As of December 31, 2017, the agency received 4,837 requests for waivers to operate at night, granted 1,233, and disapproved 2,256; the vast majority of these were disapproved because the waiver requests lacked necessary information.[8] Requests to operate at night are, by far, the most common type of waiver request the FAA receives. To date, the FAA has not received any reports of small UAS accidents operating under a night waiver.

In evaluating the waiver requests, the FAA considered the most critical factors to ensuring safety during night operations to be anti-collision lighting and operator knowledge. Accordingly, the FAA proposes to allow routine, small UAS operations at night under two

[7] 14 CFR 1.1.
[8] The total reflects a third category of waiver requests: those that were neither granted nor disapproved. These may include pending, withdrawn, or abandoned requests.

conditions. First, the operator would complete knowledge testing or training, including new subject matter areas related to operating at night. The second condition would be that the small UAS has an anti-collision light illuminated and visible for at least 3 statute miles.[9] Section IV.A. discusses these proposed requirements.

2. Operations Over People

In the 2016 rule, the FAA established that an operation over people is one in which a small unmanned aircraft passes over any part of any person who is not directly participating in the operation[10] and who is not located under a covered structure or inside a stationary vehicle. (§ 107.39). While the 2016 rule prohibited routine operations over people, it provided a process for a remote pilot to obtain a waiver to conduct operations over people. (§ 107.200).

This rule proposes to allow routine operations over people without a waiver or exemption[11] under certain conditions. The applicable conditions vary depending on the level of risk the small UAS operations present to people on the ground. The FAA proposes three categories of permissible operations over people based on the risk of injury they present: Category 1, Category 2, and Category 3. Section IV.B. discusses manufacturer and operator requirements for each category.

[9] A statute mile is 5,280 feet. This is distinguished from a nautical mile, which is approximately 6,076 feet and is often used as a unit of measure in aviation.

[10] See 81 FR at 42129. To the extent part 107 refers to direct involvement, the FAA considers such involvement to mean the remote pilot in command relies on the person's assistance for the safe conduct of the operation.

[11] Title 14 CFR107.200 states 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. Section 107.205(g) currently lists the operations over people prohibition as a regulation that is subject to waiver. The Administrator also maintains authority to issue exemptions from regulations promulgated under 49 U.S.C. 44701(a) or (b) or any of sections 44702-44706 of title 49, if the Administrator finds the exemption is in the public interest. Title 14 CFR 11.81-11.103 details the process for obtaining such an exemption.

a) Category 1

The FAA determined that small unmanned aircraft weighing less than 0.55 pounds pose a low risk of injury when operating over people. Accordingly, Category 1 is simple and straightforward: operators would be able to fly small unmanned aircraft weighing 0.55 pounds or less over people. While these operations would be subject to all of the existing requirements governing small UAS operations in part 107,[12] the FAA does not propose any additional restrictions as a condition of flying over people. If adopted, remote pilots would be able to conduct operations over people the day a final rule goes into effect. Remote operators would be responsible for weighing or otherwise determining that their small unmanned aircraft does not exceed the weight threshold. The weight restriction would apply from takeoff to landing, meaning that any cargo attached to the UAS could not cause the aggregate weight (unmanned aircraft plus cargo) to exceed 0.55 pounds.

The FAA does not propose any design standards for Category 1. Although the FAA proposes design standards for exposed rotating parts (propellers) for other categories of small unmanned aircraft operations (discussed later in this document), it does not propose comparable standards for Category 1. This is because the FAA believes that exposed rotating parts on this category of small unmanned aircraft pose a low risk of injury to people. Section IV.B.3. discusses Category 1 operations.

[12] For example, the requirements to hold a remote operator's certificate (§ 107.12), operate a small unmanned aircraft in a condition for safe operation (§ 107.15), not operate in a hazardous manner (§ 107.23), operate within visual line of sight (§ 107.31), and others would continue to apply to these operations.

b) Category 2

Category 2 would provide flexibility for operators who wish to conduct operations over people using unmanned aircraft that weigh more than 0.55 pounds. Unlike Category 1, Category 2 is not solely weight-based. The FAA proposes a set of performance-based requirements that would allow a small unmanned aircraft to operate over people if the manufacturer can demonstrate that, if the unmanned aircraft crashed into a person, the resulting injury would be below a certain severity threshold. The manufacturer would have the flexibility to design the unmanned aircraft in any way that would allow it to meet this threshold.

The requirements specific to Category 2 would have three parts. First, the small unmanned aircraft must be designed, upon impact with a person, not to result in an injury as severe as the injury that would result from a transfer of 11 ft-lbs of kinetic energy from a rigid object. Section IV.B.4. provides more detailed information about how the FAA chose this standard, including how to measure the severity of the injury. There are myriad ways a manufacturer could design a small unmanned aircraft to meet this threshold, taking into account weight, speed, altitude limitations, materials, and technological fail-safe measures. For example, a manufacturer could offset weight with speed limitations, or vice versa. Or the manufacturer could use advanced materials or construction methods that are designed to reduce or prevent injury upon impact. For example, using frangible materials, or designing aircraft to crumple upon impact in a way that would likely reduce the amount of kinetic energy transferred and, as a result, the severity of the injury. In addition, the manufacturer could design features or use technology that slow the unmanned aircraft's rate of descent or divert it away from people during a loss of control. These are just a few conceptual examples. The possibilities for designing an

unmanned aircraft to meet this standard are too vast to create an exhaustive list. By providing flexibility through performance-based requirements, the FAA enables the ingenuity of the industry to come up with ideas not yet even considered.

Second, the FAA proposes that the unmanned aircraft would not have exposed rotating parts that could lacerate human skin. There are a number of ways a manufacturer could design small unmanned aircraft to comply with this requirement. For example, a manufacturer could design a shroud to protect skin from laceration upon impact. Or it could design blades that do not lacerate upon impact. Another option could be to design the unmanned aircraft without external rotating parts. This proposal leaves the decision to choose any one of these, or create another solution. This proposal sets only the desired outcome; it does not tell manufacturers how to achieve that outcome. The FAA anticipates that manufacturers would present many different designs to meet this requirement.

Third, no small UAS could be operated over people if it has an FAA-identified safety defect. For Category 2, a safety defect would be any material, component, or feature that presents more than a low probability of causing a casualty when operating over people. For this proposal, the FAA defines a casualty to be a serious injury, which corresponds to a level 3 injury on the Abbreviated Injury Scale (AIS). Section IV.B.1. discusses the AIS and includes examples of level 3 injuries. A safety defect could include any hazardous condition that meets this threshold, including those not otherwise identified through the impact kinetic energy or exposed rotating parts analyses. Examples could include exposed wires, hot surfaces, sharp edges, faulty construction, corrupted software as well as many other hazardous conditions. Section IV.B.11.a) discusses safety defects.

Before a Category 2 small unmanned aircraft could be used to fly over people, the manufacturer would be required to demonstrate, to the FAA's satisfaction, that the aircraft met these injury threshold requirements. The process for demonstrating compliance is discussed later. If adopted as proposed, once a manufacturer demonstrated compliance to the FAA, the small unmanned aircraft could be flown over people. Operators would be required to adhere to any other existing requirements in part 107 that apply to operating small UAS generally, but the FAA does not propose any operational restrictions specific to operations over people for Category 2.

More detailed information about Category 2 operations and how the FAA developed the requirements is in Section IV.B.4.

c) Category 3

The FAA proposes a final category of operations – Category 3 – that allows for a higher injury threshold than Category 2, but that limits an individual's exposure to the risk of injury through operational limitations. Similar to Category 2, the requirements specific to Category 3 would have three parts. The first part would require a small unmanned aircraft to be designed, upon impact with a person, not to result in an injury as severe as the injury that would result from a transfer of 25 ft-lbs of kinetic energy from a rigid object. The higher injury threshold means that operators could take into account different weight, speed, altitude, material, and technology factors when choosing a mission-appropriate small UAS. For example, the unmanned aircraft could be faster, heavier, designed to fly higher, made from different materials, or use different technology. The second part would be identical to Category 2: the unmanned aircraft would not have exposed rotating parts that could lacerate human skin.

Third, as with Category 2, no small UAS could be operated over people if it has an FAA-identified a safety defect. Category 3 is distinct, however, because the safety defect would be one that presents more than a low probability of causing a fatality when operating over people.

In addition, unlike Category 1 and 2, Category 3 would have an operational requirement. Because of the higher injury threshold, there would be an increased risk of injury to people on the ground. To manage this increased risk, Category 3 operations would include three operational limitations not applicable to the other categories of operations. First, the proposal would prohibit operations over any open-air assembly of people. Second, the operations would have to be within or over a closed- or restricted-access site and anyone within that site would have to be notified that a small unmanned aircraft may fly over them. Third, for operations not within or over a closed- or restricted-access site, the small unmanned aircraft may transit but not hover over people.

As with Category 2, before a Category 3 small unmanned aircraft could be used to fly over people, the manufacturer would be required to demonstrate, to the FAA's satisfaction, that the aircraft meets the injury threshold requirements.

More detailed information about Category 3 operations and how the FAA developed the standards is in Section IV.B.4.

d) Demonstrating Compliance with Injury Thresholds

Before a small unmanned aircraft could be used to fly Category 2 or 3 operations over people, the manufacturer would have to demonstrate, to the FAA's satisfaction, that the aircraft meets the proposed requirements. The proposed process for presenting evidence of compliance

to the FAA is based on processes that the FAA currently uses for determining compliance with standards applicable to manned aircraft. For that reason, members of the manned aviation community may find the processes and terminology in this proposal familiar; however, they differ in that they are streamlined and tailored to the unique requirements of small UAS.

The proposal directs manufacturers to submit evidence of compliance using a Means of Compliance. A Means of Compliance is the term the FAA uses for the method a manufacturer would use to show that its small UAS would not exceed the injury threshold upon impact with a person. The FAA does not propose to tell manufacturers which method or test to use to establish compliance; rather, the proposal allows the manufacturer to develop a test and present evidence to the FAA showing that the test is appropriate and accurately demonstrates compliance. The FAA anticipates that manufacturers or standards setting organizations (SSOs) will come up with a variety of different types of Means of Compliance. Some could include simple measures of kinetic energy, or they could include sophisticated tests or computer modeling or any other method that accurately shows compliance.

If the FAA agreed that the Means of Compliance accurately demonstrates compliance, it would accept the Means of Compliance and allow the manufacturer to use it to demonstrate that small UAS meet the proposed requirements. Once the FAA accepts a Means of Compliance, the FAA would notify the public. The FAA would not disclose commercially valuable information in this notice. It would only provide general information stating that FAA had accepted the Means of Compliance.

Given that small UAS manufacturers have varying degrees of sophistication, the FAA proposes to offer one pre-accepted Means of Compliance that measures the transfer of kinetic

energy upon impact. The FAA stresses that manufacturers would not have to use this method; it would be merely pre-accepted for manufacturers to use if they so choose.

A manufacturer could use any FAA-accepted Means of Compliance to show that its small UAS meets the standards proposed in this rule. If the small UAS meets the standards, the manufacturer would submit a Declaration of Compliance to the FAA that identifies the Means of Compliance used and certifies compliance with all the applicable requirements. If the FAA accepted the Declaration of Compliance, the manufacturer would be able to consider the small UAS available for operations over people. The FAA would make a list publicly available of the small UAS models for which it accepted a Declaration of Compliance.

The FAA proposes an additional flexibility that would allow a small UAS to be qualified for both Category 2 or 3 operations, as long as there are safeguards that prevent the remote pilot from inadvertently switching between the two modes of operation. For example, the small UAS could have software that limits speed or altitude that makes it eligible for Category 2 operations, but have different settings for Category 3 operations. Or, a small unmanned aircraft could be eligible for Category 2 operations when unladen, but meet Category 3 requirements when carrying a payload. There are many different combinations or options manufacturers could employ to qualify small UAS for operations over people in different modes for different operations. More information on small UAS that are qualified for more than one category of operation is in Section IV.B.6.

Section IV.B.5. provides information about Means of Compliance. Section IV.B.7. includes details concerning Declarations of Compliance.

The FAA also proposes a process to rescind a previously accepted Declaration of Compliance if the FAA determined the small unmanned aircraft did not meet requirements of this rule. More information on the circumstances under which the FAA proposes to consider rescinding a Declaration of Compliance and the proposed process is in Section IV.B.7.b)(6).

e) Other Requirements for Manufacturers

First, the FAA proposes to require that each manufacturer, including anyone who assumes the role of manufacturer after making modifications, provides remote pilot operating instructions to anyone to whom it sells, transfers, or otherwise provides the small UAS for use. The operating instructions would address what types of payloads are permissible and other information relevant to the eligibility of the small UAS to operate in accordance with its Category 2 or Category 3 qualification. Section IV.B.9. discusses operating instructions.

Second, the rule proposes to require that any manufacturer holding an FAA-accepted Declaration of Compliance allow the FAA to inspect the manufacturer's facilities, technical data, and small UAS covered by that Declaration of Compliance to determine compliance. The FAA also proposes that the manufacturer allow the FAA to witness any tests required for compliance. Section IV.B.11.d) discusses inspection requirements.

Third, the FAA proposes to require that a manufacturer holding an FAA-accepted Declaration of Compliance establish a process to notify the public and the FAA of safety defects or other issues that would render the small UAS ineligible for operations over people. Section IV.B.11.b) discusses reporting requirements.

Fourth, the FAA proposes to require any holder of a Declaration of Compliance or Means of Compliance to retain certain records for a minimum of two years after ending production of related small UAS. Section IV.B.8. discusses recordkeeping requirements.

f) Rules Applicable to Individuals Who Modify Small UAS

Under this proposal, the FAA would consider not only the original person or company that designed or built a small UAS to be a manufacturer, but also anyone who modifies it after the FAA accepted its Declaration of Compliance. For example, if an individual bought a small unmanned aircraft that the FAA accepted as meeting Category 2 requirements and then modified it in a way that would change its performance so that it would no longer meet Category 2, that person would be considered a manufacturer and would be required either to requalify the small unmanned aircraft or cease operations over people. The purpose would be to prevent someone from buying a qualified small unmanned aircraft, modifying it in a way that would make it unqualified for operations over people, and then continuing to operate over people. Potential disqualifying modifications could include (but are not limited to), changing computer code to remove operational restrictions, replacing compliant propeller blades with noncompliant blades, or attaching a camera or other payload to the unmanned aircraft that was not specifically identified as approved in the manufacturer's instructions. Before flying over people after making disqualifying modifications, the person making the modification would have to test the small unmanned aircraft using an FAA-accepted Means of Compliance and submit a Declaration of Compliance. Section IV.B.7.b)(5) discusses post-acceptance modifications.

g) Other Requirements for Operators

This proposal includes several other requirements for remote pilots who operate over people. First, any small unmanned aircraft used for Category 2 or 3 operations would have to be marked with a label that identified it as either Category 2 or 3 (or both). While manufacturers would be free to label their small unmanned aircraft, ultimately the responsibility for making sure that an aircraft is properly labeled before each flight falls to the remote pilot. Section IV.B.10. discusses labeling requirements.

Second, operators would be responsible for following the manufacturer's instructions that accompany the small UAS. In some cases, small UAS qualified to operate over people may have specific instructions for operating over people. For example, a manufacturer of a small UAS qualified to operate under more than one category would have to explain how to operate in each category. Similarly, some small UAS may have a mode that does not qualify for any category of operations over people. Remote pilots would have to follow the instructions provided so that they only operated over people when their small UAS are in the right operational mode and are otherwise following all instructions or limitations for safe operations. Section IV.B.9. discusses manufacturer instructions.

Third, under existing rules, remote pilots must conduct certain pre-flight actions to ensure the safety of the operation, including assessing the operating environment and inspecting the small UAS. (§ 107.49). The FAA proposes to require, in addition to the existing pre-flight requirements, that the remote pilot ensure that the aircraft meets the requirements in this proposed rule before flying over people. One way of doing this would be for the remote pilot to verify that the small UAS is qualified for the type of operation over people he or she plans to

conduct. This would include making sure that the small UAS is marked with the appropriate category and checking publicly available information from the FAA and the manufacturer to verify that the Declaration of Compliance for that model of small UAS has been accepted by the FAA. Section IV.B.12. discusses pre-flight requirements.

Fourth, although part 107 currently does not allow operations over people in moving vehicles (§ 107.39), the FAA proposes a new section that makes clear that such operations are expressly prohibited. There is more information on operations over moving vehicles in Section IV.B.12.b).

3. Applicability to Existing small UAS

The FAA recognizes that a great number of small UAS are available in the marketplace and are in use. Accordingly, the FAA proposes to allow any manufacturer or operator to test its small UAS and submit evidence that it is eligible to operate over people using the proposed Means of Compliance and Declaration of Compliance processes described above. Section IV.B.13. discusses provisions applicable to existing small UAS.

4. Waivers

Under existing part 107, remote pilots can request a waiver from specific operational provisions. (§ 107.200). The FAA does not propose to make any changes to this process; however, it does propose to expand the list of provisions from which an operator could seek a waiver. Currently, part 107 allows operators to seek waivers from the following provisions: the prohibition on operations from a moving vehicle or aircraft; the requirement for daylight operations; the requirement to operate within visual line of sight; the provision relating to the use

of visual observers; the prohibition on operating multiple small UAS simultaneously; the requirement to yield the right of way; the prohibition on operating over people; provisions relating to operations within certain airspace; and provisions relating to certain operating limitations. (§ 107.205).

This rule proposes to include three additional types of waivers. The first would apply to operations over moving vehicles. Under existing regulations, an operator may seek a waiver to operate over moving vehicles using the waiver provision applicable to operations over people. (§ 107.205(g)). This proposal would establish a stand-alone waiver provision applicable to operations over moving vehicles to make the process clearer for operators. The second would permit an operator to seek a waiver to conduct operations over people that would not otherwise meet the requirements of this proposed rule. The third would permit an operator to seek a waiver of the anti-collision lighting requirement for night and civil twilight operations. In all cases, the waiver applicant would be required to demonstrate that the operations could be conducted at the same level of safety that the proposed requirements provide. Section IV.C. discusses waivers.

5. Miscellaneous Changes to Part 107

In addition to the provisions enabling operations at night and over people, the FAA proposes some other changes to part 107. First, under current regulations, the FAA requires the remote pilot to present his or her remote pilot certificate upon request from the Administrator. (§ 107.7). This proposal would extend that obligation to require the remote pilot to present his or her remote pilot certificate and identification in response to a request from the Administrator; an authorized representative of the National Transportation Safety Board (NTSB); any Federal,

State, or local law enforcement officer; and any authorized representative of the Transportation Security Administration (TSA). Section IV.D.1. discusses this proposed amendment.

Second, the FAA proposes to update existing regulations related to remote pilot certification. Currently, part 107 requires remote pilots to take an initial knowledge test and then another test once every two years to maintain a current remote pilot certificate. (§§ 107.61, 107.65). This rule proposes to convert the subsequent knowledge testing requirement to a knowledge training requirement. In addition, the rule proposes to update the testing and training materials to harmonize initial testing and subsequent training, and to add new information about night operations. Section IV.D.2. provides more information about knowledge testing and training.

C. Security Considerations

While the focus of this proposal is to ensure the safety of operations that fly over people, the FAA is cognizant that security concerns are paramount. As with manned aviation, safety and security walk hand in hand. For that reason, the FAA, which is primarily a safety organization, has partnered with other Federal agencies to identify and address security concerns. Through this partnership, the FAA developed an Advance Notice of Proposed Rulemaking (ANPRM), Safe and Secure Operations of Small Unmanned Aircraft Systems, seeking input on various security considerations related to unmanned aircraft.[13] The ANPRM appears separately in today's edition of the *Federal Register*.

[13] See Safe and Secure Operations of Small Unmanned Aircraft Systems, RIN 2120-AL26 (Fall 2018), available at https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201810&RIN=2120-AL26.

In particular, the FAA is cognizant of the importance of various stakeholders to be able to identify small UAS to mitigate security concerns that operations may present. Because of the importance of this particular issue, the FAA plans to finalize its policy concerning remote identification of small UAS—by way of rulemaking, standards development, or other activities that other federal agencies may propose—prior to finalizing the proposed changes in this rule that would permit operations of small UAS over people and operations at night. Section III.A.3. provides more information about security considerations.

D. Compliance and Enforcement Tools

While the FAA does not propose any new penalties or compliance and enforcement tools in this rule, all existing means of addressing noncompliance that currently apply to small UAS operators under existing part 107 or the FAA's general enforcement authority would continue to apply. The FAA expects compliance with all terms of the final rule that follows this proposal. The consequences of noncompliance could include any of the following compliance and enforcement tools the FAA has available to it.

In accordance with its current compliance philosophy, FAA's goal is to find and fix problems before they cause an accident or incident. Under this approach, enforcement is one tool the FAA uses, but it may not be the most effective tool for addressing small UAS compliance concerns, given the relative inexperience of small UAS operators. Therefore, non-enforcement tools, to which the FAA refers as compliance actions, are additional means to achieve compliance with FAA regulations concerning the safety of small UAS. Such tools include counseling in the form of operator education or an informational letter used to communicate effectively the requirements of small UAS regulations.

If an operator is unwilling or unable to comply with, or is deliberately flouting, regulations, the FAA would employ enforcement action. The FAA has a number of enforcement tools available including warning notices, letters of correction, civil penalties, and certificate actions to address violations and help deter future violations. Civil penalties for violations of the Federal Aviation Regulations range from a maximum per violation penalty of $1,437, for individual operators, to $32,666 for large companies. In addition, Congress granted the FAA the authority to levy civil penalties of up to $20,000 for interfering with law enforcement, first responders, or wildfire operations. The FAA may take enforcement action against anyone who conducts an unauthorized UAS operation or operates a UAS in a way that endangers the safety of the National Airspace System. This authority is designed to protect users of the airspace as well as people and property on the ground.

This proposed rule would not alter this enforcement regime. The FAA emphasizes, however, that certain requirements this rule proposes would increase remote pilots' responsibilities. For example, for operations at night, remote pilots in command would be responsible for ensuring their small unmanned aircraft has an anti-collision light visible for a minimum of 3 statute miles, and for completing an updated initial knowledge test or updated training. For operations over people, remote pilots in command would be responsible for ensuring their Category 1 aircraft does not exceed the proposed weight limitation. For Category 3 operations, remote pilots in command would have the responsibility of adhering to specific operating limitations. For both Category 2 and Category 3 operations, remote pilots in command would need to ensure they comply with remote pilot operating instructions. For all proposed categories of operations, remote pilots in command would be required to ensure the small UAS is

eligible for the appropriate category of operations. The FAA maintains the discretion and authority to utilize appropriate surveillance and engage in action available to the FAA when the FAA determines to do so.

Table 1 provides a brief summary of the major provisions of this notice of proposed rulemaking (NPRM).

Table 1: Summary of Major Provisions.

Issue	**Proposed Regulation**
Presentation of Certificate and Identification	Remote pilots in command must present their remote pilot certificate as well as identification to certain Federal, State, or local officials, upon request. 14 CFR 107.7(a)
Operations at Night	A remote pilot in command may operate a small UAS at night as long as: 1) The remote pilot has satisfactorily completed updated knowledge testing or training requirements; and 2) The small unmanned aircraft maintains an anti-collision light that remains lit throughout the flight. 14 CFR 107.29
Prohibition on Operation over Moving Vehicles	No operations over people located in moving vehicles. 14 CFR 107.105
Category 1 Remote Pilot Requirements	Ensure aircraft weighs 0.55 pounds or less. 14 CFR 107.110
Category 2 Remote Pilot Requirements	1) Use aircraft qualified and labeled for Category 2 operations; 14 CFR 107.115(a) 2) Ensure aircraft is labeled for Category 2 operations. 14 CFR 107.150
Category 3 Remote Pilot Requirements	1) Use aircraft qualified and labeled for Category 3 operations; 14 CFR 107.120(a)(1)

	2) Ensure aircraft is labeled for Category 3 operations; 14 CFR 107.145 Remote pilots in command cannot conduct Category 3 operations over open air assemblies, and cannot conduct these operations unless the operation occurs: 1) Within or over a closed- or restricted-access site where all people accessing the site have notice; or 2) When the aircraft does not maintain sustained flight over people. 14 CFR 107.120(a)(2) and (3)
Eligibility Requirements for Category 1	No performance-based requirements (only a requirement that the small UAS weigh 0.55 pounds or less). 14 CFR 107.110
Eligibility Requirements for Category 2	1) Meet performance-based requirements by showing the small unmanned aircraft: • will not, upon impact with a person, result in an injury more severe than the injury that would result from a transfer of 11 ft-lbs of kinetic energy from a rigid object; • does not contain any exposed rotating parts that could lacerate human skin upon impact with a person; and • does not contain any safety defects identified by the Administrator. 2) Display a label indicating eligibility for Category 2; 3) Have remote pilot operating instructions; 4) Be subject to a product notification process; and 5) Operate only after the FAA has accepted a Declaration of Compliance for that make/model. 14 CFR 107.115(b)
Eligibility Requirements for Category 3	1) Meet performance-based requirements showing the small unmanned aircraft: • will not, upon impact with a person, result in an injury more severe than the injury that would result from a transfer of 25 ft-lbs of kinetic energy from a rigid object; • Does not contain any exposed rotating parts that could lacerate human skin upon impact with a person; and • Does not contain any safety defects identified by the Administrator 2) Display a label indicating eligibility for Category 3; 3) Have remote pilot operating instructions; 4) Be subject to a product notification process; and

	5) Operate only after the FAA has accepted a Declaration of Compliance for that make/model. 14 CFR 107.120(b)
Previously Manufactured Small UAS	A small UAS manufactured prior to the effective date of a final rule implementing these regulations may be operated over people if: It weighs 0.55 pounds or less; or the make/model complies with the impact kinetic energy and exposed rotating parts requirements to render it eligible for operations pursuant to Category 2 or Category 3; and 1) The manufacturer has submitted a Declaration of Compliance for that make/model; 2) The FAA has accepted the Declaration of Compliance; and 3) The aircraft has a label appropriate for the category of operations for which it is eligible to operate. 14 CFR 107.140
Requirements for a Means of Compliance	For small UAS manufactured to be eligible for Category 2 or Category 3 operations, the small UAS must comply with the requirements of § 107.115(b)(1) or § 107.120(b)(1), as shown by test, analysis, or inspection, or any combination of these options that the Administrator has determined is acceptable. Requests for FAA acceptance of means of compliance must contain: 1) Detailed description of the means of compliance; and 2) Justification, including any substantiating material, showing the means of compliance fulfills the safety level set forth in § 107.115(b)(1) or § 107.120(b)(1). 14 CFR 107.125
Required Information for Declaration of Compliance	1) Applicant's name; 2) Applicant's physical address; 3) Applicant's email address; 4) Small UAS make/model name; 5) Small UAS serial number or range of serial numbers; 6) Whether the Declaration of Compliance is an initial or amended declaration; 7) If amended, the reasons for the re-submittal of the Declaration of Compliance; 8) Certification that the small UAS satisfies the impact kinetic energy and exposed rotating parts standards of that category through an accepted means of compliance; 9) Certification that the manufacturer has a product support and notification process; 10) Certification that the Administrator will be allowed to inspect the manufacturer's facilities, technical data, and any manufactured small UAS and witness any tests necessary to determine compliance with this subpart; and 11) Other information as required by the Administrator.

	14 CFR 107.135
Rescinding a Declaration of Compliance	The FAA may rescind a Declaration of Compliance if: 1) The make/model is no longer compliant with the impact kinetic energy requirements of the category for which it is declared; 2) The make/model is no longer compliant with the exposed rotating parts limitation; or 3) The Administrator identifies a safety defect. 14 CFR 107.135
Recurrent Knowledge Training	A person may only operate a small UAS if that person has completed the following in a manner acceptable to the Administrator within the past 24 months: 1) Passed an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73; 2) Completed recurrent training covering the areas of knowledge specified in § 107.73; or 3) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 and meets the flight review requirements specified in § 61.56, completed training covering the areas of knowledge specified in § 107.74. 14 CFR 107.65

E. Costs and Benefits

The FAA has analyzed the benefits and the costs associated with this proposed rule and expects the benefits justify the costs. This proposal would enable further operations of small UAS that will benefit the economy and enable innovation and growth across a variety of sectors, such as construction, education, infrastructure inspection, insurance, marketing, and event photography. Operations currently allowed under Part 107 would become less onerous and, in many instances, more efficient with this proposal because, in general, remote pilots would not necessarily need to avoid flying over people or clear an area of non-participating people in

advance of flying.[14] In addition, this proposal would assist the execution of first responder and emergency management planning and operations.

The costs of this rule include both the FAA converting the administration of tests to administration of training and manufacturers conducting testing, analysis, or inspection to comply with the requirements relevant to manufacturing a small UAS for operations over people. Upon analysis of these costs, the FAA concludes the proposed rule would result in a cost savings for relief provided through online training and testing for remote pilots. The regulatory analysis for this proposed rule presents a range of cost savings based on the three varying fleet forecasts. Subsequently, over the five-year analysis period the net present value cost savings of the proposed rule ranges from $24 million to $121 million at a seven percent discount rate, for net annualized costs savings between $6 million and $29 million. The following table presents quantified costs to manufacturers and the FAA and savings to remote pilots.

Table 2: Costs and Savings of Proposed Rule ($Millions)
5-Year Period of Analysis*

Low Case	7% PV	7% Annualized	3% PV	3% Annualized
Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($38)	($9)	($44)	($10)
Net Cost Savings	($24)	($6)	($29)	($6)
Base Case	**7% PV**	**7% Annualized**	**3% PV**	**3% Annualized**
Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($49)	($12)	($57)	($12)
Net Cost Savings	($35)	($9)	($42)	($9)
High Case	**7% PV**	**7% Annualized**	**3% PV**	**3% Annualized**

[14] As explained in section IV.B.12., this proposed rule would not permit Category 3 operations over open-air assemblies of people. Operations that occur pursuant to Category 1 and Category 2, however, would not be subject to this prohibition.

Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($135)	($33)	($158)	($34)
Net Costs Savings	($121)	($29)	($143)	($31)
* Columns may not sum to total due to rounding. Savings are shown in parenthesis to distinguish from costs.				

The operation of small UAS over people may result in an increased risk to safety. Although the FAA believes the probability of injuries that may occur from operations of small UAS over people is small, when that small probability is multiplied by an increased number of operations, some additional risk of injury exists. This proposed rule's performance-based standards would establish three categories of small UAS operations defined primarily by level of risk of injury posed. Compliance with the manufacturer and operational requirements that apply to these categories would mitigate the risks of operating over people.

II. Authority for this Rulemaking

The primary authority for this rulemaking is based on 49 U.S.C. 44807, which directs the Secretary of Transportation to determine whether "certain unmanned aircraft systems may operate safely in the national airspace system [NAS]." Section 44807 directs the Secretary to use a risk-based approach in making such determinations and provides such determinations may occur notwithstanding the completion of the comprehensive plan and rulemaking required in other sections of the statute. Section 44807(b) directs the Secretary to consider a specific list of factors in determining which types of UAS may operate safely: the Secretary must consider size, weight, speed, operational capability, proximity to airports and populated areas, operation over people, operation within visual line of sight, or operation during the day or night. The Secretary

must determine, based on these factors, whether operations of the UAS do not create a hazard to users of the NAS or the public. If the Secretary determines, pursuant to section 44807, 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." 49 U.S.C. 44807(c).

This rulemaking is also promulgated pursuant to 49 U.S.C. 40103(b)(1) and (2), which directs the FAA to issue 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 promoting safe flight of civil aircraft by prescribing regulations the FAA finds necessary for safety in air commerce and national security.

III. Background

A. Related FAA and DOT Actions

This rulemaking is a deliberative step in further integrating small UAS into the NAS in a safe and secure manner. The FAA is incorporating the operation of small UAS into the NAS using a phased, incremental, and risk-based approach.[15] In 2012, Congress passed the FAA Modernization and Reform Act of 2012 (Public Law 112-95). Section 333 of Public Law 112-95 directed the Secretary to determine which types of UAS do not create a hazard to users of the NAS or the public or pose a threat to national security. Based on such findings, Congress

[15] For more information regarding the operation of small UAS, see http://www.faa.gov/uas.

directed the Secretary to establish requirements for the safe operation of such UAS.[16] On June 28, 2016, the FAA published the final rule for Operation and Certification of small Unmanned Aircraft Systems (hereinafter, "2016 final rule"), which was among the first steps to allow small UAS operations.[17]

As technology improves and the utility of small UAS for activities that previously required manned aircraft increases, the FAA anticipates an increased demand for flexibility in small UAS operations. The proposal to permit small UAS operations over people and small UAS operations at night is one of a number of regulatory steps the FAA is taking to allow for this growth while still maintaining the safety of the NAS. Possible small UAS operations that may operate over people or at night include motion picture filming, newsgathering, law enforcement, aerial photography, sports photography, and construction or surveying. This proposed rule would enable further operations of small UAS that would benefit the economy by increasing opportunities for commercially beneficial small UAS operations.

1. Registration and Marking Requirements for Small Unmanned Aircraft

On December 16, 2015, the FAA published the Registration and Marking Requirements for Small Unmanned Aircraft (Registration Rule).[18] The Registration Rule established a streamlined, web-based registration system for small unmanned aircraft in 14 CFR part 48. The

[16] Section 347 of Public Law 115-254 repealed Section 333, but replaced the relevant substantive provisions, codified at 49 U.S.C. 44807.
[17] 81 FR 42064.
[18] 80 FR 78594.

FAA provided this process as an alternative to the registration requirements for manned aircraft found in 14 CFR part 47. Regardless of whether they chose the process in part 47 or part 48, the Registration and Marking rule required all small UAS owners to register by February 16, 2016.

The Registration Rule also established marking requirements for small unmanned aircraft. In accordance with that rule, all small unmanned aircraft must display a unique identifier. Each small UAS operated under part 107 must display a unique registration number, visible upon inspection of the small unmanned aircraft.

2. Operation and Certification of Small Unmanned Aircraft Systems

On June 28, 2016, the FAA and DOT jointly issued the 2016 final rule.[19] That rule, codified at 14 CFR part 107, allows small UAS operations without requiring airworthiness certification, exemption, or a certificate of waiver or authorization (COA). Part 107 generally sets forth a framework of operational rules and robust restrictions to permit routine civil operation of small UAS in the NAS in a safe manner.

To mitigate risk to people on the ground and other users of the airspace, the 2016 final rule limited small UAS to daylight and civil twilight operations, confined areas of operation, and visual-line-of-sight operations. The 2016 final rule also addressed airspace restrictions, remote pilot certification, visual observer requirements that apply when a remote pilot in command opts to use a visual observer, and operational limits to maintain the safety of the NAS and ensure small UAS do not pose a threat to national security. Finally, the 2016 final rule included a waiver provision, which allows individual operations to deviate from many of the operational limitations

[19] 81 FR 42064.

if the Administrator finds the applicant could safely conduct the proposed operation under the terms of the certificate of waiver.

In its NPRM that preceded the 2016 final rule, the agency proposed including special provisions applicable to UAS weighing less than 4.4 pounds (micro UAS), but concluded such provisions were best addressed in a separate proposal.[20] A number of comments were submitted on micro UAS operations in response to the Operation and Certification of Small Unmanned Aircraft Systems NPRM,[21] and the FAA considered many of those comments during the development of this proposal. Today's proposal for small UAS operations over people is distinct from that proposal and not all of the originally submitted comments remain relevant. Nevertheless, the agency encourages members of the public to submit comments on this proposal regardless of whether they had submitted comments to the previous proposal.

3. Secure Operations of Small Unmanned Aircraft Systems

The FAA has been engaged in extensive outreach with Federal, State, local, and tribal law enforcement entities on the subject of small UAS operations. The FAA recognizes law enforcement officials are often in the best position to detect and deter unsafe and unauthorized drone operations. Therefore, the FAA works closely with these agencies to provide information regarding the evidence needed by the FAA to take enforcement actions and provide a communications link wherein state and local law enforcement can pass along reports in a timely manner. For example, all remote pilots operating in accordance with part 107 must obtain an FAA-issued remote pilot certificate with small UAS rating. The process for obtaining this

[20] 81 FR 42064 at 42122-23.
[21] Operation and Certification of Small Unmanned Aircraft Systems, Notice of Proposed Rulemaking, 80 FR 9544 (Feb. 23, 2015).

certificate includes the same Transportation Security Administration (TSA) review procedures that are currently used under 49 U.S.C. 46111 to ensure that airman certificate applicants do not pose a security risk. Although this proposed rule would modify the recurrent knowledge testing requirements, an applicant for a remote pilot certificate would still be subject to initial and continuing TSA vetting.[22] After initial vetting, TSA conducts recurrent vetting to ensure that certificate holders do not subsequently become a security threat. This framework is similar to the framework applicable to pilots who operate manned aircraft.

The FAA remains committed to working with security partners to ensure that appropriate means exist to mitigate security risks that small UAS operations may present. In this regard, the FAA seeks input on whether certain standards and restrictions should apply to operations of small UAS. In particular, the FAA is currently engaged in two distinct projects in which the FAA seeks feedback.

On May 4, 2017, the FAA convened an Aviation Rulemaking Committee (ARC) of industry stakeholders and observers from relevant government agencies to provide recommendations regarding technologies available for remote identification and tracking of UAS. The ARC's objectives included identifying and recommending emerging technology as well as identifying requirements for fulfilling security and public safety needs of law enforcement, homeland defense, and national security communities. The ARC's members included experts with knowledge and experience in electronic data capture, law enforcement, and public safety, among other areas. The FAA is cognizant of the importance of conducting research

[22] See 49 U.S.C. 44903(j)(2)(D)(i).

to develop potential standards relevant to remote identification and tracking of small UAS and is committed to ensuring further development of such standards and protocol in the interest of enabling adequate security measures to mitigate security concerns that operations of small UAS may present. As a result, the FAA plans to finalize its policy concerning remote identification of small UAS—by way of rulemaking, standards development, or other activities that other federal agencies may propose—prior to finalizing the proposed changes in this rule that would permit operations of small UAS over people and operations at night.[23]

In addition, the FAA is collecting comments in response to its publication of Safe and Secure Operations of Small Unmanned Aircraft Systems advance notice of proposed rulemaking (ANPRM). In publishing the ANPRM, the FAA intends to gather information from the public to inform the FAA's efforts in assessing options for reducing risks to public safety and national security associated with further integration of UAS into the NAS. The FAA may consider one or more rulemaking efforts based on the comments it receives in response to the ANPRM.

B. Advantages of Operations over People and at Night

The high level of interest in small UAS rulemaking reflects the small UAS industry's strong desire for integration of unmanned aircraft in the NAS. UAS integration will likely create substantial economic, technological, and societal benefits while ensuring that the United States retains its role as a global leader in innovation and aviation safety.

[23] The UAS Identification and Tracking Aviation Rulemaking Committee charter is available at https://www.faa.gov/news/updates/media/UAS_ID_and_Tracking_ARC_Charter.pdf.

Today, remote pilots in command who are compliant with part 107 can fly a small UAS within the remote pilot's visual line of sight within a safe distance from people, but not over people who are not participating in the operation, and not at night. Without this proposed rule, the only entities allowed to operate small UAS over people or at night are: (1) public entities holding an active certificate of waiver or authorization (COA), (2) entities holding an exemption from the FAA that permits UAS operations over people or at night, (3) entities that hold a waiver to the prohibitions on operations over people or operations at night, or (4) civil small UAS that have received airworthiness certification from the FAA and operate with a COA. The FAA has issued over 6,000 exemptions for operations of small UAS, some of which permitted operations over people or operations at night. In addition, since part 107 took effect, the FAA has issued 9 waivers for operations over people and over 1,200 for operations at night. Under the terms of this proposed rule, individuals would be able to operate small UAS over people and at night in the NAS under part 107 without a waiver or exemption, as long as the remote pilot in command conducts the activity pursuant to the proposed provisions.

With this proposed rule, the FAA expects the small UAS industry to continue finding new and creative ways for deploying small UAS, and thereby grow the industry through innovation. The proposed performance-based framework would enable an entirely new realm of operations, such as emergency response efforts, newsgathering, aerial surveying and photography, and certain infrastructure inspections.

During an emergency situation, response time often corresponds to lives saved. Remote pilots in command operating pursuant to the proposed provisions would not need to expend time clearing an area of any people not directly involved in the small UAS operation before operating

the small UAS pursuant to Category 1 or Category 2. Police or special weapons and tactics (SWAT) units could operate small UAS over people in situations that would otherwise present risk to law enforcement officers and support personnel, such as a hostage situation or similar type of incident. Other examples include firefighters using small UAS over a burning building and over people while colleagues actively fight the fire inside, providing real time footage of isolated pockets of fire, safe entry or egress points, or the location of trapped people or animals. A remote pilot could provide small UAS visual or infrared imagery for search and rescue missions while personnel are active on the ground beneath the small unmanned aircraft. First responders to major transportation disasters, such as train derailments or bus accidents, could use small UAS eligible for operations over people to locate victims or assess danger from a distance while the small unmanned aircraft proceeds over people involved in responding to the disaster. This would allow more targeted and efficient rescue efforts on the ground. The advantages of such operations are driven by timely and accurate decisions that save lives and reduce injuries.

The advantages of enabling small UAS operations over people and at night extend beyond the realm of emergency response. With safety standards for operations over people, media outlets could gather aerial images and video with greater ease and safety, giving them the flexibility to cover a wide array of news stories. Likewise, the potential for scientific and professional applications are numerous. A farmer could survey an entire field, even as employees are working in it. Small UAS, which are ideal for operations at low altitudes, could enable wildlife biologists to track and collect data on animal populations in towns and cities where people may traverse below, providing more accurate data on myriad aspects such as the efficacy of pest control efforts and the progression of habitat loss. In addition, the use of small UAS

during sporting and cultural events could afford enhanced viewer experience, more dynamic visuals, and greater accuracy. Using a small UAS to observe the performance of athletes, a judge would be able to measure competitors against one another with precise data the small UAS obtains.

Permitting small UAS operations at night would obviate the need for people to engage in activities that present a risk to their safety, such as nighttime inspections of infrastructure, wildlife, and other activities that may be preferable during nighttime hours. The absence of a person actually performing such inspections or higher-risk activities would therefore result in a decrease in the associated costs of the activities. As a result, the benefits of utilizing small UAS to engage in various activities are diverse.

The FAA continues to prioritize safety as it develops subsequent rulemakings for the entire aviation community. Providing a set of flexible, performance-based regulations enables the next phase of UAS operations, thereby ushering in additional economic and societal advantages while maintaining the safety of the NAS.

C. Micro UAS Aviation Rulemaking Committee

On February 24, 2016, the FAA chartered the Micro UAS Aviation Rulemaking Committee (ARC) (hereinafter "the ARC") on the subject of enabling operations of small UAS over people. As such, the ARC provided recommendations on enabling such operations. ARC members were familiar with small UAS designed for aerial data collection and photography with a focus on safety features and miniaturization of the aircraft and sensors; in addition, ARC members' experience included development of performance-based regulations for operations

within the NAS, consensus standards, consumer product testing techniques, manufacture of unmanned aircraft, and human injury research. The ARC provided a forum to discuss and provide recommendations to the FAA on enabling the operation of micro UAS over people who are not directly participating in the operation of the UAS or under a covered structure. On April 2, 2016, the ARC provided a final report with recommendations.[24]

The ARC recommended the FAA establish four categories for operations over people with small UAS. Specifically, the ARC suggested the establishment of risk thresholds based on the probability that direct impact with a person on the ground from a small unmanned aircraft would cause an injury that qualified as level 3 or higher on the Abbreviated Injury Scale (AIS).[25] The Association for the Advancement of Automotive Medicine (AAAM) classifies AIS level 3 injuries as "serious."[26] The ARC focused on this "serious" category, and assumed any small UAS flown over people may experience a failure and therefore fall, impacting a person. The ARC did not attempt to quantify the current risk of experiencing a failure or an acceptable failure rate, and did not specify the acceptable probability of a human impact occurrence. For each particular model of small UAS to qualify for operations over people, the ARC recommended the manufacturer of that model would have to certify that the aircraft's energy upon impact, as measured by a test established by an industry consensus standards body, would not, in the most

[24] A copy of the ARC's final report has been placed in the docket for this rulemaking.
[25] AAAM developed the AIS as: "an anatomically based, consensus derived, global severity scoring system that classifies each injury by body region according to its relative importance on a 6-point ordinal scale (1=minor and 6=maximal)." See https://www.aaam.org/abbreviated-injury-scale-ais/. Explanations of the AIS were presented to the ARC by several speakers. See section IV.B.1. for a description that contains more information concerning the FAA's use of the AIS in this proposed rule.
[26] In a presentation on the historical basis for FAA occupant safety, an FAA presenter provided the following examples of level 3 injuries to the head: small penetrating skull, sinus thrombosis, ischemic brain damage, basilar fracture/loss of consciousness for 1 to 6 hours.

probable failure modes, exceed a specified threshold. Such a test would establish the typical or likely impact energy of the most probable failure mode, and not simply the worst-case condition.

Based on the foregoing structure for categorizing risk, the ARC recommended four categories of operations of small UAS over people. Under ARC Category 1, the ARC recommended a small UAS could operate over people if the small unmanned aircraft weighed 0.55 pounds or less. Based on the data the ARC received, the ARC believed the level of risk of injury posed by this category of small UAS was so insignificant that no performance standards or specific operational restrictions would be necessary. To demonstrate a small UAS qualifies for ARC Category 1 operations over people, the ARC recommended the manufacturer of small UAS either: (1) label the product retail packaging of the small UAS with the actual weight of the aircraft, or a general statement that the aircraft weighs 0.55 pounds or less; or (2) declare the aircraft weighed 0.55 pounds or less, and submit that declaration to the FAA in a form and manner acceptable to the FAA.

To conduct ARC Category 2, 3, and 4 operations, the ARC recommended a small UAS should be able to operate over people if it did not exceed the impact energy threshold specified for each category, as determined by the manufacturer using test methods contained in industry consensus standards. Additionally, the ARC recommended the remote pilot for such operations should comply with operational restrictions specified for each category. Because the level of risk increases between ARC Categories 2, 3, and 4, the ARC recommended scaling up the performance-based standards and operational restrictions in each category to mitigate the increased risks.

Under ARC Category 2, the ARC recommended that a small unmanned aircraft be permitted to operate over people if it weighed more than 0.55 pounds, but still presented a 1 percent or less chance of "serious injury" (AIS level 3 or greater) upon impact with a person. The manufacturer would be required to certify that the small UAS did not, in the most probable failure modes, exceed the typical or likely impact energy threshold, in accordance with test methods contained in industry consensus standards. The ARC also recommended the operator[27] of the small UAS comply with the manufacturer's operator manual for the small UAS, developed in accordance with industry consensus standards. Lastly, the ARC recommended the operator maintain minimum set-off distances of 20 feet vertically or 10 feet laterally away from people, and generally not operate so close to people as to create an undue hazard for them.

Under ARC Category 3, the ARC recommended a small UAS could operate over people if it presented a 30 percent or less chance of causing an AIS level 3 or greater injury upon impact with a person. The manufacturer of the small UAS would be required to certify to the FAA that the small UAS did not, in the most probable failure modes, exceed the typical or likely impact energy threshold. The ARC also recommended the operator comply with the manufacturer's operator manual for the small UAS, developed in accordance with industry consensus standards and that flight over crowds or dense concentrations of people never be permitted under this category. In addition, the ARC recommended small UAS eligible for operations over people pursuant to ARC Category 3 only be permitted to operate over people if: (1) the operation is conducted over a closed- or restricted-access work site with the permission of the site's owner or

[27] The FAA notes that the ARC used the term "operator," as the FAA proposed in the Operation and Certification of Small Unmanned Aircraft Systems NPRM. When the FAA finalized that rule, it changed the term "operator" to "remote pilot."

operator; or (2) overflight of people is limited to transient or incidental operation, rather than sustained flight over people. The performance standards and operational restrictions applicable to ARC Category 2 operations would also apply to ARC Category 3.

The ARC recommended an ARC Category 4 to include operations in which a small UAS may operate over people, including flights over crowds or dense concentrations of people prohibited in ARC Category 3, if: (1) the manufacturer of the small UAS certifies the aircraft satisfies the same impact energy threshold as small UAS eligible to conduct ARC Category 3 operations; (2) the small UAS complies with industry consensus standards; and (3) the operation is conducted in compliance with a documented risk mitigation plan, which would be developed and adopted in accordance with industry consensus standards for conducting risk mitigation. The ARC's recommended performance standards for ARC Category 3 and operational restrictions for ARC Category 2 would also have applied to ARC Category 4 operations.

The ARC recommended the means by which manufacturers would comply with the provisions would be to: (1) declare the small UAS met industry consensus standards applicable to the category; (2) submit the declaration to the FAA in a form and manner acceptable to the FAA; (3) label the product or retail packaging in accordance with industry consensus standards; and (4) provide an operating manual to the operator that includes operator instructions for flight over people. The operator would be responsible for knowing the category of operations for which his or her small UAS is qualified, and any operational limitations he or she would be required to follow.

In addition, the ARC recommended the FAA establish a distinct knowledge testing framework for ARC Category 1 operations. Based on the proposed requirements for part 107, a

majority of the ARC recommended the knowledge test be available online and the TSA vetting process (background checks) be reconsidered or eliminated for ARC Category 1 operations. The ARC based this recommendation on input that the process is unduly burdensome and therefore detrimental to safety because the process discourages operators of small UAS from complying with the procedural requirements.[28]

The FAA considered the ARC's recommendations in the context of the agency's statutory authorities and responsibilities, as well as the practical realities of administering the regulatory scheme, while carefully deliberating over the ARC's recommendations and other public policy factors.

IV. Discussion of the Proposed Rule

This proposed rule would amend part 107 to enable routine small UAS operations over people and at night. This rule would require manufacturers ensure that small UAS they build for flying over people adhere to certain standards to mitigate the risk of injury to people should the aircraft fail. This rule would also set operational standards for all remote pilots in command who conduct operations over people and who conduct operations at night.

[28] Representatives of the Air Line Pilots Association (ALPA); National Agricultural Aviation Association (NAAA); Helicopter Association International (HAI); and Professional Aerial Photographers Association, International (PAPA) did not agree with the majority of the ARC on changing the testing requirements for remote pilots conducting Category 1 operations. These organizations all maintained that an individual intending to exercise the privileges permitted under the proposed part 107, which include commercial small UAS operations, "should fully comply with the necessary training and certification as currently described in part 107, no matter the size or complexity of the aircraft." ARC Report at 13. In addition, these organizations argued that data was not provided to the ARC.

A. Operations at Night

This rule proposes permitting operations of small UAS at night, subject to specific requirements.

The requirements that accompany each of the operations this proposed rule would permit would adequately mitigate the risk of collision with other aircraft, as well as the risk of injury to people. Such an analysis is consistent with the FAA's grant of exemptions under section 333 that preceded the promulgation of part 107, as well as waivers the FAA has issued for operations that occur at night and operations over people under § 107.200.

This proposed rule would amend § 107.29 to permit operations at night only: (1) when the small unmanned aircraft has an anti-collision light that is visible for 3 statute miles, and (2) when the remote pilot in command has completed an updated knowledge test or recurrent training as applicable, to ensure familiarity with the risks and appropriate mitigations for nighttime operations. Under 14 CFR 1.1, the definition of "night" is applicable for purposes of proposed § 107.29. Section 1.1 defines "night" as follows: "the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time."

1. Analysis of Risk of Night Operations

The FAA recognizes the 2016 final rule limited operations of small UAS to daytime and civil twilight, based on the assessment that operations at night pose a higher safety risk. The FAA based this presumption on the general difficulty involved in maintaining visual line of sight and in ensuring discernment of the location of other aircraft during night hours. The portion of

the 2016 final rule that explained the agency's rationale for the prohibition stated the distance and movement of small unmanned aircraft relative to the distance and movement of other lighted manned aircraft are difficult to judge, due to the relative size of the aircraft.[29] Moreover, the agency determined visual autokinesis, which is 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; as a result, darkness increases the difficulty of perceiving 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. Based on the difficulty of perceiving reference points and other associated risks the FAA identified, the FAA opined in the preamble of the 2016 final rule that operations of small UAS at night could increase the risk of collision with people, obstacles on the ground, and other aircraft.[30] The FAA, however, acknowledged the many comments in favor of permitting operations at night and stated it planned to consider commenters' recommendations as part of future rulemaking efforts.[31]

While the FAA carefully analyzed the risks that operations of small UAS at night present, the FAA remains mindful of the fact that the remaining rules of part 107 address risks in a comprehensive manner. In this regard, aside from amending the provisions of §§ 107.29 and 107.39, none of the amendments the FAA proposes in this NPRM would change the remaining operational restrictions and requirements of part 107.[32] The FAA determined these existing

[29] 81 FR 42064, 42103.
[30] Id. at 42104.
[31] Id. at 42105.
[32] For example, remote pilots must still maintain a valid remote pilot certificate and may not operate the small UAS in an unsafe manner. Remote pilots remain prohibited from: operating small UAS from a moving vehicle (other than over sparsely populated areas) or aircraft and operating in the absence of the capability to discern visually the speed, altitude, attitude, and position of the small unmanned aircraft. In addition, remote pilots may only operate in Class G

operational provisions, in addition to the proposed requirements of an anti-collision light and additional knowledge testing or recurrent training, mitigate the risk posed by small UAS operations at night.

2. Review of Exemptions and Waivers

The current prohibition on nighttime operations of small UAS may be waived, and the FAA has analyzed the effects of risk mitigation measures the FAA requires under such waivers. Since the effective date of the rule on August 29, 2016, the agency has received 4,837[33] requests for waiver of the prohibition on nighttime operations. The agency has issued 1,233[34] waivers for operations at night, and has determined the operations that proceed in accordance with those waivers are safe.

The FAA also has granted exemptions pursuant to section 333 for UAS operations at night under 14 CFR part 91, which contains a different framework than part 107.[35] The FAA considered in its analysis the fact that it did not exempt the requirements of §§ 91.205(c) and 91.209, which require lighting on aircraft. In addition, most of the airman qualification requirements under 14 CFR part 61 applied to such exemptions. The FAA considered these two factors—anti-collision lighting and airman knowledge—as critical to ensuring safety in the NAS

airspace unless they first obtain prior authorization and must thoroughly check the area of operation and the small UAS in advance of the operation. Furthermore, remote pilots must continue to yield to other aircraft.

[33] This information is current as of December 31, 2017.

[34] This information is current as of December 31, 2017.

[35] Section 333 required the Secretary to determine which types of UAS do not create a hazard, based on considerations that include unmanned aircraft size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight. Id. Pub. L. 112-95 section 333(b)(1). Based on such determinations, the FAA issued exemptions from various operating rules applicable to manned aviation operations to enable operations of UAS. Some exemptions permitted operations of UAS at night, pursuant to certain conditions and limitations. See, e.g., Industrial Skyworks, Exemption No. 16341 (April 18, 2016) (concluding, "the petitioner's use of anti-collision lights that are visible from 5,000 feet are adequate for the PIC and [visual observer] to maintain [visual line of sight] capability and as an additional means for collision mitigation.").

when permitting the UAS operations at night under section 333. In addition, the current version of § 107.29(b) requires anti-collision lighting for operations during periods of civil twilight. The FAA has determined this requirement is a suitable risk mitigation measure for operations at night.

The FAA has also assessed the potential effects of operations of small UAS at night in conjunction with the other type of operation this proposed rule would permit, which is operations over people. First, risks of operations at night are distinct from those that operations over people present. As explained in this proposed rule, the FAA classifies the risk mitigations for operations over people via proposed categories that are based on the level of risk of injury posed. Manufacturers of small UAS who seek to produce small UAS eligible to operate over people would need to consider the mass of an anti-collision light if they include such a light on the small unmanned aircraft.

The lighting conditions at the time of the flight do not change the level of risk that small UAS operations that occur over people present. If the small UAS used in the operation complies with one of the categories of aircraft listed in proposed subpart D of part 107, then the remote pilot in command may operate the small UAS over people pursuant to the proposed requirements within subpart D, as well as other requirements that may apply.

3. Visual Observation at Night

Visual observation is the means by which a remote pilot in command ensures the small unmanned aircraft does not collide with other aircraft. Several factors influence a person's ability to detect aircraft visually. For example, size, orientation, visual clutter, and the location of the

image on a person's retina all affect the discernment of an aircraft with unaided human vision. Creating contrast, which is the difference in luminance between an object in its background, enhances the safety of aviation operations that occur at night because contrast facilitates one's ability to observe aircraft and therefore avoid a collision. Contrast consists of paint schemes, aircraft lighting systems, atmospheric conditions, and variations in background.[36]

Feedback from an FAA Pathfinder participant supports the FAA's conclusion that such contrast affects the remote pilot's ability to avoid a collision based on visual observation. The Pathfinder participant operated a small UAS at night and staged a manned aircraft in the same area as the unmanned aircraft. In that case, both the remote pilot in command and the manned aircraft pilot spotted one another more easily during night operations than during the day, due to the increased conspicuity that anti-collision lighting provided.[37]

4. Anti-Collision Lighting

Small unmanned aircraft, in most cases, are significantly smaller than their manned counterparts. The reduced size, combined with the reduced visibility due to darkness, favors requiring an anti-collision light for reduction of the risk involved with small UAS operations at night. The FAA anticipates the presence of the light will provide other aircraft with awareness of the small unmanned aircraft's presence. The FAA's rationale for the proposed anti-collision light

[36] See Williams and Gildea, A Review of Research Related to Unmanned Aircraft System Visual Observers, DOT/FAA/AM-14/9 Civil Aerospace Medical Institute (October 2014) (stating operations at night offer the potential advantage of higher contrast conditions because the small unmanned aircraft's light against a dark sky provides a difference in luminance).

[37] A copy of correspondence with staff from Pathfinder participant Burlington Northern Santa Fe (BNSF) is available in this rulemaking docket.

for night operations in this rule remains consistent with the rationale the FAA articulated in the 2016 final rule with regard to the requirement for the light during civil twilight operations.[38]

Although a remote pilot in command might be able to discern the position of the small unmanned aircraft with his or her unaided human vision when the aircraft is further away at night due to the lighted anti-collision light this proposed rule would require, the remote pilot may not be able to rely solely on that light as a manner of complying with the existing requirements applicable to visual line of sight operations. Existing § 107.31(a) requires the remote pilot to be able to see the small unmanned aircraft throughout the flight to: know the unmanned aircraft's location; determine the unmanned aircraft's attitude, altitude, and direction of flight; observe the airspace for other air traffic or hazards; and determine that the unmanned aircraft does not endanger the life or property of another.

In almost all cases, the remote pilot in command will need to restrict the operational area of the aircraft at night or use a small UAS that contains an additional system, such as position lighting, to meet § 107.31(a) requirements while operating at night. Such a necessity arises from the fact that reduced lighting and contrast at night makes it difficult for remote pilots in command to maintain the capability of visually discerning the location, attitude, altitude, and direction of the flight of the aircraft. In the interest of enabling remote pilots in command with the flexibility to determine the appropriate solution for each unique operation, the FAA decided not to propose amending existing § 107.31 to require additional requirements on visual line of sight operations at night. The FAA invites comments from the public, however, on whether it

[38] 81 FR at 42103.

should require position lighting, in addition to the anti-collision lighting the FAA proposes in this rule, for night operations.

Currently, § 107.29 requires an anti-collision light visible for 3 statute miles during periods of "civil twilight." The 2016 final rule cited 14 CFR 103.11 as the source of the requirement for an anti-collision light.[39] Section 103.11 prohibits operation of ultralight vehicles at night, and sets forth an anti-collision light requirement for ultralight vehicles during twilight periods. The FAA is aware that the anti-collision light requirement for ultralights does not constitute a precise analogy to small UAS operations. Nevertheless, the FAA has considered the anti-collision light requirement as it applies to ultralights as instructive for both the existing version of § 107.29 as it relates to civil twilight operations, as well as the version of § 107.29 that the FAA proposes in this NPRM.

In promulgating this requirement for ultralights, the FAA stated "[t]he visibility from above of ultralights operating at very low levels can be significantly enhanced by the addition of an anti-collision light on these vehicles."[40] The FAA stated, for purposes of § 103.11, an anti-collision light is "any flashing or stroboscopic device that is of sufficient intensity so as to be visible for at least 3 statute miles."[41] Overall, the 3 statute mile visibility standard for anti-collision lighting for night operations of ultralight vehicles has been a longstanding requirement.

The FAA considered incorporating the standards of 14 CFR 27.1401, Anti-collision light system, for night operations under part 107. Part 107 does not contain aircraft certification rules or standards, and the FAA concludes the reduced risk small UAS operations pose does not

[39] 81 FR 42064, 42103 (June 28, 2016).
[40] 47 FR 38770, 38773 (Sept. 2, 1982).
[41] Id. at 38773-74.

warrant application of such standards. Prescribing lighting requirements would be overly burdensome for both the FAA and manufacturers of small UAS because they would be forced to make tradeoffs that affect both the weight of the aircraft and the aircraft's power source and supply. The FAA proposes small UAS operating at night must simply have an anti-collision lighting component that is visible for 3 statute miles, rather than a light that fulfills prescriptive design criteria. The FAA, however, invites comments on the following:

- Should the FAA impose a specific color or type requirement concerning the anti-collision light; the most helpful comments on this issue will explain how a prescriptive standard would achieve the objective of ensuring safety of small UAS operations at night, in light of the risks the FAA has identified in this proposed rule.
- Are there characteristics or effects of anti-collision lights at low altitude that could have an effect on normal human activities? If so, are there potential mitigations or alternatives to consider?

5. Waiver

The FAA also proposes making the anti-collision lighting requirement for small UAS night operations subject to waiver. The FAA would consider granting a certificate of waiver allowing a nighttime small UAS operation without an anti-collision light visible for 3 statute miles if an applicant demonstrated sufficient measures to mitigate the risk associated with the proposed operation. In this regard, as with the FAA's current manner of responding to requests for waiver, the FAA would expect waiver applicants to establish that operating at night without

an anti-collision light (or with a light that is visible at a distance of less than 3 statute miles) would not reduce the level of safety of the operation.

6. Preflight Familiarization

The FAA also considers the existing preflight familiarization, inspection, and actions for aircraft operation under § 107.49 to mitigate the risk of operations of small UAS at night. Section 107.49 will continue to require the remote pilot in command to assess in advance of the operation the location of persons and property on the surface as well as other ground hazards. The remote pilot in command must also determine the functionality of the small UAS and its required components. Similar to the requirements of § 91.205(a), the FAA expects the remote pilot to check the anti-collision light in advance of the operation to ensure the light is in an operable condition for the duration of all flights during civil twilight and at night.

In addition to verifying the functionality of the anti-collision light prior to commencing the operation and after noting the locations of hazards during the assessment of the operating environment, the remote pilot in command must determine how to avoid the identified hazards to ensure continued safe operation of the small UAS in accordance with §§ 107.15 and 107.19(c). Prior to the flight, the remote pilot in command must also ensure he or she will be able to keep the small unmanned aircraft within the intended area of operation and within visual line of sight for the duration of the operation. This preflight assessment provides flexibility to the remote pilot in command and allows him or her to exercise judgment in using the principles of Aeronautical Decision Making. Advisory Circular 107-2[42] contains recommended best practices for

[42] Small Unmanned Aircraft Systems (sUAS), Advisory Circular 107-2 (June 21, 2016), available at https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_107-2.pdf

operational site assessments and avoiding flight over non-participating people, unless the operation satisfies the proposed requirements of § 107.39.

The FAA considered amending § 107.49 to include an explicit requirement to check the functionality of the anti-collision light prior to night operations. The FAA decided such an amendment is unnecessary because the language in the proposed version of § 107.29(a)(2) would specifically require a lighted anti-collision light. This language is identical to the original § 107.29(b) for civil twilight operations that also did not require checking the functionality of the light in § 107.49.

7. Remote Pilot Knowledge

The remote pilot's first-hand knowledge of the risks nighttime small UAS operations present, as well as the appropriate risk mitigations and aeronautical judgment, are critical to enhancing the safety of operations of small UAS at night. As a result, the FAA would require remote pilots complete either an updated knowledge test or recurrent training that addresses small UAS operations at night prior to operating as a remote pilot in command at night.

The additional test questions the FAA anticipates including on the initial knowledge test under § 107.73 and the recurrent training under § 107.74 would focus on night physiology and night illusions. The remote pilot in command's ability to maintain both the small unmanned aircraft and any intruding aircraft within his or her field of view will directly affect his or her ability to discern the potential for a collision.[43] As such, maintaining the ability to view the airspace pertinent to the operation is a principal mitigation of the risk small UAS operations

[43] See M.A. Crognale, UAS/UAV Ground Observer Performance: Field Measurements, DOT/FAA/AR-10/1 (Dec. 24, 2009).

present under part 107. Therefore, the additional knowledge questions and training relevant to night operations would emphasize the ability to maintain uninhibited visual observation of the airspace and would address how to detect aircraft in a dynamic, visually complex operational environment.

In addition, the FAA will continue to provide resources to remote pilots in command concerning practical tips and best practices for ensuring the safety of small UAS operations at night. The FAA publishes several resources that contain information and best practices for night operations. The FAA encourages remote pilots to become familiar with certain sections of the Aeronautical Information Manual (AIM),[44] Pilot's Handbook of Aeronautical Knowledge,[45] and Airplane Flying Handbook.[46] The FAA intends to update Advisory Circular 107-2 with specific sections pertaining to night operations and currently maintains brochures and training videos for night operations. Remote pilots have free online access to these materials.

A remote pilot who obtained his or her remote pilot certificate under part 107 prior to the effective date of this rule and has not completed updated training would not be eligible to act as remote pilot in command and operate their small UAS at night under this rule. Any person who wishes to be a remote pilot in command and operate at night must complete the updated training, which includes night operations, regardless of the amount of time that has passed since the person completed the previous test or course, before operating at night.

[44] AIM, Ch. 8: Medical Facts for Pilots, Sec. 8-1-6 "Vision in Flight," available at https://www.faa.gov/air_traffic/publications/media/aim.pdf (April 27, 2017).
[45] Pilot's Handbook of Aeronautical Knowledge, Ch. 17: Aeromedical Factors at p. 17-19 "Vision in Flight," available at https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/media/19_phak_ch17.pdf (2016).
[46] Airplane Flying Handbook, Ch. 10: Night Operations (March 23, 2017).

B. Operations Over People

This rule proposes amendments to part 107 that would enable operations of small UAS over people. The FAA bases its proposed framework on the presumption that small UAS operating under part 107 are not airworthy, given that they are not subject to the requirement of an airworthiness certificate.[47] Accordingly, the FAA proposes three categories of operation that could be conducted over people,[48] based on likelihood and severity of injuries that could result.

This section describes the FAA's proposed requirements applicable to the three categories that would ensure the safety of operations over people. These requirements address the manufacturing of small UAS that fulfill the safety thresholds of this proposed rule as well as restrictions that may apply to the operation. In addition, this section describes the measures of oversight the FAA will employ in ensuring compliance with the proposed requirements.

1. Definitions

This proposed rule includes two new definitions applicable to manufacturing small UAS eligible to conduct operations over people: "casualty" and "declaration of compliance." For purposes of this rule, the FAA considers a "casualty" as an Abbreviated Injury Scale (AIS) level 3 or greater injury. The AIS provides a means of classifying the type and severity of injuries throughout the body. Although originally designed to map a series of anatomically-defined injury descriptions using several parameters (energy dissipation, threat to life, permanent impairment, treatment period, and incidence) specifically for vehicular crashes, the U.S.

[47] 81 FR 42068-70 (stating Pub. L. 112-95 section 333(b)(2) allows for the determination that airworthiness certification is not necessary for certain small UAS, such as those part 107 covers).
[48] As discussed in the preamble of the 2016 final rule, the term "over" refers to the flight of a small unmanned aircraft directly over any part of a person, regardless of the dwell time. 81 FR 42064, 42129.

Department of Transportation as well as many university and industry research teams in the United States, Europe, and Australia have adopted the AIS severity level scale as the standard for various crash investigation teams. Within the AIS system, injuries are classified on a scale of 1 to 6, as follows:

Table 3: Abbreviated Injury Scale

AIS Level	**Definition**
1	Minor injury
2	Moderate injury
3	Serious injury
4	Severe injury
5	Critical injury
6	Non-survivable injury

Throughout this NPRM, the FAA uses the phrase "low probability of causing a casualty" for Category 2 operations to mean a low chance exists that a person whom a small unmanned aircraft impacts would experience a serious injury. The FAA notes that the AAAM classifies all AIS level 3 injuries as "serious." Similarly, although the FAA does not propose codifying a definition of "fatality" in this rule, this NPRM uses that term in descriptions concerning Category 3 operations, which appear in section IV.B.4. For purposes of this discussion, the FAA regards a "fatality" as an AIS level 6 injury, which means the injury ultimately results in death. Because a casualty is an AIS level 3 or greater injury, AIS level 6 is included within the definition of a casualty.[49] Overall, consistent with the ARC's recommendations, the FAA uses

[49] AIS 3 head injuries can result in a loss of consciousness of 1 to 6 hours, or specific types of skull fractures. AIS 3 neck injuries include dislocations, fractures, and injuries that put the spinal cord at risk. While an AIS 3 injury may not be life-threatening as a stand-alone injury, compounding factors may lead to death. Therefore, the FAA notes that a person could experience an AIS 3 injury as a result of a small unmanned aircraft impact that could develop into a more serious injury if, for example, the person does not seek the appropriate medical attention.

the AIS in assessing the levels of risks of injury small unmanned aircraft operating over people may present, in the interest of determining the appropriate manner for reducing such risks.

This proposed rule would also define a "Declaration of Compliance" as a document a manufacturer submits to certify that a small UAS conforms to the Category 2 or 3 requirements for operations over people. As discussed in section IV.B.7., this rule would require manufacturers producing small UAS for Category 2 and 3 operations to submit a Declaration of Compliance to the FAA. Although these aircraft systems would not be certificated as airworthy under this rule, the FAA would rely on a manufacturer's Declaration of Compliance to ensure the make and model of aircraft complies with the applicable standards at the time of manufacture.

2. ARC Recommendation

As noted previously, the ARC recommended a small UAS operating over people should present only a low probability of causing a serious injury to uninvolved people. The ARC used two concepts to address the risk to persons from small UAS operations over people: injury threshold and impact kinetic energy threshold. The injury threshold is the maximum injury level a person would be expected to suffer as a result of being impacted by a small unmanned aircraft under normal operating conditions. The impact kinetic energy threshold is the maximum kinetic energy that the small unmanned aircraft could transfer to a person upon impact without exceeding the injury threshold. The ARC identified threshold injury levels using the AIS for each category: a one percent chance of causing an AIS level 3 injury for ARC Category 2

operations and no more than a 30 percent chance of causing an AIS level 3 injury for ARC Category 3 operations.[50]

The ARC recommended the proposed rule should limit the kinetic energy a small UAS could transfer upon impact in order to limit the injury the small UAS could cause. The ARC encouraged the FAA to use the injury thresholds to calculate corresponding impact kinetic energy thresholds. The ARC recommended using an impact kinetic energy threshold measured in Joules per centimeter squared (J/cm^2) to calculate the impact kinetic energy thresholds that correspond to these injury thresholds, by way of a performance-based requirement that limits the risk of injury. Based on a presentation it received from Transport Canada, the ARC stated this calculation would result in a value of 12 J/cm^2, and that a quadcopter UAS weighing 4 to 5 pounds would qualify for an ARC Category 2 operation, depending on its design characteristics and operating instructions.[51]

3. Category 1 Operations

This rule would establish a category of operations over people using small UAS that weigh 0.55 pounds or less, including everything that is on board or otherwise attached to the aircraft at the time of takeoff. The FAA refers to this category as Category 1, and proposes to enable Category 1 operations without any additional manufacturer or operational restrictions beyond what part 107 already requires and any other applicable laws and regulations.

[50] ARC Report at 9-10.
[51] ARC Report at 7.

The FAA's proposal is consistent with the ARC's recommendation for Category 1 operations. Based on information from experts in government, industry, and academia,[52] the ARC concluded, "the level of risk of injury posed by this category of UAS is so low that no performance standards and no operational restrictions beyond those imposed by the proposed part 107 are necessary."[53] The ARC came to this conclusion based on the following: (1) an example provided by Dr. Paul Wilde of the FAA in which a small UAS weighing 0.55 pounds and operating over people presented a "probability of serious injury or fatality consistent with existing levels of safety for non-participating people when exposed to aviation risks;"[54] (2) data provided by Mr. Arterburn, of the University of Alabama in Huntsville's Alliance for System Safety of UAS through Research Excellence (ASSURE), who "correlated various human injury thresholds with risks associated with sporting events"[55] and suggested that a UAS, under certain conditions, could transfer as low as 38 percent of its total kinetic energy on impact;[56] and (3) the Registration Task Force's selection of a weight threshold of 0.55 pounds for registration purposes. There is more information about the ARC's analysis of the risks posed by Category 1 operations in its report, a copy of which has been placed in the docket. The FAA adopts this conclusion that a small unmanned aircraft that weighs 0.55 pounds or less poses a low risk of injury when operated over people.

[52] In addition to presentations from FAA experts, presentations made at the ARC included analyses from researchers at ASTM International (ASTM), Transport Canada, National Aeronautics and Space Administration (NASA), National Institute of Standards and Technology (NIST), Alliance for System Safety of UAS through Research Excellence (ASSURE), Virginia Tech, RTCA, Praxis Aerospace Concepts, MIT Lincoln Labs, Simpson College, Naval Sea Systems Command (NSWC Dahlgren), EASA, U.S. Navy, UAS Insurance Association, and the Consumer Product Safety Commission. See ARC Report at Appendix A

[53] ARC Report at 4.

[54] ARC Report at 6.

[55] ARC Report at 6.

[56] ARC Report at 6.

The FAA anticipates Category 1 operations would consist almost exclusively of aerial photography, due to the small size of aircraft eligible for such operations. For example, a small UAS qualified for Category 1 operations might be used to film a wedding, collect pictures of a school sporting event, or take a self-portrait. The FAA invites comments containing data on the risk of injury to persons posed by operations using small UAS that weigh 0.55 pounds or less.

The FAA anticipates manufacturers would design small UAS to meet the Category 1 qualifications for marketing purposes, but responsibility for determining whether a small unmanned aircraft weighs 0.55 pounds or less rests with the remote pilot in command. The remote pilot in command would be in the best position to determine, before flight, whether the small unmanned aircraft satisfies the weight limitation and can therefore conduct Category 1 operations. For example, the remote pilot in command may choose to add or change the small unmanned aircraft's batteries or camera, which may cause a small unmanned aircraft that previously satisfied the 0.55-pound limit to exceed that weight and no longer qualify for Category 1 operations. Overall, the remote pilot in command must ensure the small UAS is eligible for operations under Category 1 prior to operating the small UAS over people.

4. Category 2 and 3 Operations

While the proposal for Category 1 operations is based on weight alone, the proposed amendments for enabling Category 2 and 3 operations require a more sophisticated analysis. This rule proposes categorizing eligibility for Category 2 and 3 operations based on the risk of human injury, which is consistent with the ARC's recommendations. The following discussion describes the level of safety this rule proposes as the standard for limiting human injuries from the energy

a small unmanned aircraft transfers upon impact. This discussion also summarizes the sources of relevant information the FAA considered and will continue to monitor.

a) International Activities and Ongoing Research

Since the ARC, the FAA has carefully examined additional information with regard to injury risks and energy thresholds. The European Aviation Safety Agency (EASA) published a prototype regulation in August 2016, followed by a Notice of Proposed Amendment (NPA) on May 4, 2017.[57] The NPA introduces categories of permissible small UAS operations based on maximum takeoff masses; the "open" category is most permissive, and proposes a subcategory to permit small UAS operations over uninvolved people, but not over assemblies of people, as long as the aircraft does not exceed 250 grams maximum takeoff mass and does not have sharp edges. These aircraft would be limited to 50 meters (approximately 164 feet) above ground level (AGL) and eligible for operations that remote pilots of any age could conduct, provided they have educational materials to ensure competence. Other commercially built small unmanned aircraft would be permitted to operate over uninvolved people if they fulfill several product safety requirements, including either an energy transmitted to the human body less than 80 joules upon impact or a maximum takeoff mass, including payload, of less than 900 grams and a maximum cruising speed of 18 meters per second. These other aircraft would also be subject to the limit of 50 meters AGL unless the pilots conducting the operations take online training with a test, in which case they could conduct operations up to 120 meters AGL. The NPA proposes allowing

[57] Introduction of a Regulatory Framework for the Operation of Drones—Unmanned Aircraft System Operations in the Open and Specific Category, Notice of Proposed Amendment 2017-05, available at https://www.easa.europa.eu/system/files/dfu/NPA%202017-05%20%28A%29_0.pdf.

other operations that do not fulfill these criteria, as long as they do not operate directly over uninvolved people and comply with certain operational restrictions.[58]

In the NPA, EASA also states it relied on the Joint Authorities for Rulemaking on Unmanned Systems (JARUS) concept that identifies three categories based on several factors concerning the intended operations. JARUS is a collaborative group of international participants that develop guidance material to assist governing authorities in promulgating standards. The FAA participates in JARUS in developing such materials, and has considered JARUS activities and proposed policies in furtherance of the FAA's goal of integrating UAS safely into the NAS. In this regard, the FAA continues to contribute to JARUS and its stated mission to develop a regulatory framework for unmanned aircraft operations and proposals for the regulation of operations the member states would consider "low-risk."

Since 2015, the FAA has collaborated with the academic community and its affiliates by fostering cooperative research and developing intellectual capabilities of primary interest to the FAA and the UAS community, through the work of the UAS Center of Excellence under the Alliance for System Safety of UAS through Research Excellence (ASSURE). Recent research from one ASSURE study has informed the FAA's decision-making concerning operations of small unmanned aircraft over people.[59] The results of the study corroborate the FAA's impact severity estimates that form the basis for this rule, in that the ASSURE researchers used kinetic

[58] Similar to the FAA, EASA may consider ongoing research as it determines the suitability of energy thresholds and the likelihood of human injury in attempting to categorize the risk small UAS operations over people may present.
[59] Arterburn, et al., FAA UAS Center of Excellence Task A4: UAS Ground Collision Severity Evaluation: Revision 2 (Apr. 28, 2017) (hereinafter "A4 Report"). The final report underwent peer review of researchers from FAA, the National Aeronautics and Space Administration, and industry participants. The report is available in the docket for this rulemaking.

energy upon impact as a basis for estimating the severity of injury a small UAS impacting a person causes.

This research substantiates the need for the development of manufacturer standards that will address how to measure the potential for human injury that results from small UAS impacts with a person. In particular, given the significant variability in the impact dynamics and amounts of energy transfer that the report identified, the ASSURE research indicates addressing impact dynamics, aerodynamic drag, the shape and material properties of the small UAS, and other potential factors, will be persuasive aspects to consider for creating standards that ensure safety. The A4 Report also highlights the necessity for safer blade designs or restrictions that could limit the effects of exposed rotating parts.

b) FAA Proposal

This proposed rule would use the term "safety level" in the requirement applicable to means of compliance: in particular, applicants that submit means of compliance for FAA acceptance must show the means of compliance would achieve the safety level the proposed standards reach. This safety level refers to the limitation of injury severity caused by transfers of kinetic energy, exposed rotating parts, or safety defects. With regard to the impact kinetic energy limitations in this rule, the small unmanned aircraft must not be capable of causing an injury to a human being that is more severe than injury that would result from an impact kinetic energy transfer of 11 ft-lbs (Category 2) or 25 ft-lbs (Category 3) from a rigid object. In addition, this proposed rule would prohibit small UAS eligible for operations in either Category 2 or Category 3 from having exposed rotating parts that could lacerate human skin and from having any safety defects. Finally, to establish an appropriate safety level, this rule would also require certain

operational limitations for Category 3 operations. Consistent with the ARC recommendation, this rule proposes a performance-based standard that the FAA believes is equivalent to reducing the likelihood of causing a certain level of expected injury.

(1) Safety Level

This proposed rule's establishment of a safety level that, in part, limits the effects of kinetic energy upon impact arises from the FAA's consideration of the AIS as a means of establishing the acceptable injury thresholds. In the Supplemental NPRM (SNPRM) titled "Licensing and Safety Requirements for Launch," the FAA discussed the concept of levels of injury risk from impacts with inert debris resulting from commercial space launches.[60] In determining the acceptable level of risk of injury from inert debris, the FAA stated: "[o]ne must note that not every impact of debris at 11 ft-lbs or greater would necessarily result in a casualty. The probability of casualty due to such an impact is further dependent on a number of other factors specific to the debris and the impact scenario."[61] The FAA considered the concept of the risk of injury from inert debris in proposing standards for small unmanned aircraft, as explained below.

(a) Transfer of Energy from Rigid Object

This rule proposes a performance-based standard that includes the term "rigid object" with regard to the transfer of energy. For purposes of this proposed rule, the FAA considers a rigid object to be a body on which the distance between two points never changes,

[60] See Licensing and Safety Requirements for Launch, Supplemental Notice of Proposed Rulemaking, 67 FR 49456 (July 30, 2002), which the FAA finalized on August 25, 2006. 71 FR 50508.
[61] 67 FR at 49465.

notwithstanding the amount of force applied on it. Such a definition, therefore, includes a body that does not deform under the influence of forces. The FAA is fully aware that many factors affect the transfer of kinetic energy. For example, elasticity, impact dynamics, impact orientation, and a variety of other factors would ostensibly reduce the amount of energy the object actually transfers. Research suggests a rigid object impacts someone with more kinetic energy and therefore could cause injuries more severe than those a small unmanned aircraft would cause upon impact.

The A4 Report from ASSURE suggests a vertical drop test that measures kinetic energy upon impact alone is not the most accurate means of estimating injury that occurs as a result of the energy transfer. The ASSURE research also proposed alternatives to measuring injury that would result from a small unmanned aircraft that impacts a person. The study suggested other test methods that account for the design configuration and material properties of the small UAS may measure the severity of blunt trauma that results from an impact more accurately than kinetic energy measurements alone. ASSURE is conducting further research on alternative methodologies as indicators of the severity of injuries from impacts with small unmanned aircraft.

The study strongly suggests the transfer of energy from a small unmanned aircraft, while difficult to measure, is unlikely to reach 100 percent of the total kinetic energy. In this regard, the study states:

> The energy that is directly absorbed is the difference between the transferred energy and the change in kinetic energy of the impacted object. Absorbed energy

> is a function of the deformation of the impacted mass and the associated damping caused by the materials from which the impacted object is manufactured.[62]

The study indicates deformation and absorption of energy are influential factors to consider when measuring energy from a small unmanned aircraft falling on a person because "[i]n the case of a person being hit by a UAS, deformation and absorbed energy contribute to the injuries associated with blunt force trauma."[63]

The study attempted to theorize the likelihood of injury that would result from an impact with a small unmanned aircraft as compared to an impact with blunt, dense objects such as a ball of steel and a block of wood.[64] The risk of a serious injury from such objects varies, given the frangibility and dense nature of the object, among other factors. The research conducted impact testing of each of these objects and established that the transfer of energy from these objects varies greatly due to design characteristics and the variation of materials that compose the objects. The study showed the transfer of energy from a rigid object was more likely to cause injury than the energy transferred from an object that is less rigid, such as a small unmanned aircraft of the same weight. The FAA intends the practice of comparing the energy transferred from a rigid object to the transfer of energy from a small unmanned aircraft will permit manufacturers, likely by way of an industry consensus standard, to design small unmanned aircraft that fulfill the safety levels the FAA proposes in this rule. Ultimately, the FAA intends its inclusion of the term "rigid object" to provide flexibility applicable to each small unmanned aircraft design, based on limiting human injury caused by the transfer of energy.

[62] A4 Report at 32-33.
[63] Id.
[64] A-4 Report at 84.

Along with the inclusion of the term "rigid object" in the standards that would govern the qualification of small UAS eligible to conduct operations in Category 2 and Category 3, the FAA proposes measurements of energy that would ensure a low likelihood that the small unmanned aircraft would cause a casualty or fatality upon impact. The FAA's use of 11 ft-lbs as the basis for the injury standard applicable to Category 2 operations is consistent with existing commercial space safety regulations at 14 CFR part 417, Launch Safety, and longstanding Range Commander's Council (RCC) standards. Specifically, 14 CFR 417.107(c) establishes 11 ft-lbs as the impact kinetic energy threshold for inert debris from a commercial space launch operation that could cause a casualty from blunt trauma to a person not under a covered structure. The FAA bases this threshold on extensive government research of human injury thresholds discussed in the RCC Common Risk Criteria Standards for National Test Ranges, RCC Standard 321 and associated supplements. The stated intent of RCC Standard 321 is to "establish safety criteria and guidelines to provide definitive and quantifiable measures to protect mission – essential personnel"[65] and the general public from launch and reentry hazards generated by guided and unguided missiles, missile intercepts, space launches and reentry vehicles. The RCC conducted extensive testing and analysis to address blunt force injuries that may result from falling inert debris. Based upon this information and human injury criteria, the RCC established threshold values that correlate to low probabilities of specific human injury levels. Section 6.2 of RCC 321-07, for example, states "the threshold criterion for protection against blunt trauma and crushing injuries is 11 ft-lbs impact kinetic energy."[66] Section 6.2.1 of RCC 321-10 states, this

[65] RCC Range Safety Group, Common Risk Criteria Standards for National Test Ranges: Supplement 321-10 at sec. 1.3 (2010).
[66] RCC Range Safety Group, Common Risk Criteria Standards for National Test Ranges: Supplement 321-07 at sec. 6.2.a (2007).

criterion is designed to afford protection against injury levels of an Abbreviated Injury Scale (AIS) of level 3 or worse. This statement explains that 11 ft-lbs is the appropriate standard for a "low probability" of an AIS level 3 injury. In addition, the standard is consistent with the use of 11 ft-lbs as the threshold for casualties in commercial space launch safety analyses and with the ARC recommendation. The document further establishes 25 ft-lbs as a higher impact kinetic energy threshold for limiting fatalities due to blunt trauma. When modeling debris fragments and their impacts on unsheltered people, the RCC standard explains the impacts that transfer kinetic energy in the amount of 25 ft-lbs or less have a low probability of causing a fatality.

This research arose from criteria the RCC issued in 1999, which provided government and military Range Commanders a common approach to safety risk assessments.[67] These documents refer to the impact kinetic energy data in RCC Document 321-00 as the basis for calculating the casualty expectation criteria for unmanned aircraft operations at national test ranges. Using the probability of fatality data developed in RCC 321-00, the RCC determined casualty expectation criteria with the same data the FAA uses in this proposed rule to establish the impact kinetic energy thresholds.

Because the RCC impact kinetic energy thresholds are based on impacts from metallic fragments, the criteria does not take into account any potential loss of kinetic energy from non-rigid objects that can be shown to transfer only a portion of their total kinetic energy to person upon impact. The RCC thresholds presume all kinetic energy from a rigid object would transfer to a person upon impact. The ASSURE research, however, demonstrates that small UAS do not

[67] RCC Range Safety Group, Range Safety Criteria for Unmanned Vehicles: Standard 323-99 (1999); see also Range Safety Criteria for Unmanned Vehicles – Rationale and Methodology Supplement (1999).

always impact a person or surface in the same manner that metallic fragments impact them. The FAA proposal for using injury avoidance as a threshold, rather than an impact kinetic energy threshold alone, takes into account the disparity between impacts from metallic fragments and small unmanned aircraft. The performance-based standards the FAA proposes in this rule intend to encourage development of testing methodologies and other means of compliance that account for the transfer of kinetic energy that may occur upon impact from small unmanned aircraft.

With regard to analyzing the transfer of energy, the FAA considers impact kinetic energy thresholds established in the RCC standards as instructive. The RCC based its thresholds primarily on the assumption that inert debris exists in rigid form. Because kinetic energy depends on weight and speed, the human injury models of the RCC report recorded data of impacting fragments for various weights, such as one, 10, or 80 pounds. The resulting kinetic energy of these weights can be measured due to the changing velocity of the impacting fragments. For example, a lightweight unmanned aircraft flying at a certain speed could have the exact same impact kinetic energy as a heavier unmanned aircraft flying at a slower speed. Due to the variability in the kinematics of these systems, the FAA considers the transfer of this impact energy to be the determining factor for safe operations over people. For determining whether a means of compliance fulfills the safety levels the FAA proposes at §§ 107.115(b)(1) and 107.120(b)(1), the FAA will consider long-held science on which the RCC standards are based, as well as other analytical models that may be relevant at the time of the FAA's analysis.

Based on the foregoing, the FAA identified two existing impact kinetic energy thresholds that analyze public safety risk from commercial space launches, government space launches, and aircraft operations at national test ranges. The FAA concludes, based on the research cited above,

that a small unmanned aircraft that transfers no more than 11 ft-lbs of kinetic energy to a person on impact would have a low probability of causing a casualty to that person. Therefore, the FAA considers this rule's proposed standard for Category 2 to consist of the limitation of the results, or injury, that arise from a transfer of 11 ft-lbs of kinetic energy from a rigid object upon impact. Similarly, the FAA proposes setting the standard for Category 3 as limiting the injury to that of an impact of 25 ft-lbs from a rigid object because a small unmanned aircraft that transfers no more than 25 ft-lbs of kinetic energy to a person on impact would have a low probability of causing a fatality to that person. As discussed further below, the FAA also proposes standards for exposed rotating parts applicable to Categories 2 and 3 as well as operational restrictions for Category 3 operations.

(b) Measurements of Transfer of Energy

With regard to energy transfer, the FAA proposes setting the safety level in this rule as the limitation of injuries caused by the total kinetic energy transferred from a rigid object to a person upon impact, rather than the impact kinetic energy per unit area. The FAA acknowledges the ARC recommended the FAA adopt a measurement of J/cm^2 for the energy limitation aspect of this proposed rule, but declines to propose this measurement. This decision is the result of the fact that the contact area varies considerably, based on many factors (varying shapes of aircraft, size and positioning of the person, and so on). Further, the orientation of the aircraft at the time of impact will also greatly affect the contact area as well as the position of the person who is impacted. Impact kinetic energy thresholds alone consider neither the dimensions of the small unmanned aircraft nor the area of the small unmanned aircraft that makes contact with a person upon impact. Moreover, impact kinetic energy transferred to a person may result in blunt trauma

injuries. Thresholds specified in units of energy per area, such as J/cm^2, are used to measure the risk of non-lacerating, or "chunky penetration" injuries, not blunt trauma injuries.[68]

Manufacturers or others who do not seek to use an industry consensus standard may also present a manner of measuring energy transfer the FAA deems acceptable, via a custom means of compliance. Once the FAA accepts a means of compliance for measuring the transfer of energy that accounts for mitigating factors, such as dissipation or absorption of post-impact kinetic energy by the small unmanned aircraft, the FAA would consider the means as fulfilling the performance-based requirements of Category 2 and 3, respectively. As described below, manufacturers would then take advantage of the accepted means of compliance by declaring a particular make and model of small UAS they have manufactured fulfills the appropriate standard by submitting a declaration of compliance.

At present, no means of measuring exists to establish that a specific amount of energy equates with a likelihood of injury. Nevertheless, the FAA's adoption of a performance-based standard as a performance-based measurement should encourage development of various means of compliance to ensure small UAS do not present an unacceptable level of risk of injuring a person when operating over people. The FAA emphasizes further research is necessary on the subject of proper modeling of small unmanned aircraft impact physics as it correlates to human injury. From the variation of kinetic energy thresholds in the historical blunt trauma research, the FAA understands the rigidity of the small unmanned aircraft can have an effect on the impact dynamics, as seen when comparing small UAS data with rigid object data points. Additional

[68] Impact kinetic energy per unit area, such as J/cm^2 is the most appropriate means of measuring non-lacerating or "chunky penetration" injuries, not blunt trauma injuries. A4 Report at 83 (Table 30, comparison of energy densities and related metrics for chunky penetration).

research may suggest other ways of measuring injury that results from the transmission of energy upon impact.

The FAA seeks comment on whether establishing an impact kinetic energy threshold and using kinetic energy transferred upon impact is the appropriate method to measure the potential injury a small unmanned aircraft could cause upon impact with a person.

(c) Reduction in Likelihood of Injury

As noted above, the FAA uses the term "safety level" to refer to the limitation of injury severity caused by transfers of kinetic energy from a rigid object, exposed rotating parts, or safety defects. The FAA proposes to establish the safety levels set forth in Category 2 and 3 based on a risk assessment that does not attempt to predict the precise types or probability of injuries. A chain of events must occur for a small UAS to cause an injury. A Category 2 operation resulting in a low probability of casualty and a Category 3 operation resulting in a low probability of fatality assumes a small UAS would experience a failure during an operation over people and that it would impact a person. A one hundred percent chance that each of these events would occur is impossible. Therefore, the probability of injury such thresholds would present is uncertain.

This proposal also does not consider which part or section of a small unmanned aircraft impacts a person, but rather assumes the occurrence of the worst case in a typical failure mode. For example, the orientation of a small unmanned aircraft as it impacts a person might affect the amount of kinetic energy it transfers. Similarly, if the arm of a small unmanned aircraft is bendable or breakable and comes into contact with a person, the full energy of the impact might

not transfer to the person; therefore, that person may experience an injury of reduced severity. The FAA assumes that, to determine the maximum kinetic energy the small unmanned aircraft transfers upon impact with a person, the test would utilize the aircraft orientation likely to cause the most harm to the person. For example, the standard assumes the small unmanned aircraft would not impact the person at an angle or in a manner that curtails the fall of the small unmanned aircraft. The standard does not take into account these less hazardous orientations because a small unmanned aircraft's position at the time of impact with a person is unpredictable.

In addition, the FAA is aware that different parts of the human body have different vulnerabilities depending on the weight of the impacting object. The 11 ft-lbs and 25 ft-lbs thresholds for Category 2 and 3 consider these variations using data, analyses, and studies performed by the RCC. This threshold also considers these variations for all parts of the body for both adults and children, including when people are in various positions, such as standing, sitting, and prone.

The FAA seeks comment on methods, processes, or procedures used in the studies on which the FAA bases these proposed standards. In particular, the FAA invites comment on the costs associated with meeting these proposed standards, in light of such research. Collecting operational safety data for small UAS operations over people will assist in the FAA's evaluation of the effectiveness and continued applicability of the safety standards the agency proposes. The FAA also seeks comment on the need for a process, and the details of that process, to enable the FAA to reassess and possibly adjust the safety thresholds in this proposed rule based on such safety data. The FAA acknowledges the lack of certainty concerning failure rates and estimates

of injury severity based on failures. The FAA seeks specific information regarding methods used to deal with such uncertainty.

(2) Exposed Rotating Parts

Exposed rotating parts, which could cause lacerations or other serious injuries if these parts were to come into contact with a person, are a feature common to small UAS on the market today. Due to the hazards this feature can pose, the FAA has determined small UAS eligible for operations in Category 2 and 3 of this proposed rule must be designed such that they would not lacerate human skin upon impact with a person.

The ARC recommended manufacturers limit the risk of injuries caused by exposed rotating parts because energy transfer requirements alone would not mitigate this risk sufficiently. The ARC stated the analysis of exposed rotating parts should "focus on serious injury (level 3 or greater)" without any distinction based on the category of operation. Although the ARC used the term "exposed rotating parts" to identify any rotating part that could cause an injury, the most common example of this on a small unmanned aircraft is a propeller. In a multi-rotor unmanned aircraft configuration, propellers are generally arranged symmetrically around the periphery of the unmanned aircraft. In a fixed-wing unmanned aircraft configuration, propellers are generally arranged in either a puller (propeller in front) or pusher (propeller in back) configuration. These propellers generally spin at high speeds, and could cause injuries, even if on small unmanned aircraft.

The ASSURE study predicted that the severity of cutting or tearing injuries could be greater than impact injuries from existing rotorcraft designs on UAS.[69] The study indicated blade tip speed, blade sharpness, and leading edge sharpness may all significantly affect the potential for laceration of human skin from UAS blades. The ASSURE study clarified that all propellers can lacerate skin. Based on this research, the FAA concludes any small UAS that conducts operations over people should not have exposed rotating parts capable of lacerating human skin upon impact with a person. Manufacturers would need to ensure the small UAS fulfills this standard using a means of compliance the FAA accepts. This requirement would not apply to operations of small UAS that occur pursuant to Category 1. The FAA invites public comment, however, on the issue of whether operations of small UAS eligible to operate pursuant to Category 1 should be subjected to a performance-based requirement for exposed rotating parts.

The FAA is aware that exposed rotating parts could be capable of injuries beyond just lacerations. For example, injuries to hair, teeth or eyes, rather than skin, may occur. The FAA, however, considered carefully the proposed limitation on exposed rotating parts that could lacerate human skin and determined the prohibition on skin lacerations, combined with the limitation on transfer of kinetic energy on impact and prohibition of safety defects, will mitigate the risk of injuries that may not involve skin. Moreover, the FAA is keenly aware that permanently disfiguring injuries could result from lacerations of skin.[70] As a result, and based on

[69] A4 Report at 89.

[70] In this regard, the FAA's decision to ensure protection of skin from lacerating injuries is similar to the logic the National Highway Traffic Safety Administration employs. See Federal Motor Vehicle Safety Standards: Glazing Materials, 65 FR 44710, 44711 (July 19, 2000) (explaining NHTSA's decision to assess whether "advanced glazings" are more likely to cause lacerations than "current glass," and stating, "[a]lthough facial lacerations injuries are relatively minor (AIS 1 or 2), they … can be disfiguring").

the ASSURE research that highlighted the concern that exposed rotating parts present, the FAA proposes a general prohibition on such parts that could lacerate skin.

This proposal is the result of the agency's determination that any allowance for serious injury from exposed rotating parts would have a compounding effect and would add to the overall level of risk for Category 2 and 3 operations. The FAA concluded that this proposed standard of prohibiting lacerations of human skin would maintain the risk posed by Category 2 operations as a low probability of causing a casualty, and Category 3 operations as a low probability of causing a fatality. As described below, manufacturers would fulfill this standard by either providing descriptions of their test methodology and test data; analyses with substantiating data; or inspection information.

A manufacturer may establish it has fulfilled the limitation on exposed rotating parts by ensuring the small unmanned aircraft simply does not have parts that are exposed. For example, if the propellers that provide lift and thrust for the small unmanned aircraft are internal to the unmanned aircraft, such as in a ducted fan configuration, and are incapable of making contact with a person as a result of an impact, then the parts would not be exposed, and the aircraft would satisfy this proposed requirement. The FAA may require testing and analysis to conclude the rotating parts could not become exposed as a result of an impact with a person. For example, if the forces on the small unmanned aircraft during an impact with a person could cause structural failures that result in the rotating parts becoming exposed, then that design would not achieve the requisite safety level of this proposed rule. The FAA seeks comment on other means of compliance it could include in a final rule.

5. Means of Compliance

This rule proposes several performance-based requirements that would accommodate varying means of compliance. In this manner, the FAA would build flexibility into the regulations, which would allow the regulatory scheme to progress alongside the fast pace of small UAS innovation and development. Additionally, this rule would establish a process by which the FAA could expedite the acceptance of voluntary consensus standards as means of compliance with requirements related to impact kinetic energy and exposed rotating parts. This proposal would align with the direction of the Office of Management and Budget (OMB) Circular A-119, which favors the use of performance-based regulations and voluntary consensus standards. The FAA proposes to accept both voluntary consensus standards and non-consensus standards as means of compliance with the proposed performance-based requirements.

Given the current absence of voluntary consensus standards that could apply to operating small unmanned aircraft over people, the FAA is proposing one means of compliance for each proposed performance-based standard for operations over people, to allow interested stakeholders to begin demonstrating compliance as soon as this rule goes into effect. Additionally, the FAA is proposing a process by which it would approve additional means of compliance. A voluntary consensus standards body, an industry, a manufacturer, or an individual may develop these means of compliance. Each means of compliance, including the FAA's proposed means, would constitute one way, but not the only way, to satisfy the proposed performance-based standards. The FAA would consider other means of compliance as entities or individuals develop and submit them to the FAA for review.

a) Establishing Compliance

The FAA proposes to require a manufacturer producing a small UAS eligible for Category 2 or 3 operations to establish compliance with the proposed safety level by using a means of compliance the FAA has accepted. A manufacturer would then declare on its Declaration of Compliance what means of compliance, or combination of them, it used. This proposal sets forth three ways of establishing compliance: (1) the FAA-proposed means of compliance, discussed in this preamble; (2) an FAA-accepted means of compliance developed by a voluntary consensus standards body; and (3) an FAA-accepted custom means of compliance developed independent of either the FAA or a voluntary consensus standards body. A custom means of compliance would require more extensive review by the FAA than a means of compliance developed by a voluntary consensus standards body.

(1) FAA-Provided Means of Compliance

Under this proposed rule, any person may establish compliance with the applicable safety levels the FAA proposes in this rule in a variety of ways. The FAA must affirmatively accept the means of compliance before a manufacturer can rely upon it to demonstrate compliance. Because no means of compliance currently exist to address the requirements this rule proposes, the FAA proposes one means of compliance it would accept immediately, to allow manufacturers to demonstrate their small UAS would fulfill the level of safety the FAA proposes in this rule for operations over people. Section IV.B.5.c) provides a description of this means of compliance. The FAA may provide additional FAA-accepted means of compliance based on future research.

(2) Voluntary Consensus Standards Body Means of Compliance

A voluntary consensus standards body develops standards that incorporate openness, balance, due process, appeals process and consensus. These characteristics also necessarily result in voluntary consensus standards being peer reviewed. Because voluntary consensus standards bodies are composed of a wide selection of industry participants, and often include FAA participation, the FAA expects its review of a means of compliance developed by a voluntary consensus standards body to be more expeditious than a custom means of compliance developed in the absence of a voluntary consensus standards body.

The FAA has an extensive history of working with voluntary consensus standards bodies such as RTCA, ASTM International, Society of Automotive Engineers (SAE), and Institute of Electrical and Electronics Engineers (IEEE). In accordance with the ARC recommendation to use industry consensus standards for small UAS, and with the precedent already set for general aviation aircraft, the FAA anticipates voluntary consensus standards bodies to take the lead in offering means of compliance for FAA review.

(3) Custom Means of Compliance

The FAA proposes that a manufacturer or other person may propose a custom means of compliance to fulfill the safety level set forth in this proposed rule's impact kinetic energy or exposed rotating parts standards. As discussed further in this section, a custom means of compliance would be subject to a more comprehensive review than a means of compliance submitted by a voluntary consensus standards body. If a person proposes an alternate means of

compliance to the impact kinetic energy or exposed rotating parts requirements in the rule, or an alternate method to any FAA-accepted means of compliance, the FAA would evaluate the means of compliance on a case-by-case basis. A custom means of compliance would need to set forth a manner by which an applicant could comply with the impact kinetic energy and exposed rotating parts standards of § 107.115(b)(1) or § 107.120(b)(1), as applicable.

Applicants should consider carefully the additional time and effort that could be necessary to coordinate a new or alternate means of compliance when scheduling their projects. FAA coordination may require the efforts of FAA technical specialists, Chief Scientific Technical Advisors, and other government agencies. The use of existing FAA-accepted means of compliance would be more expeditious because the FAA has already reviewed them. Not all developers of custom means of compliance would be manufacturers who submit a Declaration of Compliance. The FAA, therefore, would provide a process by which an applicant could submit a custom means of compliance for FAA review separate from submitting a Declaration of Compliance. This process is described in further detail in Advisory Circular 107-2.

When reviewing a custom means of compliance, the FAA would utilize a comprehensive set of criteria. To demonstrate compliance with the impact kinetic energy or exposed rotating parts requirements, the FAA would determine whether the applicant has shown compliance by testing, analysis, or inspection that demonstrates the manufacturer has met the appropriate level of safety provided in the proposed standards. The FAA would also determine whether the custom tests or analyses are performed in accordance with accepted methods used by the medical industry, consumer safety groups, or other peer-reviewed test methods. In addition, the FAA would determine whether the proposed means of compliance required unreasonable skill on

behalf of the remote pilot in command or incorporation of mitigations to meet the standards. Lastly, the FAA would determine whether the means of compliance addressed design features such as deployable devices, parachutes, or other features. Those additional features would require the FAA's review to determine whether they assist in achieving an acceptable means of compliance when those features function as intended.

The FAA's proposed regulatory text in § 107.125 of this rule sets forth the information the FAA must receive in determining whether to accept the means of compliance. This information would ensure FAA oversight at a level that is appropriate for the risk operations of small UAS over people present. In addition, the model for ensuring compliance that the FAA proposes in this rule would also permit the FAA's adoption of an industry consensus standard that fulfills the applicable standard.

b) Submittal and FAA Acceptance of Means of Compliance

As described previously, manufacturers or industry stakeholders may establish compliance in a variety of different ways; however, the FAA must affirmatively accept the means of compliance before the manufacturer can rely on it for self-certification.

Any person may submit a means of compliance to the FAA for review. To submit a means of compliance, a person would be required to identify whether the manufacturer achieves compliance by way of test, analysis or inspection, and provide a detailed description of the means of compliance that establishes exactly how the testing, analysis, or inspection fulfills the safety level set forth in the standards of § 107.115(b)(1) or § 107.120(b)(1). The rule proposes requiring any person who submits such a custom means of compliance to provide any

substantiating data, studies, information, or the like to explain precisely how their proposed means of compliance achieves the safety level that the standards of § 107.115(b)(1) or § 107.120(b)(1) represent. For example, if a manufacturer would achieve compliance by conducting testing, then the manufacturer's request for the FAA's acceptance of the means of compliance should include test procedures that outline the test methodology, an analysis to support the equivalency of the testing to the safety level identified in § 107.115(b)(1) or § 107.120(b)(1), and all substantiating data that supports the test, methods, results, and conclusions. On the other hand, if a manufacturer seeks to achieve compliance by analysis, then the manufacturer should submit the standard to which the manufacturer compared his or her specific model of small unmanned aircraft and explain how the data and interpretation of it establishes that the manufacturer fulfills the applicable standard. For example, if the manufacturer has a simulation with modeling of the impact dynamics that the FAA has validated, then the FAA would evaluate the analysis that utilizes the impact dynamics data to confirm that the analysis establishes fulfillment of the standard. In sum, anyone may submit a variety of types of means of compliance using testing, analyses, inspections, or any combination of them, in seeking the FAA's acceptance of their means of compliance. As described previously, the FAA would more closely scrutinize custom means of compliance not submitted by a voluntary consensus standards body.

The FAA would indicate acceptance of a means of compliance by publishing a Notice of Availability in the *Federal Register* identifying the means of compliance as accepted and by sending a letter to the applicant accepting the proposed means of compliance. If a manufacturer referred to a custom means of compliance on its Declaration of Compliance, FAA acceptance of

that Declaration of Compliance would also indicate acceptance of the custom means of compliance.

Once the FAA has accepted a custom means of compliance, the FAA would consider it as equally valid as a voluntary consensus standard that the FAA had accepted. If the FAA did not accept a custom means of compliance, the FAA would notify the applicant of the rationale for its decision and would reject any associated Declarations of Compliance that rely on that particular custom means of compliance. For both custom means of compliance and voluntary consensus standards, the FAA could rescind a previously accepted means of compliance if the FAA determined from service history that the means of compliance did not meet the applicable standards for operations over people.

c) Types of Means of Compliance

This proposal provides latitude for people who request acceptance of a means of compliance to show compliance by testing, analyses, inspections, or any combination of the three. In all proposed means of compliance cases, the FAA would review data based on the worst-case scenario of a typical failure of the small unmanned aircraft. The applications for approval of proposed means of compliance that include data and relevant information regarding a reasonably foreseeable worst-case scenario will facilitate the most straightforward, efficient type of review from the FAA. In general, the FAA expects the amount of information needed to justify the proposed means of compliance will be proportionate to the complexity of factors relevant to both common and worst-case scenarios.

(1) Tests

Anyone may submit test data to show their small UAS fulfills the safety level the FAA proposes in this rule. The description below describes tests used for both a pre-accepted means of compliance based solely on the impact kinetic energy measurement, as well as tests used for an alternate means of compliance.

(a) Impact Kinetic Energy Transfer

As explained below, this proposed rule includes one potential means of compliance that manufacturers may use to declare compliance. For all potential means of compliance, the FAA expects manufacturers, during their testing, to install or enable any mechanisms that could affect the transfer of kinetic energy upon impact. For example, manufacturers must employ any systems that could limit the velocity of the small unmanned aircraft upon which the means of compliance relies. In such cases, the manufacturer should provide information on the proper use of those systems or equipment, as well as any restrictions, in the remote pilot operating instructions, as discussed in section IV.B.9.

The FAA anticipates a person who seeks to comply via a custom means of compliance would implement these types of systems or equipment through hardware, software, or a combination of both. If an operator can operate the small UAS regardless of whether these systems or equipment are enabled or installed, such as in a variable-mode small UAS, then the manufacturer should provide information in the remote pilot operating instructions to ensure remote pilots in command understand any restrictions or limitations associated with the different modes.

Pre-Accepted Means of Compliance

One means, but not the only means, of complying with the proposed limitation with regard to the transfer of kinetic energy upon impact would entail a manufacturer's calculation of kinetic energy transferred when a small unmanned aircraft impacts a person. This type of means of compliance would not account for impact dynamics or other factors, but consists of using only the formula the FAA describes to measure kinetic energy upon impact. Use of this formula alone would establish the small unmanned aircraft fulfills one of the standards described above because 11 ft-lbs (for Category 2 operations) and 25 ft-lbs (for Category 3 operations) are thresholds that establish low probability of occurrence of a casualty or fatality would exist, respectively.

This pre-accepted means of compliance would be based on the maximum performance capabilities of a small unmanned aircraft during a typical failure mode. To test a small unmanned aircraft using this means of compliance, a manufacturer would first determine the maximum forward airspeed that the small unmanned aircraft may attain at full power in level flight during typical environmental conditions. The manufacturer would use a reliable and accurate airspeed measurement method. For example, a manufacturer could measure the maximum speed using a GPS groundspeed indicator, a radar gun, or tape measure and stop watch. Next, the manufacturer would determine the ground impact speed resulting from an unpowered free-fall from the highest altitude the small UAS is capable of attaining at full power. The ground impact speed could be determined by performing a drop test from the altitude determined in the previous step using a

reliable and accurate vertical speed measurement method under typical environmental conditions.[71]

If a manufacturer determines it is unreasonable to perform a drop test from the highest attainable altitude, then the manufacturer may perform a drop test from a lower altitude sufficient to determine the small unmanned aircraft free-fall aerodynamic characteristics, such as the coefficient of drag, to calculate accurately the ground impact speed from a free-fall from the highest attainable altitude. The substantiating data the manufacturer would submit would include sufficient information concerning the environmental conditions and the maximum speeds the manufacturer utilized, as well as any unique test conditions for both the level flight and free-fall scenarios.

The above tests account for speeds a small unmanned aircraft could reach prior to or during a typical failure mode, such as losing power and falling with both a vertical and horizontal speed component. The tests do not take into account small UAS failure modes or pilot actions that would cause the small unmanned aircraft to exceed the speeds determined in the previous steps. One example is a powered descent in which the ground impact speed of the small unmanned aircraft exceeds its unpowered free-fall ground impact speed. The FAA assumes these types of failure modes or pilot actions are not typical, and while possible, have a low likelihood of occurring. If a manufacturer determines these types of failure modes or pilot actions could

[71] Small unmanned aircraft operated under part 107 may not exceed the speed limitations in part 107 unless authorized under a Certificate of Waiver or an exemption. See 14 CFR107.51(a) (stating the ground speed of the small unmanned aircraft may not exceed 87 knots (100 miles per hour)) and § 107.205 (listing § 107.51(a) as a provision that is subject to waiver).

typically occur and result in speeds greater than those determined in the previous steps, then the manufacturer should use higher speeds to determine the maximum impact kinetic energy.

Once the manufacturer determines the maximum speeds associated with a horizontal and vertical impact, the manufacturer would ascertain the highest combination of these speeds that he or she could achieve as a result of a reasonably foreseeable failure. These conclusions would lead to the manufacturer's determination of the maximum impact kinetic energy. In such a case, the manufacturer should use the highest combination of horizontal and vertical impact speeds unless he or she can show the highest combination is not possible in a reasonably foreseeable failure and another combination is therefore more appropriate. The manufacturer should assess reasonably foreseeable failures caused by system or equipment loss of function or malfunction as well as those that pilot error could cause.

To calculate the impact kinetic energy, manufacturers would use the following equation:

$$KE_{impact} = 0.0155 * w * v^2$$

where KE_{impact} is the maximum impact kinetic energy in ft-lbs, w is the weight of the small unmanned aircraft measured in pounds, and v is the maximum impact speed measured in feet per second (ft/s).[72]

[72] The FAA used the constant 0.0155 in order to allow a person to plug in the weight, rather than the mass, of a small unmanned aircraft. Using the following equations, KE = ½ *mass*velocity^2 and mass= weight/gravity, the FAA determined that, in English units, KE = ½ * weight/32.17 * velocity^2 and KE = ½ * (1/32.17) *weight* velocity^2 therefore KE = 0.0155 * weight * velocity^2. Note that 32.17 is the gravitational constant measured in English units.

For example, a small UAS that weighs 1.0 pound and has a maximum impact speed of 26 ft/s has a maximum impact kinetic energy of:

$$KE_{impact} = 0.0155 * 1.0 * (26)^2 = 10.5 \text{ ft-lbs}$$

Similarly, a small UAS that weighs 1.0 pound and has a maximum impact speed of 40 ft/s has an impact kinetic energy of:

$$KE_{impact} = 0.0155 * 1.0 * (40)^2 = 24.8 \text{ ft-lbs}$$

Utilizing the formula $KE_{impact} = 0.0155 * w * v^2$, the two tables below provide examples of maximum impact speeds, rounded to whole numbers, associated with the impact kinetic energy thresholds of the different categories and the weight of the small unmanned aircraft. One table provides speeds in feet per second and the other table provides speeds in miles per hour. Manufacturers could use these tables when following this proposed means of compliance based on the maximum performance of a small UAS. These tables do not consider any energy-absorbing characteristics of a small unmanned aircraft that may reduce the amount of energy transferred to a person during an impact.

Table 4: Maximum Impact Speeds (ft/sec) for a given weight and impact kinetic energy[73]

	Maximum speed (ft/sec)	
Weight (lbs)	**Category 2 (11 ft-lbs)**	**Category 3 (25 ft-lbs)**
1.0	26	40
1.5	22	33

[73] The values provided in Tables 4 and 5 are based on the factors summarized in footnote 75.

2.0	19	28
2.5	17	25
3.0	15	23

Table 5: Maximum Impact Speeds (mph) for a Given Weight and Impact Kinetic Energy

	Maximum speed (mph)	
Weight (lbs)	**Category 2 (11 ft-lbs)**	**Category 3 (25 ft-lbs)**
1.0	18	27
1.5	15	22
2.0	13	19
2.5	11	17
3.0	10	16

This proposed means of compliance does not account for the use or testing of design features such as parachutes, ballistic recovery systems, or other deployable devices that, once deployed, create drag to reduce the maximum impact speed. The discussion below, concerning custom means of compliance, addresses the potential use of such design features.

As discussed in section IV.B.7.b), if a remote pilot in command or other person modified a small unmanned aircraft in a manner that increases its maximum speed or weight beyond what is identified in the remote pilot operating instructions, then the small unmanned aircraft would no

longer fulfill the safety level set forth at § 107.115(b)(1)(i) or § 107.120(b)(1)(i). To conduct operations over people, a manufacturer would have to verify that the modifications satisfied the impact kinetic energy requirements by re-testing and submitting a new Declaration of Compliance for the modified small UAS.

Custom Means of Compliance

Under this proposal, any person may propose a custom means of compliance showing the small unmanned aircraft achieves the safety level the FAA proposes in § 107.115(b)(1) or § 107.120(b)(1). At the time of this proposal, the FAA has not identified a means available to determine the actual amount of kinetic energy that is transferred upon impact with a person. Nevertheless, research into this area is ongoing. Taking advantage of the opportunity to employ a customized solution that ensures compliance with the safety levels set forth in §§ 107.115(b)(1) and 107.120(b)(1), the manufacturer would request the FAA's acceptance of a means of compliance that establishes how the manufacturer has made this determination.

The structural configuration, materials of construction, or other design features may function to reduce the amount of the total kinetic energy that is transferred to a person from a small unmanned aircraft during an impact. The FAA's proposed means of compliance described above does not take into account the effect of these aspects during an impact with a person, because it assumes that the total kinetic energy of the small unmanned aircraft would be transferred to the person upon impact. In reality, however, the small unmanned aircraft may transfer much less energy. For example, the presence of energy-absorbing materials, or an energy-absorbing protective cage, may reduce the transfer of kinetic energy during an impact with a person. Under these circumstances, a manufacturer may wish to provide data showing the

amount of kinetic energy that is transferred to a person during an impact, based on the impact-absorbing characteristics of the small unmanned aircraft. In this regard, some small UAS manufacturers may seek to use design features such as parachutes or other deployable devices to establish that a reduced amount of transferred energy exists for their small unmanned aircraft. Such design features would require the FAA's review to determine whether they assist in achieving an acceptable means of compliance if the small UAS is reliant on the proper functioning of these features.

The means of compliance discussed in the preceding paragraphs should not be confused with the Declaration of Compliance discussed in Section IV.B.7.b), below. The testing or analysis conducted to determine the maximum kinetic energy that a small unmanned aircraft could transfer to a person upon impact during a typical failure scenario would be the actual means of compliance under this rule. The Declaration of Compliance would be the "evidence" or "artifact" that is the final step in demonstrating to the FAA that the small UAS is in compliance with this proposed rule.

(b) Exposed Rotating Parts

Anyone who seeks approval of a means of compliance may establish, using test descriptions, results, and data, that a small unmanned aircraft does not contain any rotating parts that could cause lacerations of human skin. An industry consensus organization could develop a standard for small unmanned aircraft that have rotating parts that are protected by safety features, such as propeller guards. The standard could require testing to support the determination that the protective safety features accomplish their intended function of preventing rotating parts from contacting a person during an impact. If the manufacturer has tested those safety features and

established they would remain intact during an impact, this could be one means of demonstrating that exposed rotating parts would not be capable of lacerating human skin. If a small unmanned aircraft has rotating parts that are exposed without any protective safety features, this rule proposes to permit manufacturers or others to show through testing, analysis or inspection that the rotating parts are not capable of lacerating human skin upon impact with a person. Manufacturers or others who seek to obtain approval of a means of compliance could submit testing results and data that consider the size, shape, rotational speed, material, and orientation of the rotating parts, and concludes that these parts could not cause lacerations under any impact scenarios.

The more sophisticated or complex the materials or design of the small unmanned aircraft, the more sophisticated the analysis or testing should be. If a small unmanned aircraft had propellers made out of soft, flexible material, a manufacturer would likely not need to employ a means of compliance that had used a sophisticated analysis or testing to demonstrate that the exposed rotating parts are not capable of causing a laceration. However, if a manufacturer chooses to design a small unmanned aircraft with exposed propellers that have sharp leading edges, are made of a rigid material such as a carbon fiber composite and are driven by high torque motors, that manufacturer would likely have to perform a more sophisticated analysis or testing to demonstrate that the propellers are not capable of lacerating human skin upon impact with a person.

Tests and associated data could also consist of utilizing exposed rotating propellers at maximum revolutions per minute (RPM) and contacting a medium that accurately represents human skin to establish the propeller would not lacerate human skin. Similarly, for shrouded

propellers, such a test would establish that the propellers, while turning, would not lacerate human skin. This test would establish the effectiveness of the shroud or covering in a dynamic impact scenario. Such a test may consist of a drop test or test using a pendulum to show the shrouds remain effective when the propeller did not lacerate the medium that represents human skin.

Further, in the exemplar test described above, the test data manufacturers or others submit would likely require a description of the skin media used to determine that the shrouded propellers did not lacerate human skin. Research that has led to the development of standards and analyses on the subject of laceration injuries includes the use of media such as a medium that is 10 percent gelatin,[74] a pig cadaver,[75] plasticine,[76] and a medium that may include chamois, among other components.[77] In this rulemaking, the FAA does not endorse any of the aforementioned media as substitutions for human skin. Rather, a manufacturer or industry consensus group that seeks acceptance from the FAA of a means of compliance for establishing exposed rotating parts would not lacerate human skin may provide test data, analyses, or information that employs one of the above media, or another medium. The FAA would review

[74] Nicholas and Welsch, Ballistic Gelatin 2, Pennsylvania State University Applied Research Laboratory, (2004), available at http://www.firearmsid.com/Gelatin/Ballistic%20Gelatin%20Report.pdf.
[75] Sullivan et al, The Pig as a Model for Human Wound Healing, The International Journal of Tissue Repair and Regeneration (2001); Simon and Maibach, The Pig as an Experimental Animal Model of Percutaneous Permeation in Man: Qualitative and Quantitative Observations An Overview, Skin Pharmacology and Physiology 13.5 at 229-34 (2000).
[76] Röhrich et al, Skin Injury Model Classification Based on Shape Vector Analysis, BMC Medical Imaging (2012), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3599354/.
[77] Bir, et al., Skin Penetration Surrogate for the Evaluation of Less Lethal Kinetic Energy Munitions, 220 Forensic Science International 126, 127 (2012), available at http://www.sciencedirect.com/science/article/pii/S0379073812000801?via%3Dihub.

the entire submission of information in order to determine whether the agency will accept the potential means of compliance.

(2) Analysis

A person may submit means of compliance that consist of analyses to establish they have achieved the level of safety set forth in § 107.115(b)(1) or § 107.120(b)(1). In general, the FAA envisions many proposed means of compliance could employ computer modeling analysis to comply with the energy transfer standard or the exposed rotating parts standard.

(a) Impact Kinetic Energy Transfer

A proposed means of compliance may involve the use of analyses to predict the amount of kinetic energy transferred upon impact with a person. For example, a person who submits a means of compliance for acceptance may seek to incorporate the aerodynamic effects (including drag) of the small unmanned aircraft in a dynamic model of impact with a person. The person could utilize computational fluid dynamics (CFD) and finite element modeling (FEM) into the simulation. Such a simulation would analyze the aerodynamic properties of the aircraft.[78] The model would calculate the interaction of the geometry of the object in a flow field of the medium. Further, the model may also simulate the dynamic interaction of the aircraft structure with a validated model of a person to calculate the amount of kinetic energy that is transferred.

The person who seeks FAA acceptance of the means of compliance would need to document the justification by including any analysis or validation testing. Such records should

[78] CFD, as used in the example above, refers to a simulation that incorporates Navier-Stokes equations in a mathematical and computational program that utilizes a multi-dimensional model of an object. Constantin and Fioas. Navier-Stokes Equations. Univ. of Chicago (1988).

establish validity of the aerodynamic modeling as well as any other modeling techniques used in the computation of impact kinetic energy values. Therefore, in evaluating the proposed means of compliance based on analysis, the FAA would expect submission of a full description of the process and an explanation of the precise effect of the aerodynamic or other characteristics that influence the flight envelope in which the small unmanned aircraft operates. As with all proposed custom means of compliance, the FAA would expect to evaluate information and data concerning the worst-case scenario of a typical failure, combined with mean data that depicts common scenarios within the aircraft's flight envelope.

(b) Exposed Rotating Parts

A person may also choose to confirm that exposed rotating parts on the small unmanned aircraft they have manufactured would not lacerate human skin by submitting analysis. Such analysis could include verified data from relatable studies that models the small unmanned aircraft's propellers at a maximum RPM, and the material choice of the propeller and strength characteristics of an average human's skin in an FEM simulation,[79] and performs a finite element analysis (FEA)[80] to determine the laceration characteristics of the propeller. In such a case, the FAA would expect the justification related to this method to explain the rationale for concluding

[79] FEM, as used in the example above, refers to the utilization of multi-dimensional model of an object that subdivides the model into smaller components with attached algebraic equations to help represent complex geometry and the dynamics associated to such geometry during simulated stresses or impacts.

[80] FEA, as used in this example, is a numerical analysis of a system to simulate the impact dynamic reaction when developed with the material and design characteristics of the small unmanned aircraft and surrounding objects that are relevant to the analysis. Manufacturers may use FEA in computer modeling by using boundary value problems for partial differential equations and variation methods from calculus disparities to approximate a solution using algebraic equations attached to small, subdivided pieces of the model and by minimizing an associated error function.

that the use of the previously accepted data and FEA methodology is appropriate for the small UAS design at issue.

(3) Inspection

Manufacturers may also opt to confirm that the small UAS they have manufactured would fulfill the safety level set forth in this proposed rule by submitting information based on inspection. The FAA would expect a full description of the inspection and the results or conclusions from that inspection in order to accept the means of compliance. Often, manufacturers may use the inspection option when a small UAS has undergone modifications.

(a) Impact Kinetic Energy Transfer

For purposes of establishing that the kinetic energy a small unmanned aircraft transfers upon impact does not exceed the applicable standard, a manufacturer may submit records to establish the manufacturer has performed an inspection verifying that the small UAS adheres to the standard. For example, a small UAS model the FAA has previously determined fulfills the standard may continue to do so after a modification when the manufacturer has simply replaced a part on the small unmanned aircraft that weighs less than the original part. The manufacturer would provide justification to verify the new part does not alter the small unmanned aircraft such that it would increase the kinetic energy the small unmanned aircraft transfers upon impact. In this example, the manufacturer would present information to establish that the overall weight and structure of the small unmanned aircraft did not change to render it out of compliance with the applicable standard regarding energy transfer.

(b) Exposed Rotating Parts

In addition, a manufacturer's design with propeller blade guards to fulfill the prohibition on exposed rotating parts may lend itself to a verification of the means of compliance by way of inspection. For example, a manufacturer with a previously accepted means of compliance who wishes to replace or upgrade propellers could do so with a propeller design of the same size, fit and weight that has fulfilled the previously accepted means of compliance, and thus demonstrate compliance through inspection means and not need to retest or perform another analysis. When the manufacturer has completed previous tests the FAA had verified demonstrated the effectiveness of blade guards, the Administrator may presume replacement of propellers would not have an effect on the function of the guard to prevent laceration.

6. Aircraft with Variable Modes and Configurations

Although this rule proposes three distinct categories of operations over people, the FAA proposes to allow small UAS to be configured to conduct operations within more than one category. For example, an aircraft may be designed in such a way that it would be qualified to conduct Category 2 operations in one mode or configuration, and Category 3 operations in another mode or configuration. Alternatively, a small UAS could meet the requirements to operate over people in one mode or configuration, but not in another. For example, an aircraft could operate within the restrictions of an operation over people, but could also operate using higher performance characteristics when not operating over people.

To transition between various modes or configurations, a manufacturer may choose to use a variety of methods, such as software-enabled performance limitations including altitude or

groundspeed limitations, hardware configurations, or any combination thereof. Using different modes or configurations, a manufacturer could design a small UAS to meet the performance capabilities of multiple categories of operations over people. Additionally, a manufacturer could design a small UAS that has removable propeller guards or cages that would need to be installed for operations over people but could be removed when not operating over people.

The design of a small UAS should not permit a remote pilot to change the mode or configuration inadvertently. Regardless of whether the method of transitioning between various modes or configurations involves software or control station selections, a change of mode or configuration must result only from a deliberate action on the part of the remote pilot in command. For example, a remote pilot in command could be required to enter a passcode that would intentionally alter the mode of operation, thereby switching the category of operation for the aircraft.

To test a small UAS with multiple modes or configurations, a manufacturer should test the small UAS in the mode or configuration that allows the small UAS to meet the requirements for the category to which a manufacturer wishes to declare compliance. If a small UAS could meet the requirements for operations in both Category 2 and Category 3 based on the mode or configuration in which the small UAS is operated, then the manufacturer must submit to the FAA a Declaration of Compliance that includes each category for which the manufacturer has tested or analyzed the small UAS.

The FAA seeks comment on the need for means of compliance that address incorporation of software, including software updates or changes, to enable performance limitations, variable modes, or variable configurations to meet the safety level proposed in this rule. The FAA also

seeks comment on how the FAA should review an acceptable means of compliance for the impact kinetic energy or exposed rotating parts safety thresholds to address the appropriateness of using software to limit or establish the small UAS performance to meet the safety level proposed in this rule.

7. Declaring Compliance

The FAA agrees with the ARC recommendation that self-certification is the appropriate method for manufacturers to declare compliance with a performance standard. Self-certification, combined with the FAA's determination that the means of compliance the manufacturer has used is acceptable, will ensure the small UAS meets the appropriate safety level the FAA proposes in this rule. In addition, the FAA's other proposed measures for overseeing manufacturers, as described in section IV.B.12, below, would result in a level of oversight and accountability the FAA has determined is appropriate for manufacturers of small UAS that certify eligibility to operate over people in accordance with this proposed rule.

a) Applicability to Manufacturers

In this proposed rule, the FAA would consider a manufacturer to be any person or entity that designs, produces, or modifies a small UAS that is eligible to operate over people within the United States under part 107. The FAA expects the most common form of manufacturer under this proposed rule would be an entity that produces and sells a complete and operable small UAS.

Additionally, an entity that sells a kit that contains all the components and parts from which to build an operable small UAS would be considered a manufacturer. The kit would

contain all the components necessary to build the small UAS and would not require the owner to purchase any additional materials to meet the requirements of this proposed rule. A kit manufacturer would be required to test the assembled, completed small UAS, rather than its component parts, to demonstrate the small UAS satisfies the standard for Category 2 or 3 operations.

A person who builds a small UAS from parts not provided as a kit would also be a manufacturer under this proposal. For example, anyone may purchase the component parts of a small UAS separately and build small UAS themselves. The FAA would consider such a person to be a manufacturer, and would require submission of a Declaration of Compliance regarding the eligibility of the small UAS to conduct Category 2 or 3 operations.

A manufacturer would also be a person who modifies a small UAS covered under an existing Declaration of Compliance to a condition that is non-compliant with the original declaration. “Non-compliant” means the small UAS has been altered such that it no longer matches the configuration that was originally declared. Any person who makes this kind of a change would be required to submit a new Declaration of Compliance for the modified configuration(s) prior to conducting operations over people within that category. Not all modifications would cause a previously determined small UAS to become non-compliant, however. A manufacturer may include a list of acceptable modifications in the remote pilot operating instructions to ensure that a remote pilot in command who may replace parts or otherwise modify the small UAS is aware of which modifications would allow it to remain compliant in the category to which compliance has been declared.

Additionally, a manufacturer may be a person who modifies a small UAS to be compliant with one or more categories of operations over people. For example, this would include a person who modifies a small UAS not previously eligible to conduct operations over people to a small UAS that is eligible to conduct Category 2 or 3 operations over people. Similarly, a person who modifies a small UAS that was previously qualified to conduct only Category 2 operations so that it may now conduct only Category 3 operations, by, for example, increasing the weight of the small unmanned aircraft, would be a manufacturer. The manufacturer identified on the most recent FAA-accepted Declaration of Compliance would not carry the responsibility for the new configuration of the small UAS that is the subject of the Declaration. Instead, the person who made the modification assumes the role of the manufacturer. A person making such modifications and still seeking to operate over people would have to first submit a new Declaration of Compliance.

The FAA would not consider a person performing maintenance on a small UAS, including replacement of components and parts in accordance with the manufacturer's maintenance or operating instructions, to be a manufacturer as long as the maintenance or replacement does not alter the configuration or characteristics of the small UAS such that it no longer meets its Declaration of Compliance. As a result, such a person would not need to submit a new Declaration of Compliance. For example, if a manufacturer provides replacement propellers with instructions on how to install them, someone could install the parts in accordance with the manufacturer's instructions. If the manufacturer, however, does not provide or identify propellers in the remote pilot operating instructions with specific maintenance instructions, the

owner could inadvertently become a manufacturer by virtue of replacing those propellers with different replacement parts.

The FAA applies the term manufacturer as described in this section for the purposes of proposed subpart D of part 107 only. For example, a UAS manufacturer that holds a type certificate (TC) or production certificate (PC) would not be a manufacturer under this proposal because the regulatory oversight for a TC/PC holder is codified at 14 CFR part 21. Rather, this discussion applies only to manufacturers of non-type-certificated or non-production-certificated small UAS who declare compliance with the standards of either Category 2 or Category 3 for operations over people.

b) Declarations of Compliance

For a small UAS to be eligible to conduct Category 2 or 3 operations over people, this proposed rule would require a manufacturer to declare compliance with the impact kinetic energy and exposed rotating parts standards applicable to aircraft eligible to conduct Category 2 or 3 operations demonstrated through an FAA-accepted means of compliance. The manufacturer would do this by submitting a Declaration of Compliance via an electronic form available on the FAA's website. For Category 1 operations, manufacturers would not be required to submit a Declaration of Compliance.

By submitting a Declaration of Compliance, a manufacturer would also certify that it 1) established and maintained a process to notify owners of small UAS and the FAA of any unsafe conditions that render those small UAS non-compliant with proposed subpart D, 2) would correct any safety defects the FAA identified, and 3) would allow the Administrator to inspect its

facilities, technical data, and any manufactured small UAS and witness any tests necessary to determine compliance with this subpart. As explained below in section IV.B.7.b)(4), a manufacturer would be permitted to label its small UAS for Category 2 or 3 operations after it receives notification of acceptance of its Declaration of Compliance from the FAA.

(1) Contents of Declaration of Compliance

The proposed Declaration of Compliance would be an electronic form available on the FAA's website. A manufacturer interested in labeling a small UAS as eligible for Category 2 or 3 operations over people would submit a Declaration of Compliance to the FAA. A completed Declaration of Compliance would include information the Administrator would require for both determining that a small UAS complied with the regulation and tracking those models of small UAS that were declared compliant with the regulation. A manufacturer would declare compliance with the safety level established by the impact kinetic energy and the exposed rotating parts standards and include the following information:

- Means of compliance used,
- Name of the manufacturer,
- Physical address of the manufacturer,
- Email address of the manufacturer,
- Small UAS make and model
- Serial number or range of serial numbers for the small unmanned aircraft (open-ended are permitted), and

- Whether the Declaration of Compliance was an initial or an amended Declaration of Compliance.

In the event a manufacturer is re-submitting the Declaration of Compliance, the manufacturer would be required to include the reason for such re-submittal. For example, the re-submittal could be to correct a safety defect, or it could be to correct the misspelling of the manufacturer's name or an incorrect address.

The FAA would make information contained in Declarations of Compliance publicly available. By posting the Declarations or otherwise making the information in the Declarations publicly available , the FAA and the public would be able to determine which make and model of small UAS are eligible to conduct Category 2 and 3 operations over people.

(2) Declaring Compliance for Multiple Small UAS with the Same Make and Model

The FAA understands that manufacturers who are producing the same make and model of small UAS on a large scale may not wish to perform individual unit testing to demonstrate that each small UAS meets the requirements of this proposal. The FAA would encourage these manufacturers to establish and maintain a production quality system and design configuration control system to provide for consistent repeatability. Such a system would provide increased confirmation that each individual small UAS meets the requirements of the category of operations for which the manufacturer declared compliance, so that a manufacturer could avoid testing every unit it constructed. If a manufacturer utilizes a quality assurance system, the FAA

would remain confident that each unit subsequently manufactured would comply with the proposed impact kinetic energy, exposed rotating parts, and safety defects standards.

(3) Multiple Categories of Operation

This proposal would also allow a manufacturer to design a small UAS that could meet the performance requirements of multiple categories of operations over people. If a manufacturer conducts testing or engages in analysis or inspection to determine a small UAS could meet the requirements for operations in both Category 2 and Category 3 in the appropriate modes or configurations, the small UAS manufacturer would need to submit only one Declaration of Compliance to the FAA. On that Declaration of Compliance, the manufacturer would identify the categories of operation for which it determined the small UAS was compliant, and the means of compliance used for each category.

(4) FAA Acceptance of Declaration of Compliance

This proposed rule would require a manufacturer to provide information on its Declaration of Compliance regarding whether it has used an FAA-accepted means of compliance or a custom means of compliance the FAA has not yet accepted. A manufacturer would label its small UAS for Category 2 or 3 operations once it receives notification of acceptance of its Declaration of Compliance from the FAA. Once the FAA accepts a Declaration of Compliance, the FAA would make the Declaration of Compliance, or information from the Declaration, publicly available.

If a manufacturer uses a custom means of compliance that the FAA has not yet accepted, the FAA must review and accept the means of compliance before it accepts the Declaration of

Compliance. This could result in additional review time prior to acceptance of the Declaration of Compliance. The FAA would notify the manufacturer upon its decision regarding acceptance of the custom means of compliance and Declaration of Compliance.

(5) Modifying a Small UAS and Resubmitting a Declaration of Compliance

Any person who modifies a small UAS in a way that could affect the eligibility of the small UAS to operate over people under Category 2 or Category 3 of this proposed rule would be required to submit a new Declaration of Compliance before the small UAS could be operated over people. This requirement would not apply to those situations in which an individual performs a modification that the manufacturer identifies in the remote pilot operating instructions as an allowable change or modification for that small UAS, as discussed in section IV.B.9. When a manufacturer seeks to submit a Declaration of Compliance for a small UAS that was not previously eligible for operations over people, however, the FAA would undertake the same review process to verify the small UAS fulfills the performance-based standards described previously.

The requirement to submit a new Declaration of Compliance would ensure any small UAS operated under this framework meets the applicable requirements for operations over people. In this way, the FAA would have the ability to track the responsible manufacturer as well as any modifications that the small UAS may undergo during its lifetime. For these reasons, the FAA would require any person who modifies a previously declared small UAS to take on the responsibilities of a manufacturer and submit a new Declaration of Compliance if the modification took the small UAS outside the configuration originally declared.

(6) Rescission Process

Under this proposed rule, the FAA would rescind a manufacturer's Declaration of Compliance if the agency becomes aware that a small UAS for which a manufacturer has declared compliance is no longer qualified for operations over people. The FAA is proposing new procedural rules, described below, to govern any action to rescind a Declaration of Compliance. Therefore, the FAA's rules under 14 CFR part 13 would not apply.

(a) Notification of Safety Issues

The FAA proposes in § 107.135(c) that it would notify the manufacturer when the FAA becomes aware of a safety issue that could affect a manufacturer's Declaration of Compliance, either because the small unmanned aircraft is not compliant with the exposed rotating parts or kinetic energy standards, or because the small UAS has a safety defect as described in sectionIV.B.11.a). If a safety issue arises in which the small UAS no longer fulfills the safety level set forth in this proposed rule, either by way of a safety defect, material, component, or feature on the small UAS, then the manufacturer must notify the FAA. At that point, the manufacturer would have the opportunity to discuss the potential safety issue with the FAA. As a result of such a discussion, the FAA may determine that a safety issue does not actually exist, that the manufacturer has incorporated an adequate mitigation to address and correct the safety issue, or that a safety issue still exists.

(b) Proposed Rescission of a Declaration of Compliance

If the FAA determines, as a result of the discussion described above, that a safety issue remains unaddressed, the FAA would send the manufacturer a notice of proposed rescission of a Declaration of Compliance. The notice would set forth the agency's basis for the proposed rescission and provide the manufacturer 10 business days to submit evidentiary information to refute the proposed notice of rescission.

(c) Notice of Rescission of a Declaration of Compliance

After receiving a proposed notice of rescission, a manufacturer may provide information demonstrating the small UAS meets the requirements of this part within 10 business days. If a manufacturer fails to establish that a safety issue does not exist, or if the manufacturer fails to respond within 10 business days, the FAA would issue a notice rescinding the Declaration of Compliance. At this point, the FAA would publish this rescission. The FAA would also specify on its website for which category the Declaration of Compliance has been rescinded. Remote pilots in command would not be permitted to operate the particular small UAS over people if the FAA has rescinded the Declaration of Compliance.

If the FAA rescinds a Declaration of Compliance as a result of a safety issue, a manufacturer would be able to modify the small UAS such that the safety issue is resolved, at which point the manufacturer could submit a new Declaration of Compliance. The FAA would

review the new Declaration of Compliance and notify the manufacturer of whether the FAA has deemed it acceptable.

(d) Petition for Reconsideration of a Rescission of a Declaration of Compliance

Once a Declaration of Compliance is rescinded, a manufacturer would have the opportunity to petition the FAA for reconsideration. A manufacturer seeking reconsideration under this rule must petition the FAA within 60 days of the date of issuance of the notice of rescission. The petition would have to show: 1) the lack of a material fact in the original response to the notification of the safety issue, and address why that fact was not present in the original response; 2) an important factual error existed in the decision to rescind the Declaration of Compliance; or 3) the FAA did not correctly interpret a law, regulation, or precedent. The FAA would consider this petition and issue a final agency decision either affirming or withdrawing the rescission of the Declaration of Compliance. A manufacturer could appeal the final agency decision as provided in 49 U.S.C. 46110.

(e) Emergency Rescission of a Declaration of Compliance

Prior to rescission of a Declaration of Compliance, the FAA would typically initiate the safety issue notification process with the manufacturer as discussed previously. However, if the Administrator determines an emergency exists and safety of persons on the ground requires an immediate rescission of a Declaration of Compliance, the FAA may exercise its authority under

49 U.S.C. 46105(c)[81] to issue an emergency order rescinding a Declaration of Compliance. Under these circumstances, rescission would go into effect immediately, prior to the FAA initiating the notification process or the rescission procedures described above. The order would remain in effect until the basis for issuing the order no longer exists. The emergency order would be considered a final agency decision; as such, a manufacturer may appeal the decision as provided in 49 U.S.C. 46110 following the issuance of the order.

8. Recordkeeping Requirements

This proposed rule would require manufacturers maintain small UAS records related to their Declarations of Compliance for a minimum of two years after ceasing production. The FAA also proposes to require manufacturers to retain the substantiating data for a custom means of compliance for as long as the means of compliance remains accepted. In the event of a safety defect, or if the FAA initiated an action against a manufacturer, this information would be critical to determine the cause, scope, and severity of the defect or infraction. The FAA requests comment on the appropriateness of this proposed amount of time for record retention.

For a Declaration of Compliance that uses an accepted means of compliance, the manufacturer would keep substantiating data that includes a description of the method used to demonstrate compliance as well as the results. Specifically, if the manufacturer established compliance by testing, the manufacturer would retain detailed information on the test method

[81] When the Administrator determines that an emergency exists related to safety in air commerce and requires immediate action, the Administrator may issue an immediately effective order to meet the emergency, with or without notice. 49 U.S.C. 46105(c).

and the results used to demonstrate the small UAS meets the applicable impact kinetic energy and exposed rotating parts standards.

For a custom means of compliance submitted independently of a Declaration of Compliance, the submitter would keep:

- Test procedures that outline the test methodology (if the manufacturer established compliance by testing);
- An analysis or record of inspection to establish the equivalency of the means of compliance to the safety level identified in this proposal; and
- Substantiating data that supports the test (if applicable), methods, results and conclusions.

This information would likely include details on the method and the results the submitter used to demonstrate the small unmanned aircraft meets the applicable impact kinetic energy and exposed rotating parts standards. Substantiating data could include detailed information on whether the testing or analysis was done consistent with accepted methods used by the medical industry, consumer safety groups, or other peer-reviewed test methods. Such information should also indicate whether the proposed means of compliance required unreasonable skill or mitigation to meet the requirements.

For a Declaration of Compliance that uses a custom means of compliance that requires direct FAA review, a manufacturer would keep both the records for its Declaration of Compliance and its custom means of compliance, as discussed above. The FAA may require access to that information in several types of situations. For example, if the FAA rescinded a

Declaration of Compliance, it may request the original set of substantiating data from a manufacturer if a manufacturer elects to correct the safety issue and submit a new Declaration of Compliance for the same small UAS. Upon resubmittal, the FAA would likely require all substantiating data from prior to the identification of the safety issue, as well as supporting data after anyone had made modifications. Additionally, if a manufacturer submitted a Declaration of Compliance and identified a custom means of compliance the FAA had not previously accepted, the FAA would require the manufacturer to submit substantiating data to facilitate the FAA's review of the means of compliance.

9. Remote Pilot Operating Instructions

In order to operate a small UAS safely over people, the remote pilot in command would be responsible for knowing what category of operations his or her small UAS is eligible to conduct, and what technical and operational limitations apply to the operations. Accordingly, the FAA proposes to require manufacturers to provide remote pilot operating instructions with product-specific information related to operations over people that would occur in Category 2 or Category 3.

This proposed requirement is consistent with the ARC's recommendation. Specifically, the ARC recommended small UAS manufacturers provide operating manuals to the operators of the small UAS that would include operating instructions for Category 2 and 3 operations.[82] The ARC did not provide any information regarding the contents of the operating manual, leaving

[82] ARC Report at 7-8. The FAA uses the term "remote pilot operating instructions" in this proposal in lieu of the ARC's suggested term of "operating manual," to avoid confusion with manned aircraft flight manuals.

that determination to future voluntary consensus standards. The ARC recommended the FAA require the operator to comply with the operating manual.

This rule proposes to require manufacturers to provide operating instructions upon sale, transfer, or use of the aircraft by someone other than the manufacturer. This requirement would apply to anyone who is a manufacturer for the purposes of this proposed rule, as described above in section IV.B.7.a). In addition, the manufacturer would be required to keep the instructions up-to-date to account for any changes it makes to an aircraft over time.

Specifically, the FAA proposes in §§ 107.115(b)(3) and 107.120(b)(3) that the remote pilot operating instructions include, at a minimum, the following information:

- General information, including system description and system limitations, and the category or categories of operations over people for which the manufacturer of the small UAS has declared compliance;
- If modifications of the small UAS can occur, those modifications the manufacturer has determined do not bring the small UAS out of compliance with the category declared; and
- If the small UAS has variable modes or configurations, information regarding those modes or configurations.

Existing regulations require remote pilots to conduct a preflight inspection and ensure that the small UAS is in a condition for safe operation.[83] These existing regulations would

[83] The remote pilot in command must check the small UAS to ensure it is in a condition for safe operation prior to each flight. 14 CFR 107.15(a). Further, no person may continue flight of the small unmanned aircraft when he or she knows or has reason to know that the small UAS is no longer in a condition for safe operation. § 107.15(b).

continue to apply to operations over people conducted under the terms of this proposed rule. The additional information contained in the remote pilot operating instructions would serve to inform a remote pilot in command of the characteristics of the small UAS, which in turn would assist the remote pilot in conducting his or her preflight check and ensuring the small UAS is in a condition for safe operation prior to conducting a Category 2 or 3 operation.

Manufacturer-required components that make up the small UAS must be listed in the remote pilot operating instructions to help the remote pilot ensure that all components of the small UAS are present. This is necessary because, if a small UAS is missing any components, the small UAS would not comply with the category of operations over people for which the manufacturer declared compliance. A manufacturer must also clarify the category or categories of operations over people for which the small UAS is eligible.

The FAA proposes requiring in §§ 107.115(b)(3)(ii) and 107.120(b)(3)(ii) that a manufacturer include in the remote pilot operating instructions all modifications the manufacturer has determined would not change the ability of the small UAS to meet the requirements for the category of operation for which the manufacturer declared compliance. The FAA acknowledges that modification of a small UAS is a routine event for some remote pilots. Some modifications may not change the flight characteristics of the small unmanned aircraft; for example, replacing one camera with another that has the same weight and size but better optics.

Section 107.49(a) requires that, prior to flight, the remote pilot in command must 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 becoming aware of: (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. The preflight assessment must also include verification that all control links between the ground control station and the small unmanned aircraft are working properly. 14 CFR 107.49(c). Finally, § 107.49 requires that, if the small UAS is powered, the remote pilot in command must ensure that there is enough available power for the small UAS to operate for the intended operational time.

However, changing small unmanned aircraft components such as propellers or other articles necessary for flight may change the flight characteristics of the small unmanned aircraft, and could potentially change the small UAS eligibility to conduct operations over people.

The modifications described in proposed §§ 107.115(b)(3)(ii) and 107.120(b)(3)(ii) could consist of adding or exchanging products and evaluating them based on characteristics such as weight, size and shape. For example, a manufacturer could list certain makes and models of payload cameras, or provide weight and size limits along with a generic shape description. A remote pilot would then be able to switch out any payload cameras that meet the described parameters and continue to operate over people. The manufacturer would have to ensure, through an accepted means of compliance, that the small UAS with the included modifications would remain in compliance with the performance-based requirements for the applicable categories of operations. If a person modified a small UAS in a manner not included in the remote pilot operating instructions, the small UAS may no longer comply with its associated Declaration of Compliance. This is because if a person changed anything related to design, performance, coefficient of drag, or energy-absorbing materials, the original test results or analyses concerning the transfer of impact kinetic energy could change, and such alteration could change the category of operations or cause the small UAS to exceed the applicable standard. The same principle would apply concerning the presence of exposed rotating parts. Therefore, should a person make a modification that is not listed in the remote pilot operating instructions, the FAA would consider that person as the new manufacturer of the small UAS, and would require compliance with manufacturer requirements to operate the aircraft over people.

The remote pilot operating instructions must also state whether the small UAS has modifications that will change the determination of the small UAS fulfilling the standard for the category of operation the small UAS is eligible to conduct. For example, a manufacturer may add an interchangeable camera to the small unmanned aircraft that would affect the small unmanned aircraft's eligibility for operating over people in Category 2 or 3 operations.[84] By this proposed rule, the FAA would require the manufacturer to inform remote pilots of the effect of such options to the extent the exercise of those options may affect compliance with the applicable standards. Without this information, a person could change the flight characteristics of the small unmanned aircraft and make it non-compliant with Category 2 or 3 requirements.

For a small UAS that has variable modes or configurations, the FAA would require a manufacturer to provide instructions on how to verify what mode or configuration the small UAS is in, and how to switch between modes or configurations. This information would facilitate a remote pilot's verification that his or her small UAS is in the correct mode or configuration to conduct a certain category of operations over people. Similarly, if a remote pilot chooses to operate in a different category of operations over people, or in a mode or configuration that is not permitted for operations over people but is permitted under part 107, he or she could consult the remote pilot operating instructions to determine how to change the mode or configuration to the desired settings.

[84] As discussed in section IV.B.5.b), manufacturers must submit a declaration of compliance that identifies a means of compliance the FAA has accepted. When verification of compliance assumes the presence of a component affixed to the aircraft, the FAA must receive information concerning this because it would likely affect the mass of the small unmanned aircraft.

The FAA would not require the manufacturer to provide remote pilot operating instructions in a particular format. For example, a manufacturer could choose to provide the operating instructions as part of the packaging of a small UAS, make them available electronically, or provide them in some other way. Manufacturers with products currently on the market would be free to choose whether to incorporate the instructions into existing materials, or they could create a new set of instructions that are specific to operations over people. For products in production before this rule is finalized but subsequently declared to be in compliance and eligible for operations over people, the manufacturer would be responsible for developing remote pilot operating instructions and making them available to remote pilots and owners. The FAA would not prescribe the method for making the instructions available, but acknowledges publishing them online would be an efficient and effective way.

Although the FAA does not propose requiring the remote pilot operating instructions to contain information in addition to the items enumerated above, the FAA encourages small UAS manufacturers to provide additional operational information to remote pilots. Examples of such information appear in Advisory Circular 107-2, which accompanies this NPRM.

10. Labeling Requirements

The FAA proposes to require that manufacturers label any small unmanned aircraft that are qualified for Category 2 or 3 operations over people. Such labeling would assist the FAA in its oversight role by providing a simple and efficient way to determine whether an operation is consistent with this proposal. In addition, it would provide notice to the remote pilot of which category of operations he or she is eligible to conduct using that aircraft.

In its report, the ARC recommended a manufacturer of a small UAS "label the product or product retail packaging in accordance with industry consensus standards,"[85] and that the operator be responsible for knowing the category in which his or her small UAS qualifies to operate. Therefore, the operator would presumably know which operating limitations he or she must follow. The proposed labeling requirement would assist the FAA in its oversight role because it provides an efficient means for an inspector to evaluate whether an operation is consistent with the category or categories of operation the small UAS may conduct. Because Category 3 operations would entail unique operating limitations, the label on small unmanned aircraft eligible to conduct Category 3 operations would indicate to the remote pilot that he or she must adhere to the applicable operating limitations.[86]

The FAA is not proposing a specific location for label placement due to the numerous design variations of small unmanned aircraft. In the case of very small unmanned aircraft, manufacturers may need to exercise creativity in determining the location best suited to satisfying the proposed labeling requirement. Labeling a non-critical surface would likely prevent wear and removal during normal operations.

The FAA declines to propose a prescriptive labeling requirement that specifies exactly how a manufacturer must label an aircraft, what size font to use, and so on. Due to the large variety of small UAS models that exist, such a prescriptive requirement would be unnecessarily

[85]ARC Report at 10.

[86] The labeling requirement this rule proposes is not the sole means by which a remote pilot in command will be aware of the operating limitations applicable to Category 3 operations. Remote pilots in command must maintain awareness of updated regulations, as required by proposed §§ 107.73(a) and 107.74(a) in this rule. As a result, initial knowledge testing and recurrent training implemented after the effective date of a final rule implementing this proposed rule would include operations over people as a subject area on both the test and training.

limiting for manufacturers. Instead, a manufacturer could label the aircraft by any means as long as the label is in English, legible, prominent, and permanently affixed to the aircraft. For example, a manufacturer could use the following labels: “Category 2”, “Category 3”, “Cat. 2”, or “Cat. 3”.

Given that a small UAS could be qualified to conduct more than one category of operations, the FAA proposes requiring a manufacturer label the small UAS with each category of operations the small UAS is qualified to conduct. For example, a small UAS qualified to conduct Category 2 operations may also be qualified to conduct Category 3 operations. The manufacturer would label such a small UAS with each category, as follows: “Cat. 2, 3” or “Category 2, 3”. The label could be painted onto, etched into, or affixed to the aircraft by some other permanent means.

Some small UAS manufactured prior to final publication of this rule may qualify for a category of operations over people. In a situation in which a manufacturer declared a previously existing make/model of small UAS eligible for Category 2 or 3 operations and has provided remote pilot operating instructions as described in section IV.B.9., the remote pilot could then label that small unmanned aircraft in accordance with the Declaration of Compliance.

In addition to the proposed requirement that a manufacturer label the aircraft, the FAA also proposes requiring a remote pilot ensure his or her small unmanned aircraft is properly labeled before conducting any operations over people. A clear and legible label will enable a remote pilot, an inspector, or a member of the public to identify the types of operations a small UAS may conduct. If a label degrades such that it is no longer legible or attached to the aircraft, the remote pilot is responsible for providing a new label before operating over people. The

proposed labeling requirement would apply regardless of whether a person obtains a small UAS directly from a manufacturer or as a subsequent transfer. No pilot would be able to operate the small UAS over people unless he or she verifies the label meets the requirements of this rule.

11. Manufacturer Accountability

After a manufacturer has declared that a specific small UAS fulfills the standard of a particular category, this proposal would require the manufacturer to monitor the small UAS to ensure it complies with the requirements of this subpart. Specifically, a manufacturer should monitor the validity of the means of compliance used to ensure the continued fulfillment of the safety level the standards at §§ 107.115(b)(1) and 107.120(b)(1) establish. The manufacturer should also track the construction, related safety analysis, and service history to ensure they do not reveal any hazardous conditions or safety defects that could increase the risk of a small UAS operation over people. Moreover, the manufacturer has a continuing obligation to ensure that the remote pilot operating instructions satisfy the regulatory requirements. To satisfy these obligations, a manufacturer may have to monitor its manufacturing processes, small UAS operational usage, and collection of accident and incident data. Manufacturer monitoring could also include information that owners and operators of the small UAS provide. Should the FAA identify a safety issue that warrants review of a manufacturer's data, records, or facilities, a manufacturer would be required to grant such access.

a) Safety Defects

The FAA proposes to require that a manufacturer build a small UAS qualified to conduct Category 2 or 3 operations such that it does not contain any safety defects. For the purposes of

this proposal, a safety defect refers to a material, component, or feature on a small UAS that increases the likelihood that the small UAS could cause a casualty or fatality to a person during an operation over people. Under this proposal, a safety defect would cause a small UAS to exceed a low probability of causing a casualty (Category 2) or a fatality (Category 3) to a person during an operation over people. For example, exposed wires or hot surfaces on a small unmanned aircraft could cause electrocution or burns to a person upon impact. Many small unmanned aircraft utilize lithium polymer or lithium-ion batteries as the primary energy source; damaged or defective batteries could cause casualties from battery fires or explosions. Sharp edges or projections on a small unmanned aircraft could cause lacerations or puncture wounds as a result of an impact with a person. As small UAS designs evolve over time, potentially hazardous features or characteristics, unknown at the present time, could emerge.

The FAA would identify safety defects through a variety of means. The FAA may receive consumer complaints, industry safety bulletins, or an individual manufacturer's notification that a safety defect has arisen. Once the FAA has formally identified a safety defect, it would notify the manufacturer of the defect. The manufacturer would have an opportunity to respond by either correcting the defect or demonstrating the small UAS does not contain any materials, components, or features that increase the probability of casualty or fatality for the category of operations for which the manufacturer declared the small UAS as compliant. If the manufacturer is unable to demonstrate the small UAS does not contain any safety defects, the FAA may initiate proceedings to rescind the manufacturer's Declaration of Compliance.

As an ongoing requirement, manufacturers would be responsible for correcting any safety defects they identify after manufacturing the small UAS, to ensure continued qualification for

Category 2 or 3 operations. In the event the FAA rescinds a Declaration of Compliance, no small UAS covered by that declaration could operate over people. The small UAS could resume operations only after the FAA reinstates acceptance of the Declaration of Compliance, accepts an amended Declaration of Compliance, or accepts a new Declaration of Compliance that applies to that small UAS. Either the original or a subsequent manufacturer could submit a new Declaration of Compliance in accordance with this proposed rule.

The FAA would publish any final rescission of a Declaration of Compliance on the FAA website, and may publish notification of the safety defect in the *Federal Register* as a Notice of Availability. These actions would serve two purposes: first, to notify remote pilots that the identified aircraft are no longer safe to conduct operations over people and second, to put manufacturers on notice not to incorporate the material, component, or feature into any future small UAS a manufacturer wishes to qualify for Category 2 or 3 operations over people without appropriate mitigations. The FAA notes the rescission of a Declaration of Compliance would not render a small UAS inoperable, but rather only unsafe for operations over people. The FAA seeks comment on whether this process provides sufficient opportunity for notice and comment for manufacturers aside from those whose products the safety directive directly implicates, and whether the process provides the public sufficient opportunity for notice and comment.

If the FAA rescinds a Declaration of Compliance, the FAA would publish the applicable makes and models of small UAS that are no longer eligible to operate over people. Remote pilots would be required to refrain from using those aircraft to operate over people until the manufacturer institutes an acceptable correction. To correct a safety defect, a manufacturer could develop a correction and test the aircraft to ensure the aircraft does not increase the probability of

causing a casualty or fatality when operated over people with the correction. The manufacturer would then submit a new Declaration of Compliance to the FAA identifying the means of compliance the manufacturer used to correct the safety defect.

Alternatively, the owner or remote pilot of a small UAS may elect to correct a safety defect associated with his or her aircraft. Should any person choose this option, he or she could submit a Declaration of Compliance to the FAA identifying the means of compliance used to correct the safety defect. That person, by means of modifying the small UAS such that it is again in compliance with the operation over people requirements, would become the manufacturer of his or her specific small UAS, and would assume all responsibilities that apply to manufacturers under this proposal.

b) Public and FAA Notification Process

This proposed rule would require a manufacturer to certify on its Declaration of Compliance that it has established a process to notify the public and the FAA if the manufacturer identifies an issue with its small UAS that would render the small UAS ineligible for operations over people. Reporting a safety defect to the FAA would not automatically result in the rescission of a Declaration of Compliance. The FAA would evaluate the report and correspond with a manufacturer to determine whether taking corrective action or rescission would be appropriate.

A manufacturer must notify the FAA of any safety issues it identifies. Reporting such issues would both assist the FAA in discovering product hazards and identifying risks of injury the FAA could address through direct communication with manufacturers, publication of Notices

of Availability in the *Federal Register*, or education. Manufacturers' reporting would provide a timely and effective source of information about small UAS because manufacturers often learn of potential product safety problems at an early stage. For this reason, this proposed rule would require manufacturers to develop a system for maintaining and reviewing information about their products that might identify when their product may have a defect that increases the probability of causing injury during operations over people. Such information would include, but is not limited to, consumer complaints, warranty returns, insurance claims or payments, product liability lawsuits, reports of production problems, product testing, or other critical information concerning their products.

Subsequent to manufacturers' discovery of noncompliance, this rule would require manufacturers notify the FAA and the public of the existence of the safety defect. Manufacturers' notification to the FAA should describe the nature of the noncompliance and how the manufacturer plans to address it. As stated above, such notification would not automatically result in the rescission of the Declaration of Compliance, but would involve the FAA corresponding with manufacturers to resolve the issue to ensure safety.

Notification to the public and owners of that make/model would also be a critical step in ensuring continued safety. Such notification could take the form of a notice on a manufacturer's website, electronic notification to owners who have registered the small UAS with the manufacturer, or an update to the small UAS software advising the remote pilot of the change in status. The FAA encourages manufacturers to exercise diligence to ensure the intended audience receives communications involving any potentially non-compliant conditions. In this regard, the FAA encourages manufacturers to design and utilize a system that would facilitate

communication between the manufacturer and the owners of the small UAS and would successfully inform members of the public at large. In general, the FAA contends potential consumers and the public have an important interest in being aware that proximity to a particular small unmanned aircraft may pose an undue hazard.

c) Falsification

As defined in this proposal, a Declaration of Compliance would be a record submitted by a manufacturer for a small UAS that certifies the small UAS is eligible for operations pursuant to Category 2 or Category 3 under subpart D of this part. Records are subject to compliance with the falsification provisions of the existing terms of § 107.5. These provisions prohibit any fraudulent or intentionally false record from being made, kept, or used to show compliance with any requirement of part 107. Accordingly, falsifying any part of any record intended to constitute proof of compliance with manufacturer requirements under this proposal could subject the person who submitted the record to a civil penalty, and would be a basis for rescinding a Declaration of Compliance.

d) Access to Facilities

Under this proposed rule, a manufacturer must grant the FAA access to its facilities upon the FAA's request as described in § 107.7, to validate compliance with this subpart. As part of a manufacturer's Declaration of Compliance, the manufacturer would agree to allow the FAA to inspect its facilities, technical data, and any manufactured small UAS and witness any tests necessary to determine compliance with this subpart. Some occurrences may necessitate facility

inspection. For example, facility access would likely become necessary when the FAA and the manufacturer are working together to address a safety defect.

e) FAA Publication of Status of Declarations of Compliance

The FAA proposes making available on the FAA website the status of each manufacturer's Declaration of Compliance for public access to enable remote pilots to determine which small UAS (by make, model, serial number, and/or category declared) are eligible for operations over people. If the FAA rescinds a Declaration of Compliance, the FAA would notify the public of the rescission and would identify the small UAS associated with the rescinded Declaration of Compliance as no longer eligible for operations over people. In this way, remote pilots would be aware of whether the model of small UAS they are utilizing was eligible for operations over people.

12. Operational Requirements and Remote Pilot Restrictions

The FAA proposes to include in § 107.49 a requirement that a remote pilot ensure he or she is using a small UAS eligible to conduct an operation over people. This verification would need to occur as part of the pre-flight inspection. Advisory Circular 107-2 would include updates with suggestions concerning the pre-flight procedures a remote pilot could follow to be compliant with this proposed rule.

As a general matter, the FAA acknowledges pilot experience may be relevant in determining whether the operation of a small UAS qualified to operate in either Category 2 or 3 adheres to the safety level the FAA contemplates in this proposed rule. In this regard, the ARC recommended that remote pilots conducting operations over crowds be required to have more

training or experience than other pilots, but did not recommend specifically what such training or experience would involve. The FAA sees value in an experience requirement, however, at this time, lacks information and data to assess how much training or time piloting a particular aircraft is warranted. In order to gather information on what mitigations would be appropriate, the FAA requests comments on the following questions: To conduct operations over open-air assemblies using a small unmanned aircraft that can transfer up to 25 ft-lbs kinetic energy to a person upon impact, should the remote pilot-in-command have additional skills, experience, or currency beyond what part 107 currently requires? If so, what kind of skill, experience, or currency should be required (e.g., minimum time operating the small UAS to be used, minimum number of take offs and landings, etc.)? How should that skill, experience, or currency be documented? The FAA will consider carefully all input it receives on this topic.

To conduct Category 1 operations, § 107.110 would require a remote pilot to ensure the small unmanned aircraft weighs 0.55 pounds or less on takeoff and for the duration of the flight, including everything that is on board or otherwise attached to the aircraft. To confirm a small UAS aircraft is eligible to conduct Category 1 operations, a remote pilot could weigh the aircraft. To conduct Category 2 and 3 operations, §§ 107.115(a) and 107.120(a)(1) would require a remote pilot in command to use a small UAS that is qualified and labeled to conduct those operations.

To confirm a small UAS is eligible to conduct Category 2 or 3 operations, a remote pilot must ensure an FAA-accepted Declaration of Compliance exists for his or her small UAS. A situation may occur in which a small UAS previously eligible for operations over people in either Category 2 or Category 3 would either no longer be compliant with the standards with

which compliance was declared or would be ineligible for such operations due to rescission of the Declaration of Compliance that previously applied to it. The remote pilot would have to verify the flight eligibility status of his or her small UAS.

a) Distances from People

The FAA declines to propose that the remote pilot maintain a specific minimum distance from people during small UAS operations because the existing requirements of part 107, combined with the new proposed subpart D, provide a sufficient manner of mitigating risks. Part 107 already requires the remote pilot to ensure the small UAS operation does 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.[87] In addition, a prescriptive minimum distance from people is not appropriate; for some operations, such a distance may be too burdensome, and for others, it might be too conservative. The FAA acknowledges, however, that the ARC recommended a "small UAS must be operated at a minimum distance of 20 feet above people's heads, or 10 feet laterally away from people" for Category 2 and 3 operations.[88]

Section 107.19(c) requires the remote pilot in command to ensure the operation will not pose any undue hazard to other people, other aircraft, or other property in the event of a loss of control of the small UAS. The FAA believes § 107.19(c), as a performance-based requirement, allows a remote pilot in command to determine what specific stand-off distance (if any) is appropriate to the specific small unmanned aircraft and operation that he or she is conducting. To determine this stand-off distance, the preamble of the 2016 final rule stated that a remote pilot

[87] See §§ 107.19(c), 107.23(a), 107.31(a)(4) and 107.49(a)(3).
[88] ARC Report at 11.

should consider the small unmanned aircraft's course, speed, and trajectory to determine whether the small unmanned aircraft would go over or impact a person who is not directly involved in the flight operation (uninvolved person).[89] To comply with §§ 107.19(c), 107.23(a), 107.31(a)(4), and 107.49(a)(3), therefore, a remote pilot conducting operations over people would likely consider several factors when making the determination of a stand-off distance from uninvolved people, all of which the remote pilot must tailor to the intended operation.

The FAA has not received information to demonstrate that a prescriptive stand-off distance would provide a safety benefit beyond complying with part 107's current requirements; therefore, the FAA maintains the position it articulated in the 2016 final rule. Due to the large variety of operations and types of small UAS that exist, and consistent with the mitigations in part 107, the importance of providing flexibility to the remote pilot outweighs any benefit of having a prescriptive standard.

The remote pilot is best suited to determine what distance would be safe and thereby ensure operation of the small UAS would pose no undue hazard to other aircraft, people, or property in the event of a loss of control of the aircraft for any reason. For example, a remote pilot might factor in the traffic along nearby roads, current and forecasted weather conditions, the likelihood of people gathering or transiting under or near the flight path, and property located in or near the flight path. The remote pilot would use this information, in addition to his or her knowledge of the performance of the small UAS under normal operating conditions and probable

[89] 81 FR 42064, 42129. In addition, § 107.23(a) prohibits operating a small UAS "in a careless or reckless manner so as to endanger the life or property of another." Section 107.31(a)(4) requires that the remote pilot in command maintain an ability to see the aircraft and make a determination that the unmanned aircraft does not endanger others. Section 107.49(a)(3) requires the remote pilot in command to conduct a preflight assessment of the risk to persons and property, factoring in their locations.

failure modes such as lost link, fly-away, and power failure, to identify a suitable horizontal and vertical distance from people and property to ensure the small UAS operation would not create an undue hazard. These distances may include an area around people and property.

The FAA requests comment on the following question: Does a prescriptive standard exist for a minimum vertical or horizontal distance that would apply equally across a large variety of operations and aircraft and that would provide a safety benefit that outweighs the importance of allowing the remote pilot the flexibility to assess each unique situation? The FAA further requests data to support any comments identifying a prescriptive standard.

b) Prohibition on Operations Over a Moving Vehicle

Part 107 currently prohibits the operation of a small UAS over a moving vehicle in the absence of a waiver. The FAA established this prohibition because the moving vehicle operating environment is dynamic, as the remote pilot in command cannot control it directly. In addition, the potential forces that would result when a small unmanned aircraft impacts a moving vehicle on a road pose unacceptable risks due to head-on closure speeds. For example, the impact kinetic energy of a small unmanned aircraft on a person who is moving at 40 miles per hour on a motorcycle would be much greater than on a person who is stationary. Impact with a small unmanned aircraft may also distract the driver of a moving vehicle and result in an accident.

The FAA is considering, however, allowing the operation of small UAS over moving vehicles in absence of a waiver. The agency seeks public comment on whether it should take this action, in this or a future rulemaking. The most useful comments on this issue will include data on whether operations over moving vehicles would either increase or decrease safety risks,

including distracted driving or other hazards to traffic. The FAA encourages commenters to include information, with supporting data, on how to mitigate any risks they identify.

c) Restricted Areas of Operation

Due to the increased risk of injury associated with the higher impact kinetic energy threshold, the FAA proposes restricting the areas where Category 3 operations may occur. This rule would permit small UAS eligible for operations in Category 3 to fly over people only when the operator conducts the operation over a closed- or restricted-access site and when people with access to the site have been notified that a small unmanned aircraft may fly over them. In the alternative, if the operation was over people not within a closed- or restricted-access site, the small UAS operating in Category 3 must not sustain flight over one or more people during its operation. For example, small UAS conducting operations pursuant to Category 3 would be limited to transient flights over people unless the operation occurs in a closed- or restricted-access site in which the people within the site have received notice. Moreover, unlike Categories 1 and 2, all Category 3 operations would be prohibited from occurring over open-air assemblies of people.

For Categories 1 and 2, the FAA proposes to permit operations at any location, in accordance with the other requirements of this proposed rule, part 107, and any other applicable laws and regulations. The absence of any restrictions on the location of Category 1 or 2 operations is due to the fact that these categories present a low risk of injuring people. A small UAS qualified to conduct Category 1 or 2 operations could operate over open air assemblies and in public spaces with no applicable restrictions.

In its report, the ARC recommended the FAA prohibit flight over crowds or dense concentrations of people for ARC Category 3 operations. The ARC also stated:

> Category 3 UAS may only operate over people if: (1) the operation is conducted over a closed- or restricted-access work site with the permission of the site's owner or operator; or (2) overflight of people is limited to those who are transient or incidental to the operation, i.e., the overflight of people is incidental to the operation and is not sustained.[90]

Compared to Categories 1 and 2, Category 3 operations under this proposed rule present a higher likelihood of causing a casualty by blunt trauma. In this regard, Category 3 operations could utilize heavier, faster, or higher-operated small UAS. Permitting Category 3 operations would allow for continued and uninterrupted operation at a site, minimize disruption of normal site operations, and limit situations that could compromise the site's operational safety. Examples of closed- or restricted-access sites over which Category 3 operations could be conducted include, but are not limited to:

- Agricultural fields in which workers are conducting agricultural operations;
- Bridge inspections that include workers who may be conducting inspection or construction activities;
- Filming operations that include movie set location employees, such as caterers, set designers, and actors; and
- A wedding in which access is available only to guests and a small UAS is conducting aerial photography or filming operations.

[90] ARC Report at 4.

Based on the increased risk associated with Category 3 operations, the FAA proposes to prohibit operating over open-air assemblies of people, as well as the other restrictions described above. The FAA proposes allowing Category 3 operations at closed- or restricted-access sites because the general public would be unable to access the site. In this regard, a closed- or restricted-access site would permit access to those involved in the activity that occurs on the site, but not to the general public. Those people who are permitted access to the closed- or restricted-access site could be advised of precautions or other recommended actions to ensure safety during a small UAS operation.

The FAA would expect a remote pilot to ascertain whether a site is closed- or restricted-access prior to conducting Category 3 operations under this provision. A remote pilot could accomplish this by identifying sites that restrict access to the general public through, for example, public notices and signage, flagging and barricading, erecting temporary fencing, or providing escorts, as appropriate. Remote pilots would be responsible for monitoring activity during the small UAS operation to ensure access to the site remains closed or restricted. Remote pilots must control vehicle and pedestrian access routes onto the site to prevent inadvertent or unauthorized entry of persons onto the closed- or restricted-access site.

In addition, this rule proposes to require that a remote pilot verify that people with access to the closed- or restricted-access site were provided notice that a small UAS may operate over them within the site. The FAA anticipates this notice will enhance the situational awareness of the people over whom the operations will occur. For the purposes of this proposal, actual notice could include a written notice posted at the entry point to the restricted area. When a person receives a letter or contract stating small UAS operations may occur over him or her, this would

serve as sufficient actual notice, no matter the amount of time that passes between receipt of the information and the small UAS operation. By this proposed rule, the FAA encourages operators to provide verbal notice in addition to the written notice in cases in which a verbal notification is necessary to ensure the information is received and understood. The remote pilot would not have to be the person who provides the notice, but he or she must ascertain people below the small unmanned aircraft have received notice before conducting a Category 3 operation over a closed- or restricted-access site.

Alternatively, Category 3 operations could take place outside a closed- or restricted-access site as long as the small unmanned aircraft does not maintain sustained flight over a person who is not directly involved in the operation. This requirement would prohibit holding above, or maintaining sustained flight above, any part of any person during a Category 3 operation that occurs outside a closed- or restricted-access site. This would include hovering above any person's head, flying back and forth over a person, or circling above an uninvolved person in such a way that the small unmanned aircraft remains above some part of that person. The intent of this proposed requirement is ensuring only momentary exposure to any one person occurs for Category 3 operations.[91] Overall, restricting Category 3 operations from maintaining sustained flight over people enhances safety by reducing the likelihood of injury by limiting protracted duration of a flight over a person or persons.

[91] The FAA considers "exposure," to mean the amount of time during which the small unmanned aircraft would be in a position over or a near a person in which, if it were to experience a failure, it would likely impact the person. For example, in the event a person is lying down, this rule would not permit a small unmanned aircraft to maintain sustained flight over any part of that person.

The ARC suggested permitting flights to occur only over uninvolved people who may loiter beneath the aircraft. The FAA declines to adopt such a suggestion because doing so would place a heavy burden on the remote pilot to anticipate constantly a person's actions during an operation, which could affect the remote pilot's ability to operate the small UAS safely, as the obligation may present a distraction.

In some circumstances, it may not be possible for a small unmanned aircraft to take off and land inside a closed- or restricted-access site. The proposed requirements for Category 3 operations would allow for takeoffs and landings to occur outside the site and transition to the site to conduct the desired operation provided the aircraft does not maintain sustained flight over uninvolved persons when outside the site.

13. Provisions Applicable to Existing Small UAS

The FAA recognizes a significant number of small UAS have already been sold and are operating in the NAS under part 107. Some remote pilots and manufacturers of small UAS may wish to use existing small UAS to conduct operations over people. The FAA does not seek to preclude existing small UAS from conducting these operations, and recognizes the economic benefits of not requiring current owners of small UAS to procure new aircraft solely for the purpose of operations over people when existing aircraft may fulfill the proposed safety level of this rule.

Accordingly, manufacturers of existing small UAS may follow the procedures in this proposed rule to establish the eligibility of their small UAS to operate over people. Once a manufacturer has demonstrated through an FAA-accepted Means of Compliance that the existing

small UAS meets the safety levels in this proposed rule, it would submit a Declaration of Compliance establishing compliance with the proposed requirements in §§ 107.115(b)(5) and 107.120(b)(5). A manufacturer would identify those small UAS to which the declaration applied by listing the aircraft serial numbers on the Declaration of Compliance submitted to the FAA. Once submitted, the FAA would handle a Declaration of Compliance for an existing small UAS in the same manner it proposes to handle a Declaration of Compliance submitted for a newly manufactured small UAS. A manufacturer would also be responsible for developing remote pilot operating instructions for the existing aircraft, and making those instructions available to remote pilots or owners of the small UAS.

The FAA emphasizes this proposal would require a manufacturer make the remote pilot operating instructions available; the FAA does not propose requiring a manufacturer to locate owners or remote pilots operating these small UAS and provide the instructions personally to them. Rather, if a remote pilot owns an existing aircraft that a manufacturer has identified on a Declaration of Compliance as eligible for Category 2 or 3 operations, and the remote pilot intends to conduct operations over people using that aircraft, the remote pilot would be able to access the remote pilot operating instructions if the manufacturer posted them online.

Finally, the FAA proposes the remote pilot be permitted to label an existing small unmanned aircraft, not previously labeled, in accordance with the labeling requirements of this rule. The FAA recognizes that requiring a manufacturer to contact all remote pilots of a particular make and model of small UAS and provide labels to those persons would be unreasonable. However, the option for a remote pilot to label the aircraft would not preclude a manufacturer from making a label available, either as a website download or for cost, which a

remote pilot could then affix to the aircraft. A remote pilot could choose to label his or her existing aircraft in any manner that meets the requirements of the regulations.

C. Waivers

In the 2016 final rule, the FAA noted its process to integrate UAS is ongoing. As such, the FAA decided to proceed with an incremental approach, which included waiver authority in the regulatory text of part 107 to permit new technologies and unique operational circumstances that part 107 may currently restrict. The FAA does not propose any changes to the existing waiver process in part 107. The FAA proposes, however, to amend 14 CFR 107.205 to allow waivers for specific types of operations over people this proposal would otherwise limit, as well as to allow waivers for the anti-collision light requirement that applies to operations at night and during civil twilight.

1. Prohibition on Operations Over a Moving Vehicle

This proposal would allow small UAS operations over people in moving vehicles through the part 107 waiver process. Although this rule does not address mitigations concerning the types of risks associated with operating a small UAS over a person located in a moving vehicle, the FAA would allow these operations if a waiver applicant is able to demonstrate that these operations can be conducted safely pursuant to the terms of the certificate of waiver. As stated above, the FAA does not propose altering the prohibition on operating over a moving vehicle in this NPRM, but seeks comments on this topic.

2. Operations Over People

While this proposal would enable certain routine operations over people, other operations would remain prohibited. For example, operations using small UAS that exceed the Category 2 or 3 thresholds for kinetic energy transfer would remain prohibited. Under current regulations, an operator that wishes to conduct prohibited operation over people may request a waiver under § 107.205(g). The FAA does not propose to change that provision. Operators seeking to operate over people, but beyond the limits of this rule's requirements, would be able to request a waiver under § 107.205(g).

Some operators of small UAS may seek a waiver of more than simply the operational restrictions applicable to Category 3. For operations over people that would occur, for example, in an aircraft that does not achieve the safety level the FAA proposes in this rule, the FAA may consider an application for waiver of the proposed prohibition of § 107.39. The FAA anticipates such applications would consider the rationale the FAA has provided in this proposed rule, in an effort to understand the FAA's views on the acceptable level of risk, as well as the agency's expectations with regard to safety of operations over people. As such, the FAA would continue to scrutinize applications for waiver of § 107.39 in light of the agency's risk-based decision-making process, and determine whether any waiver application fulfills the waiver application requirements. In this regard, the FAA expects any person who seeks a waiver of § 107.39 would present a unique risk assessment of the intended area of operation that proves the operation

would either present a de minimis risk or that the operator's proposed limitations or provisions would mitigate the risk sufficiently.[92]

D. Remote Pilot in Command Requirements

Since promulgating part 107, the FAA determined that certain amendments to part 107 would enhance clarity as well as consistency with other FAA regulations. As a result, this rule includes a proposal to add to § 107.7 the requirement for remote pilots to present their remote pilot in command certificate with small UAS rating, as well as a form of identification, to authorized individuals upon request. Lastly, this rule proposes permitting remote pilots to maintain currency of their remote pilot in command certificates by participating in recurrent training, rather than knowledge testing.

1. Presentation of Remote Pilot in Command Certificate

Section 107.7 ("Inspection, testing, and demonstration of compliance") requires a remote pilot in command, owner, or person manipulating the controls of a small UAS to present to the Administrator, upon request, the remote pilot certificate with small UAS rating and any other document, record, or report the regulations of this chapter require. This proposed rule will align the text of § 107.7 with 14 CFR 61.3(l), which requires pilots to present airman certificates upon request.

[92] For example, one waiver for operations over people included a small unmanned aircraft that only weighed 18.5 grams, while another waiver relies primarily on containment of the operational environment and conclusions regarding reliability of the small unmanned aircraft, which weighs 8 kg. or 17.7 lbs. See Waiver No. 107W-2016-00993A (May 3, 2017) and Waiver No. 107W-2017-03788 (Sept. 25, 2017). In both cases, the FAA first assessed the risks, then provided mitigation measures sufficient to address the level of risk that the operation presented.

The FAA proposes amending § 107.7 to require remote pilots to present their remote pilot in command certificates to the Administrator, authorized representatives of the National Transportation Safety Board (NTSB) or Transportation Security Administration (TSA), or any Federal, State, or local law enforcement officer, upon request from any such officials. As noted above, § 61.3(l) includes a parallel requirement for airman certificates, medical certificates, and other similar documents, along with photo identification. When the FAA promulgated 14 CFR § 61.3(l), the agency cited security concerns regarding the identification of pilots as the primary impetus for the requirement. 67 FR 65858 (Oct. 28, 2002). The same rationale applies to remote pilots. Law enforcement officials, the Administrator, and the NTSB and TSA must be capable of correctly identifying remote pilots in command in the event that an operation raises security concerns or issues concerning safety in the NAS. Such a provision will enhance the ability of other government agencies and officials to conduct timely investigations in the interest of ensuring safety and security pursuant to their authority.

The FAA proposes requiring presentation of both the remote pilot in command certificate and one of the types of identification the remote pilot could use to establish his or her identity at a knowledge testing center. Section 107.67(b) states a person's application for a knowledge test must include proof of the applicant's identity that contains the person's photograph, signature, date of birth, and permanent mailing address. This proposed requirement would apply equally to remote pilots who hold a certificate under 14 CFR part 61 and obtained their remote pilot certificate by fulfilling the requirements of § 107.61(d)(2).

2. Changes to Knowledge Testing Framework

Following the implementation of part 107, the FAA re-evaluated its testing requirements for remote pilots. This proposed rule would amend the knowledge testing framework by requiring remote pilots to complete recurrent training, rather than pass knowledge tests, to maintain a current remote pilot in command certificate with small UAS rating.

a) Recurrent Knowledge Testing and Training

The FAA maintains the current initial testing requirement to evaluate a remote pilot's knowledge for operating in the NAS is critical, given the absence of a requirement for a practical test or proficiency course in obtaining a remote pilot certificate. The FAA proposes requiring recurrent training every 24 months, in lieu of recurrent knowledge testing, however, so remote pilots maintain ongoing familiarity with small UAS operations and the provisions of part 107. Moreover, recurrent training, which a remote pilot can complete online, presents a less costly option and will achieve a level of assurance of knowledge that is comparable to the assurance a recurrent test provides. In this regard, the FAA's current use of online training enables the FAA to tailor the training to address the pilot's areas of knowledge in which improvement is necessary. The FAA intends to employ this type of mechanism to remote pilot training, in order to customize the training.

The recurrent training the FAA contemplates in this proposal may take different formats. The primary way the FAA anticipates remote pilots may fulfill the recurrent training requirement would be to complete questions throughout the training, the completion of which the FAA will consider satisfactory once the applicant achieves a score of 100 percent. The FAA may also

allow small UAS training to occur within a proficiency program or other approved program. The FAA would either offer, or review and approve, all such training that could fulfill the requirement of the proposed version of § 107.65(b) and (c).

The FAA anticipates the proposed change from recurrent knowledge testing to completion of recurrent training will continue to serve as an important risk mitigation measure. As UAS operations in the NAS continue to evolve, training provides the opportunity to re-emphasize the requirements of part 107 and incorporate any changes the FAA has made to part 107 as a part of subsequent rulemakings, such as this one. A training course provides the FAA with a way to ensure remote pilots are aware of the key requirements that affect them, address new or changed requirements in part 107 as a result of subsequent rulemakings, and highlight the tools and resources available to remote pilots. Such training would ensure remote pilots maintain awareness of recommendations for decision-making so they can continue to operate safely within the boundaries part 107 has established.

Because pilots could complete online training to fulfill the recurrent training requirement, this rule would not require travel to any kind of knowledge testing center every 24 calendar months. Upon completion of the training course, the pilot would be able to print a completion certificate, which the pilot would use to demonstrate aeronautical knowledge recency in accordance with the proposed revisions to § 107.65.

The FAA uses the term “training” rather than “training course” in the proposed regulatory text in the relevant sections that address training requirements, which would provide the opportunity for the FAA to consider completion of special pilot proficiency programs, such

as an FAA-provided WINGS course[93] specific to small UAS operations, to suffice for fulfillment of the training requirements. Such a program would offer tools and resources to strengthen decision-making skills and thereby enable the remote pilot to continue to ensure he or she operates safely in accordance with part 107. Overall, the FAA expects a recurrent online training course, pilot proficiency program, or similar option would keep remote pilots informed about enhancements to the small UAS industry while reducing costs associated with travel to knowledge testing centers.

b) Aeronautical Knowledge Areas

The FAA re-evaluated the knowledge topics that are required for initial knowledge tests and those required for training currently identified in §§ 107.73 and 107.74, respectively. In particular, the FAA reviewed the associated knowledge testing standards identified in the Remote Pilot – Small Unmanned Aircraft System Airman Certification Standards (sUAS ACS) document[94] and the resource guidance identified in the Remote Pilot sUAS ACS. As explained above, knowledge regarding operations at night is one of the measures the FAA seeks to employ to ensure the safety of operations at night. As such, the FAA proposes adding a knowledge area that would cover night operations for the initial knowledge test and the training. This area would include questions on night physiology and night illusions.

The FAA also plans to update its guidance, training, and testing material, including the associated knowledge testing standards identified in the sUAS ACS document and the resources

[93] WINGS is a voluntary pilot education and proficiency program the FAA offers. The program addresses accident causal factors associated with common pilot errors, lack of proficiency, and faulty knowledge, and is available online. WINGS provides the opportunity and the structure for pilots to continue pilots' aviation education.
[94] The FAA's sUAS ACS is available at https://www.faa.gov/training_testing/testing/acs/media/uas_acs.pdf.

listed in that ACS, to ensure the information is available for those remote pilots who seek to operate a small UAS at night. In addition, the FAA would provide educational items to the small UAS community through various means of communication such as FAASafety.gov, FAA.gov/UAS, and industry organizations.

The existing subject areas on the recurrent knowledge test for remote pilots include fewer topic areas than subject areas on the initial knowledge test. This proposed rule would amend this by requiring inclusion of the same list of subject areas on both the initial test and the recurrent training for pilots who hold a remote pilot certificate under § 107.65(b). As for pilots who already hold a pilot certificate under 14 CFR part 61 as described in § 107.65(c), this proposed rule would likewise require the initial training and the recurrent training cover identical subject areas. The FAA has carefully evaluated the topics applicable in each category and concludes that consistency in pilots' adequate knowledge in all topic areas listed is important for ensuring safety of small UAS operations in the NAS. Topics such as weather, small unmanned aircraft loading, determining the performance of the small UAS, the effects of drugs and alcohol, and radio communication procedures are all sufficiently important to warrant a place in recurrent small UAS training.

In addition, pilots who hold a part 61 certificate and therefore need to complete only an abbreviated listing of topic areas should be required to complete training on weather, small unmanned aircraft loading, and determining the performance of the small UAS. Although the 2016 final rule stated that the validation of skills necessary for a pilot who holds a part 61 certificate to complete flight review for manned aircraft obviated the need to address these topics in recurrent training for unmanned aircraft, the FAA has now revisited its analysis and concluded

such a distinction is not well-founded.[95] For example, although a pilot who holds a part 61 certificate will understand the effects of weather on a manned aircraft, such effects could be very different for operations of small UAS. Likewise, determining the performance of a manned aircraft is distinct from the manner in which a pilot should determine the performance of a small UAS; in this regard, the preflight check requirements of § 107.49 are distinct from those codified in part 91 and in other, similar regulations specific to manned aircraft.

The fact that remote pilots operating under part 107 are not subject to flight reviews or any practical test criteria from the FAA also forms a basis for the FAA's rationale in making the recurrent training area topics match the initial topic areas. The FAA has no means of knowing remote pilots' weaknesses or areas in which they lack experience or recollection. As a result, the FAA's presumption that each pilot may lack recollection with regard to every subject area is reasonable. For the foregoing reasons, the FAA now proposes to abandon the distinctions in the topic areas of initial knowledge tests (or training courses) and recurrent training.

Those remote pilots who hold a remote pilot certificate with a small UAS rating who completed initial knowledge testing or training prior to this rule becoming final would not have been tested or initially trained on operations at night. Although all remote pilots who choose to exercise the privileges of their remote pilot in command certificate could receive training through an online recurrent training course that would cover the subject matter, a period of time would exist for some remote pilots in which operations over people would be permitted and those remote pilots would not have completed recurrent training that includes instruction on night operations. As with all airman certificate holders, the FAA expects such remote pilots

[95] See 81 FR 42064, 42162.

would adhere to the regulations under which they operate even when those regulations change. As a result, remote pilots who operate at night without having first completed the updated training this rule proposes would be operating in violation of § 107.29. The FAA would update its guidance, training, and testing material to ensure information is available for those remote pilots who seek to exercise this new privilege, and would alert the small UAS community accordingly, through various means of communication.

In addition, the regulatory text the FAA proposes with regard to eligibility and recency requirements for a remote pilot certificate includes the phrase "in a manner acceptable to the Administrator." The FAA's addition of this phrase would serve to ensure remote pilots who already hold a remote pilot in command certificate under part 107 and are not yet required to complete their recurrent training would not need to re-take a knowledge test or complete training immediately, simply because the subject area listings of §§ 107.73 and 107.74 have changed. Instead, remote pilots who wish to operate a small UAS at night must take the updated knowledge test or training before operating at night.

V. Other Amendments

For purposes of consistency throughout part 107, as well as clarity, this rule also includes proposals to make certain, specific amendments to various provisions of part 107. These amendments are minor and concise.

A. UAS Exemption-Holders

The existing text of § 107.1 excludes from the applicability of part 107 remote pilots who hold an exemption for a UAS operation pursuant to section 333 of Public Law 112-95. The text

identifies the remote pilot as the person who is excluded from the applicability of part 107. The FAA has concluded this identification is imprecise, as the text should identify the excluded party as the exemption-holder, rather than the remote pilot. In addition, on October 5, 2018, the President signed the FAA Reauthorization Act of 2018.[96] The statute codified within title 49 of the United States Code the authority previously provided in section 333 of Public Law 112-95. As a result, the citation within 107.1(b)(3) should reflect 49 U.S.C. 44807 as the exemption authority. The FAA proposes re-phrasing the text of § 107.1(b)(3), accordingly.

B. Remote Pilot in Command

Section 107.19 outlines the responsibilities of the remote pilot in command under part 107. Following the promulgation of part 107, the FAA identified the need for a minor edit to paragraph (c) of § 107.19, which currently requires each remote pilot in command to "ensure 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." The FAA amends the phrase "loss of control of the aircraft" to say "loss of control of the small unmanned aircraft," for clarity. The FAA's intention in promulgating § 107.19(c) was to ensure the remote pilot in command remains responsible for the safe operation of a small unmanned aircraft when a loss of control of that small unmanned aircraft occurs. The remote pilot in command is not responsible for ensuring the safety of another person's aircraft in the event of loss of control; as a result, this proposed rule amends the text of § 107.19(c), accordingly.

[96] Pub. L. 115-254.

C. Operation of Multiple Small UAS

The FAA proposes amending the existing text of § 107.35, which prohibits contemporaneous operation of more than one small unmanned aircraft. Following the promulgation of part 107, the FAA realized its use of the term "operate" in § 107.35 could result in the perception that a single company or operator was prohibited from employing more than one remote pilot in command and conducting more than one small UAS operation at the same time. The FAA's proposed change to this section would allow companies to run two or more simultaneous small UAS operations, provided each aircraft is under the control of its own remote pilot in command.

VI. Privacy

In the 2016 final rule, the FAA acknowledged various organizations' and commenters' concerns regarding the use of small UAS to collect information about individuals. In that rule, the FAA noted that privacy concerns were beyond the scope of the FAA's mission to ensure safety and efficiency of aviation operations in the NAS, but discussed various methods by which the FAA intended 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.

Proposed regulations to address privacy concerns are beyond the scope of the FAA's mission. Nonetheless, the FAA has consistently recognized the importance of stakeholder engagement regarding privacy implications associated with UAS integration and incorporated

privacy considerations into the UAS Test Site Program and the UAS Integration Pilot Program, under its contracting authority.

The FAA acknowledges unique characteristics and capabilities of UAS may pose uncertainties with regard 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 operation of the aircraft. News helicopters, aerial surveys, film/television production, law enforcement, and other such manned aircraft have long placed cameras and other sensors on them, for a variety of purposes.

Although the FAA regulates the safe and efficient operation of 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. Substantial, ongoing debate among policymakers, industry, advocacy groups and members of the public has occurred 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. In recognizing the importance of addressing privacy concerns in the proper forum, the FAA has partnered with other agencies with the mandate and expertise to identify, develop, and implement appropriate mitigation strategies to address such concerns. The FAA's discussions with stakeholders have informed the FAA as it furthers plans for UAS integration. As the FAA stated in a July 20, 2018 press release,[97] Congress exclusively authorized the FAA to regulate aviation safety, the efficiency of

[97] Federal Aviation Administration, Press Release – FAA Statement—Federal vs. Local Drone Authority, available at https://www.faa.gov/news/press_releases/news_story.cfm?newsId=22938.

navigable airspace, and air traffic control, among other things. The FAA further stated, "[l]aws traditionally related to state and local police power – including land use, zoning, privacy, and law enforcement operations – generally are not subject to federal regulation." As a result, cities and municipalities, while not permitted to have their own rules or regulations governing the operation of aircraft, may generally determine the location of aircraft landing sites. The FAA expects the Department of Transportation's UAS Integration Pilot Program[98] to provide the FAA with insight on how best to involve local jurisdictions in the integration of UAS into the airspace while considering local interests in conjunction with aviation safety.

With regard to the information manufacturers and operators may submit in accordance with this proposed rule's requirements, the FAA conducted a privacy impact assessment (PIA) under 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 effect the proposed rule might have on collecting, storing, and disseminating personally identifiable information (PII) of manufacturers and UAS operators. The FAA also examined and evaluated protections and alternative information-handling processes in developing the proposed rule to mitigate potential privacy risks. A copy of the draft PIA is posted in the docket for this rulemaking.[99]

[98] 82 FR 51903 (Nov. 8, 2017); Presidential Memorandum for the Secretary of Transportation (Oct. 25, 2017), available at https://www.whitehouse.gov/the-press-office/2017/10/25/presidential-memorandum-secretary-transportation.

[99] Upon finalization, PIAs are posted on the Department of Transportation's Privacy Program page, available at https://www.transportation.gov/individuals/privacy/privacy-impact-assessments#Federal%20Aviation%20Administration%20(FAA).

VII. Section 44807 Statutory Findings

To determine whether certain UAS may operate safely in the NAS pursuant to 49 U.S.C. 44807, the Secretary must find that the operation of the UAS would not create a hazard to users of the NAS or the public. The Secretary must also determine whether a certificate under 49 U.S.C. 44703 ("Airman certificates") or section 44704 ("Type certificates, production certificates, and airworthiness certificates, and design and production organization certificates"), or a certificate of waiver or certificate of authorization, is required for the operation of small UAS subject to this proposed rule. Using a risk-based approach, the Secretary proposes to determine that small UAS operations under this proposed rule would operate safely in the NAS; the individual findings section 44807 requires are as follows.

A. Hazard to Users of the NAS or the Public

Section 44807(b)(1) requires the Secretary to determine which types of small UAS operations, as a result of their size, weight, speed, operational capability, proximity to airports and populated areas, operation over people, and operation within or beyond visual line of sight, or operation during the day or night do not create a hazard to users of the NAS or the public. In the 2016 final rule, the Secretary's finding of acceptable risk was based on the following mitigations: requiring operations to be conducted within visual line of sight; limiting maximum gross weight of the small unmanned aircraft to be 55 pounds; limiting the operating altitude to below 400 feet above ground level (AGL); requiring remote pilots to hold valid, current certificates; defining the area of operation; and prohibiting operations over any person who is not directly participating in the operation. This proposed rule would allow operations over uninvolved people; however, these aircraft would still be required to comply with the other

restrictions codified in part 107. The additional hazard posed by operating directly over people would be mitigated through manufacturer requirements and operational restrictions, including limited areas of operation for Category 3 aircraft. This rule would also allow for operations at night. The proposed risk mitigation measures of an illuminated anti-collision light and increased airman knowledge would provide sufficient risk mitigation for such operations.

Accordingly, the Secretary proposes to find that small UAS operations subject to this proposed rule would not create a hazard to users of the NAS or the public. The FAA invites comments on this proposed finding.

B. Certificate Requirements

Additionally, 49 U.S.C. 44807(b)(2) requires the Secretary to determine whether small UAS operations subject to this proposed rule pose a safety risk sufficient to require airworthiness certification or airman certification.

Due to the provisions in this proposed rule, in addition to the existing provisions in part 107, the risks associated with small UAS operations over people are significantly distinct from the risks that other types of aircraft operations present. Under part 107, a remote pilot must make a determination of whether the small UAS is in a condition for safe operation prior to and during flight operations. This proposed rule would also require a remote pilot to ensure that his or her unmanned aircraft weighs 0.55 pounds or less or has an FAA-accepted Declaration of Compliance prior to operating over people. Similarly, operations at night may only occur after the remote pilot has taken the updated knowledge test or training that includes content on night

operations and when the small unmanned aircraft maintains an illuminated anti-collision light. These proposed requirements serve to mitigate the risks the proposed operations would present.

Small UAS operations that occur in accordance with this proposal and the requirements of part 107 would pose significantly less risk than the level of risk that heavier aircraft present. Moreover, small UAS operating under part 107 must remain in a condition for safe operation. Therefore, the Secretary proposes to find, pursuant to 49 U.S.C. 44807(b)(2), that airworthiness certification would be unnecessary for small UAS subject to this proposed rule.

Part 107 currently requires a remote pilot in command certificate prior to conducting operations under part 107. The FAA has carefully tailored the knowledge and training requirements of part 107, subpart C, to ensure remote pilots in command are adequately aware of the restrictions and requirements of part 107. This framework is a key component of the Secretary's determination. As a result, the Secretary proposes to find, in this proposed rule, that a certificate under 49 U.S.C. 44703 is required. The FAA invites comments on these findings.

VIII. 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 proposed rule. We suggest readers seeking greater detail read the full regulatory evaluation, a copy of which is available in the docket for this rulemaking.

In conducting these analyses, FAA has determined that this proposed rule: (1) Has benefits that exceed costs; (2) is not 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) would have a significant positive economic impact on a substantial number of small entities; (5) would not create unnecessary obstacles to the foreign commerce of the United States; and (6) would not create a Federal mandate likely to result in the expenditure of more than $155 million annually under the Unfunded Mandates Reform Act of 1995 (Public Law 104-4). These analyses are summarized below.

1. Assumptions and Data

The benefit and cost analysis for the regulatory evaluation is based on the following assumptions:

- The analysis is conducted in constant dollars with 2016 as the base year.
- Because the commercial small UAS industry may evolve differently from current expectations, the FAA determines that a five-year period of analysis is appropriate.
- We use a three percent and seven percent discount rate for the costs and benefits as prescribed by OMB in Circular A-4.[100]
- The small UAS vehicle forecasts used in this analysis are based on the Federal Aviation Administration's FAA Aerospace Forecast 2017-2037.[101]
- Small unmanned aircraft that weigh 0.55 lbs. or less (Category 1) are not part of this analysis as costs are zero to minimal.
- The FAA estimates that 15 existing models may satisfy the performance-based requirements of the rule for Category 2 and Category 3 operations with little or no modification. These operations would be subject to the cost of obtaining a Declaration of Compliance. The FAA also assumes manufacturers would likely introduce a comparable number of compliant models in each of the subsequent years of the analysis.
- The FAA estimates that the remote pilot operating manual is 6 pages in length and requires 150 hours to develop at an hourly rate of $72.91.
- The FAA assumes that five percent of submitted Declarations of Compliance (DoC) documents would be rescinded, rewritten, and resubmitted for acceptance. It is assumed that DoCs resubmitted to the FAA would be accepted.

[100] https://www.whitehouse.gov/omb/circulars_a004_a-4. Accessed August 3, 2017.

[101] FAA Aerospace Forecast Fiscal Years 2017-2037 at 30-33, available at http://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2017-37_FAA_Aerospace_Forecast.pdf.

- The FAA assigns the United States Department of Transportation guidance on the hourly value of time and hourly value of travel time savings as to equal $25.40 for the analysis period.[102]

2. Benefits Summary

This proposed rulemaking would further integrate small UAS into the NAS by enabling operations over people and nighttime operations. These would benefit the economy and encourage innovation and growth across a variety of sectors, such as construction, education, infrastructure inspection, insurance, marketing, and event, film and sports photography.

Today, remote pilots who comply with part 107 can fly a small UAS within a safe distance from people, but are not able to operate over people who are not participating in the operation. Without this proposed rule, the only entities allowed to operate small UAS over people in the NAS are public entities holding an active certificate of waiver or authorization (COA), entities with an FAA-issued exemption, entities that hold a waiver to the prohibition on operations over people provision of part 107, or small UAS that have received airworthiness certification from the FAA who also operate with a COA. When this proposed rule is finalized, individuals would be able to conduct operations of a small UAS over people in the NAS and at night under part 107, so long as the activity is conducted by a small UAS that complies with the proposed provisions.

[102] Time savings is estimated to be median hourly wage plus benefits as described in the U.S. Department of Transportation Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis dated September 27, 2016.

3. Costs and Savings Summary

A manufacturer would incur costs for demonstrating compliance with the safety requirements of this proposed rule and providing a Declaration of Compliance to the FAA. For both Category 2 and Category 3 operations, this proposed rule would also require the manufacturer to label the aircraft for the appropriate category of operation and to provide remote pilot operating instructions for the small UAS upon sale, transfer, or use by someone other than the manufacturer. Additionally, a small UAS manufacturer would be responsible for the development of a website or other notification process for the purpose of notifying the public of the continued eligibility of small UAS for operations over people under this proposed rule. The costs to the FAA from this proposed rule include notice to a manufacturer that a Declaration of Compliance has been accepted (or rescinded); the development of a website for the FAA to notify the public of small UAS that have a Declaration of Compliance rescinded; and altering knowledge test questions into a training format. FAA costs are minimal.

Over the five-year period of analysis, the total present value cost of the proposed rule is about $14 million with annualized costs of $3 million (using a seven percent discount rate).

This proposed rulemaking would have quantified cost savings. Part 107 currently requires an applicant for a remote pilot certificate with a small UAS rating to go to a knowledge testing center and take the initial knowledge test to be eligible for the remote pilot in command certificate. To maintain the privileges of that certificate, remote pilots currently must pass a recurrent knowledge test at a knowledge testing center every 24 calendar months thereafter. This proposed rule would remove the requirement for completing a recurrent aeronautical knowledge test at a knowledge testing center and replace the requirement with completing online training.

As a result, the remote pilot in command who does not also hold a current certificate under part 61 would be relieved of costs associated with recurrent knowledge testing every 24 months. The cost savings include the elimination of the knowledge test fee; the elimination of the mileage expense for travel to and from the knowledge testing center; and the elimination of the opportunity cost of time studying for the knowledge test and travelling to the knowledge testing center. In total, these costs savings average $460 every 24 calendar months per affected remote pilot.

The full regulatory evaluation for this proposed rule presents a range of cost savings based on three varying fleet forecasts. Subsequently, over the five-year period of analysis, this proposed change would provide a total present value cost savings between $38 million and $135 million with annualized cost savings between $9 million and $33 million (using a seven percent discount rate).

The net present value cost savings (less costs) of the proposed rule ranges from $24 million to $121 million at a seven percent discount rate with net annualized costs savings between $6 million and $29 million. The following table presents quantified costs to manufacturers and the FAA and savings to remote pilots.

Table 6: Costs and Savings of Proposed Rule ($Millions)

5-Year Period of Analysis*

Low Case	7% PV	7% Annualized	3% PV	3% Annualized
Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($38)	($9)	($44)	($10)
Net Cost Savings	($24)	($6)	($29)	($6)
Base Case	7% PV	7% Annualized	3% PV	3% Annualized

Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($49)	($12)	($57)	($12)
Net Cost Savings	($35)	($9)	($42)	($9)
High Case	7% PV	7% Annualized	3% PV	3% Annualized
Costs (Manufacturers and FAA)	$14	$3	$15	$3
Cost Savings (Remote Pilots)	($135)	($33)	($158)	($34)
Net Costs Savings	($121)	($29)	($143)	($31)
* Columns may not sum to total due to rounding. Savings are shown in parenthesis to distinguish from costs.				

4. Benefit Cost Summary

This rulemaking responds to Congressional direction that instructs the Secretary of Transportation to determine whether "certain unmanned aircraft systems may operate safely in the national airspace system."[103] This proposed rule has been initiated at the request of the Administrator and the Secretary of Transportation after consultation with the Office of Management and Budget, and the Office of Science and Technology Policy in the Executive Office of the President. This high-level interest reflects a strong desire from industry for operating small UAS over people and is another step toward an eventual full integration of unmanned aircraft systems operating in the NAS. This rule would expand the opportunities for part 107 remote pilots and supports innovation in the emerging UAS industry.

The operation of small UAS over people may increase safety risk. Although the FAA believes the probability of injury from operating small UAS over people is small, when that small probability is multiplied by an increased number of operations, the risk of the occurrence of injury increases. The proposed performance-based standards would establish three categories

[103] See Pub. L. 115-254 347 (2018), codified at 49 U.S.C. 44807.

of small UAS operations defined primarily by level of risk of injury posed. Additional manufacturer and operational requirements would also apply to certain categories of small UAS to mitigate the risks of operating over people.

B. Regulatory Flexibility Act

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.

The FAA believes this proposed rule would have a significant impact on a substantial number of small entities. Therefore, under Section 603(b) of the RFA, the initial analysis must address:

- Description of reasons the agency is considering the action.
- Statement of the legal basis and objectives for the proposed rule.
- Description of the record-keeping and other compliance requirements of the proposed rule.

- All federal rules that may duplicate, overlap, or conflict with the proposed rule.
- Description and an estimated number of small entities to which the proposed rule will apply.
- Description of Significant Regulatory Alternatives for Small Entities.

1. Description of Reasons the Agency is Considering the Action

This rulemaking proposes performance-based requirements to allow small UAS to operate over people or at night under part 107 without obtaining a waiver or exemption. Currently under part 107, a remote pilot must obtain a waiver or exemption explicitly allowing operations over people or at night. As of July 10, 2017, the FAA has received 2,155 requests for waiver to permit operation at night, 477 requests to permit operating over people, and 228 requests to permit operating over people at night.[104]

The proposed requirements would allow small UAS to operate over people and during the hours of night while minimizing the risk these operations may pose to the general public. For operations over people, the FAA's proposed performance-based standards would establish three categories of small UAS operations defined primarily by level of risk of injury posed. Additional manufacturer requirements and operational restrictions beyond those already in part 107 would apply to certain categories of small UAS to mitigate the risks associated with each category.

This rulemaking also proposes to remove the requirement for completing a recurrent aeronautical knowledge test at a knowledge testing center and replaces the requirement with completing training that requires passing an online knowledge check by achieving a 100% score.

[104] As of September 2017, part 107 Non-Airspace Waivers totaled 5,835. Of these 5,835 waivers, 3,915 have been disapproved and 1,060 have been approved. Of the remaining waivers, 543 are in process, with another 317 withdrawn.

As a result, the remote pilot in command who does not also hold a certificate under part 61 would be relieved of costs associated with recurrent knowledge testing every 24 months.

2. Statement of the Legal Basis and Objectives for the Proposed Rule

The FAA promulgates this rulemaking pursuant to the authority set forth in 49 U.S.C. 44807. Section 44807 directs the Secretary of Transportation to determine whether "certain unmanned aircraft systems may operate safely in the national airspace system." If the Secretary 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, including operation related to research, development, and testing of proprietary systems."[105]

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. Lastly, 49 U.S.C. 46105(c) allows the Administrator to issue immediate orders to address an emergency related to safety in air commerce.

The FAA intends this rule will be an important step in further integrating small UAS operations into the NAS. This rule would permit operations of small UAS over people and

[105] 49 U.S.C. 44807(c).

operations at night without first obtaining a waiver. This proposed rule would also amend the knowledge testing requirements in part 107 to provide for recurrent training to substitute for in-person knowledge testing. With this proposed rule, the FAA expects the small UAS industry to continue finding new and creative ways for utilizing small UAS, and thereby grow the industry through innovation. The FAA's overall objective in this proposed rule is to ensure safety while encouraging new uses of small UAS in the NAS.

3. Description of the Record-Keeping and other Compliance Requirements of the Proposed Rule

The proposed rule would require the manufacturer to declare that a small UAS meets applicable performance-based requirements by using a means of compliance by test, analysis, or inspection, or any combination of these options. A manufacturer could perform any necessary tests contained in the means of compliance in-house or they could rent a testing facility with the necessary equipment to show compliance with the injury limitation based on transfer of kinetic energy upon impact. The manufacturer would certify the results from this means of compliance testing on its Declaration of Compliance to the FAA.

The proposed rule would require manufacturers of small UAS who use a means of compliance the FAA has accepted for Category 2 or Category 3 operations, to make available to the Administrator the Declaration of Compliance and any other document, record, or report that the proposal requires, upon the FAA's request. The proposed rule would provide record retention requirements for manufacturers who submit either a Declaration of Compliance or a means of compliance to the FAA. With today's minimal cost of producing electronic documents and mass storage hardware devices, the FAA expects manufacturers would keep all relevant documents,

records, or reports required in an electronic format and properly back up their storage systems. Therefore, this requirement would add minimal to no costs to the manufacturers because manufacturers would already have computer systems, with sufficient memory available, to store and produce the documents this proposal requires.

The proposed rule would require a manufacturer to label a small unmanned aircraft qualified for Category 2 or Category 3 operations with each category for which the small UAS is qualified to operate such that the label is in English, legible, prominent, and affixed onto the small unmanned aircraft by some permanent means. In addition, the FAA proposes requiring remote pilots to ensure their small unmanned aircraft are properly labeled before conducting any operations over people. The FAA believes the cost of adding the additional labeling information for the category for which the small UAS is qualified to operate would be minimal given that UAS typically come with a label containing information such as the name of the manufacturer, serial number, and model name or number. In addition, if the label has worn out due to use or age, the remote pilot could satisfy the proposal by using a permanent marker, or etching the category into the body of the small unmanned aircraft.

The proposed rule would require a small UAS manufacturer to establish and maintain a product support and notification process to notify the public and the FAA of any safety issues that would render the aircraft ineligible for operations over people. The FAA believes manufacturers of small UAS would have such a system already developed and in place to handle their warranties and to inform users of their small UAS about new developments and new products they are bringing to the marketplace. This proposal does not require the owner of a small UAS to send in a warranty card or provide the manufacturer any personal contact

information. Therefore, the FAA believes the cost of this requirement would be minimal. The FAA notes a manufacturer could be an individual that modifies a small UAS and then sells it. According to the proposal, this individual would also be required to have a notification and support process in place. The FAA envisions this process would be scaled to the production, so the individual who sells a single aircraft could establish a much smaller scale process. For example, the manufacturer could simply email the owner of the small UAS and advise them of any safety issues. The FAA also believes for a small-scale manufacturer or a modifier, the requirement to maintain a product support and notification process would also result in minimal costs.

4. All Federal Rules that may Duplicate, Overlap, or Conflict with the Proposed Rule

The FAA is unaware that the proposed rule will overlap, duplicate or conflict with existing federal rules.

5. Description and an Estimated Number of Small Entities to which the Proposed Rule Will Apply

This proposed rule would apply to two separate communities of small entities: manufacturers of small UAS and entities that operate small UAS. The FAA has not quantified the number of manufacturers that would be subject to the proposed rule because the FAA cannot reasonably predict how the market will develop for individual commercial uses of small UAS. However, one database that the FAA has access to identifies 2,126 manufacturers of UAS

worldwide.[106] Out of these 2,126 manufacturers, over 72 percent are foreign entities. Additionally, Association of Unmanned Vehicle Systems International (AUVSI) examined the top 15 platforms used by section 333 exemption holders, and determined that only 3 of the 15 platforms are manufactured by U.S. entities, with over half (8 platforms) manufactured by DJI Industries, a company based in China. It is not known how many of these manufacturers currently build, or will build in the future, small UAS that may fit within the bounds of this rulemaking. The FAA requests comments on the number of U.S. owned and operated small manufacturers of small UAS that would be affected by this proposed rule.

To be eligible for operations over people, a manufacturer must submit a Declaration of Compliance that would generally include the test report that is generated by following an acceptable means of compliance. Based on information from industry, the FAA estimated the one-time cost for developing the means of compliance to be $200,000.[107] The FAA considers this cost as an upper bound; as methods become standardized, the cost will be reduced. To provide flexibility to small entities, this rule proposes several performance-based requirements that would accommodate varying means of compliance. In this manner, the FAA would build flexibility into the regulations, which would adapt to the fast pace of small UAS innovation and development. The FAA requests information and data on the cost of developing varying means of compliance for small manufacturers.

[106] AUVSI Air Platform Database (accessed August 2018).

[107] The FAA received aggregated cost data that included the full rental of a research facility that has a drop tower, the set-up of the facility, testing equipment costs, the cost of small UAS to be tested, and the cost of time experts spend on testing and analysis among other information. The FAA did not receive itemized cost data to perform a sensitivity analysis of the costs for varying means of compliance.

The FAA determines many of the small UAS operations over people or at night will be conducted by small business entities. Based on analysis conducted by AUVSI, over 85 percent of waivers granted have been to small businesses.[108] Therefore, the FAA determines this proposed rule would have a positive significant economic impact on a substantial number of small entities.

6. Description of Significant Regulatory Alternatives Considered for Small Entities

The FAA considered both more and less costly alternatives as part of its NPRM because the RFA requires the agency to consider significant regulatory alternatives that meet the agency's statutory objectives and minimize the costs to small entities. The FAA rejected the costlier alternatives due to policy considerations and the undue burden imposed on small UAS operators. The less costly alternatives and the FAA's reasons for rejecting those alternatives are discussed below. In addition, the FAA discusses performance-based means of compliance that may provide additional flexibility and minimize costs to small entities.

- The FAA considered hands-on remote pilot flight training as part of the requirements for operating a small UAS over people or at night. However, at this time, the FAA does not have enough knowledge or experience with the operation of small UAS on a large scale to assess whether training beyond part 107 requirements is warranted.
- The FAA considered allowing Category 3 operations on a closed- or restricted-access site without requiring notice that the operation was taking place. The FAA rejected

[108] (AUVSI) Association of Unmanned Vehicle Systems International. As of July 31, 2017, 1,074 waivers had been issued of which 85 percent were granted to small entities (entities with less than 10 employees).

this alternative due to the increased severity of an injury resulting from a small unmanned aircraft impacting a person with up to 25 foot-pounds of kinetic energy.

- The FAA considered proposing a Category 4 to include operations in which a small UAS may operate over people, including flights over crowds or dense concentrations of people, if: (1) the manufacturer of the small UAS certifies the aircraft satisfies the same impact energy threshold as small UAS eligible to conduct Category 3 operations; (2) the small UAS complies with industry consensus standards; and (3) the operation is conducted in compliance with a documented risk mitigation plan. The FAA rejected this alternative due to the increased severity of an injury resulting from a small unmanned aircraft impacting a person with up to 25 foot-pounds of kinetic energy.

- The FAA considered incorporating the standards of 14 CFR 23.1401 or § 27.1401 ("Anti-collision light system") for night operations under part 107. Part 107 does not contain aircraft certification rules or standards, and the FAA concludes the reduced risk small UAS operations pose does not warrant application of such standards. In addition, the diverse range of aircraft that may operate under part 107 render prescriptive lighting requirements for all types of operations at night impractical. Prescribing lighting requirements would be overly burdensome for both the FAA and manufacturers of small UAS, because they would be forced to make tradeoffs that affect both the weight of the aircraft and the aircraft's power source and supply.

    - The FAA considered the status quo. In other words, requiring those entities that want to perform operations over people or operations at night to go through the process of

obtaining a waiver. The FAA rejected this alternative due to the undue burden it would impose on small UAS operators without an expectation of an increased level of safety.

As previously discussed in this section, the FAA considered and incorporated performance-based requirements that would accommodate varying means of compliance and potentially provide flexibility to small manufacturers. However, the FAA did not identify itemized cost data to perform a sensitivity analysis of the costs for varying means of compliance for small manufacturers. Instead, the FAA estimates the cost of developing a means of compliance assuming it would involve the full costs of testing in a research facility. The FAA requests information and data on types of means of compliance that would be flexible and scalable and minimize costs to small manufacturers.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Public Law 96-39), as amended by the Uruguay Round Agreements Act (Public Law 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 as 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. The FAA has considered the ongoing work of international organizations and other countries. No international standards currently exist for the types of operations the FAA proposes

in this rule. In addition, the FAA's proposed requirements would not create any obstacle to foreign commerce. The FAA will maintain its awareness of other countries' and international organizations' work in developing potential standards relevant to small UAS operations.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Public Law 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.

Although this proposed rule is a significant regulatory action, it does not contain a mandate that would impose costs on the private sector of more than $155 million annually.[109] As a result, the requirements of Title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires 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 (as implemented by

[109] The Unfunded Mandates Reform Act of 1995 defines "Federal private sector mandate" as "any provision in legislation, statute, or regulation that … would impose an enforceable duty upon the private sector … or would reduce or eliminate the amount of authorization of appropriations for Federal financial assistance that will be provided to the private sector for the purposes of ensuring compliance with such duty." Pub. L. 104-4 section 658 (1995).

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 rule proposes to add a new information collection for the Operation of Small Unmanned Aircraft over People. This information collection includes the estimated burdens for the Declaration of Compliance, Means of Compliance, and the development of remote pilot operating instructions.

This proposed rule also eliminates information collection requirements from the 2016 final rule as a result of changes to the recurrent knowledge testing requirement. In addition, it may reduce the number of waiver applications the FAA receives because under this proposed rule, most operations at night and some operations over people would be permissible in the absence of a waiver.

Below is a discussion of each of these information-collection requirements in 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.

Summary for Declaration of Compliance and Means of Compliance: The information collection addresses a manufacturer's submission of the Declaration of Compliance and the Means of Compliance to the FAA for the purpose of demonstrating that the small UAS fulfills the applicable standards for Category 2 and Category 3 operations. It also addresses manufacturers' compliance with the record retention requirements associated with submitting justification to establish compliance.

The Declaration of Compliance includes the following information:

- manufacturer's name, physical address, and email address;
- the small unmanned aircraft system make, model name, and serial number;
- whether the Declaration of Compliance is an initial declaration or an amended declaration, and if amended, the reason for resubmittal;
- A process for notifying customers of conditions that could render the small UAS ineligible for operations over people; and
- certification that the manufacturer has demonstrated that the small unmanned aircraft satisfies the kinetic energy and exposed rotating parts standards through an accepted Means of Compliance.

The Means of Compliance demonstrates through test, analysis, or inspection that the small UAS is eligible for operations pursuant to Category 2 and/or Category 3. The Means of Compliance includes the following information: detailed description of the means of compliance, and justification (including any substantiating material) showing the means of compliance establishes achievement of or equivalency to the safety level identified.

Use: The FAA uses the Declaration of Compliance and Means of Compliance to either accept or not accept that the manufacturer has demonstrated compliance with the requirements applicable to Category 2 and/or Category 3 operations.

Table 7: Annual Burden Estimate for Declaration of Compliance and Means of Compliance (In Hours)

Year	Initial	Resubmitted	Pages	Hours Per Page	Hourly Burden

1	15	0.75	50	1	787.5
2	15	0.75	50	1	787.5
3	15	0.75	50	1	787.5
Total					**2,362.5**

The cost for the information collection on an hourly basis is a wage of $72.91, for an annual cost of $57,417 for the small UAS manufacturers to submit their declarations. Over the 3-year analysis period, the total cost is approximately $172,250 in 2016 dollars.

Summary for Remote Pilot Operating Instructions: The information collection addresses the manufacturer's recordkeeping associated with the development and maintenance of remote pilot operating instructions for small UAS operating over people. The remote pilot operating instructions must address, at a minimum:

- A system description that includes the required small UAS components, any system limitations, and the declared category or categories of operation;
- Modifications that will not change the ability of the small UAS to meet the requirements for the category or categories of operation the small UAS is eligible to conduct, and
- Instructions for how to verify and change the mode or configuration of the small UAS, if they are variable.

Use: In order to operate a small UAS safely over people, the remote pilot would be responsible for knowing what category of operations his or her small UAS is eligible to conduct, and what technical and operational limitations apply to the operations. Accordingly, the FAA proposes to require manufacturers to provide remote pilot operating instructions with product-specific information.

Table 8: 3-Year Burden Estimates for Remote Pilot Operating Instructions (Hours)

Year	Operating Instructions	Pages	Hours Per Page	Hourly Burden
1	15	6	25	150
2	15	6	25	150
3	15	6	25	150
Total				**450**

The cost per hour for the information collection is a wage of $72.91, for an annual cost of $10,937 for small UAS manufacturers to develop and maintain remote pilot operating instructions. Over the 3-year analysis period, the total cost is approximately $32,810 in 2016 dollars.

Summary for Labeling of Unmanned Aircraft: Given that a small UAS could be qualified to conduct more than one category of operations, the FAA proposes requiring a manufacturer label the small UAS with each category of operations the small UAS is qualified to conduct. For example, a small UAS qualified to conduct Category 2 operations may also be qualified to conduct Category 3 operations. The manufacturer would label such a small UAS with each category, as follows: “Cat. 2, 3” or “Category 2, 3”. The label could be painted onto, etched into, or affixed to the aircraft by some other permanent means.

Use: The proposed labeling requirement would assist the remote pilot to know what category of operations his or her small UAS is eligible to conduct, and what technical and operational limitations apply to the operations. The proposed labeling requirement would also assist the FAA in its oversight role because it provides an efficient means for an inspector to evaluate whether an operation is consistent with the category or categories of operation the small UAS may conduct. Because Category 3 operations would entail unique operating limitations, the

label on small unmanned aircraft eligible to conduct Category 3 operations would indicate to the remote pilot that he or she must adhere to the applicable operating limitations.[110]

Table 9: 3-Year Burden Estimates for Labeling Unmanned Aircraft (Hours)

Year	Number of Platforms	Hours Per Redesign	Hourly Burden
1	15	2	30
2	15	2	30
3	15	2	30
Total			**90**

The FAA assumes that a manufacturer would redesign a label already affixed to the aircraft, and that the label redesign and redesign approval would take a maximum of two hours at an hourly wage of $72.91, for an annual cost of $2,187. Over the 3-year analysis period, the total cost is approximately $6,562 in 2016 dollars.

Summary for Replacing Recurrent Knowledge Testing Requirement with Recurrent Training. The FAA is proposing to revise existing information collection 2120-0021, Certification: Pilots and Flight Instructors, to reflect a reduction in the information collection burden as a result of replacing recurrent in-person knowledge testing with recurrent online training.

Following the implementation of part 107, the FAA re-evaluated its testing requirements for remote pilots. The FAA maintains the current initial testing requirement to evaluate a remote pilot's knowledge for operating in the NAS is critical, given the absence of a requirement for a

[110] The labeling requirement this rule proposes is not the sole means by which a remote pilot in command will be aware of the operating limitations applicable to Category 3 operations. Remote pilots in command must maintain awareness of updated regulations, as required by proposed §§ 107.73(a) and 107.74(a) in this rule. As a result, initial knowledge testing and recurrent training implemented after the effective date of this proposed rule would include operations over people as a subject area on both the test and training.

practical test or proficiency course in obtaining a remote pilot certificate. The FAA, however, has concluded that requiring recurrent training in lieu of recurrent knowledge testing will achieve the necessary assurance the FAA seeks with regard to remote pilots' ongoing familiarity with small UAS operations and the provisions of part 107. Recurrent training, which a remote pilot can complete online, presents a less costly option and will achieve a level of assurance of knowledge that is comparable to the assurance a recurrent test provides.

The FAA maintains that completion of training every two years is important in ensuring the remote pilots' familiarity with small UAS operations under part 107. As a result, this proposed rule would replace the recurrent knowledge testing requirement with a requirement to complete an online recurrent training, which the FAA may tailor to address any knowledge areas in which the remote pilot needs improvement. Thus, each remote pilot eligible to take recurrent knowledge training as a result of this proposed rulemaking would no longer be required to take a knowledge test.

Use: A training course affords the FAA the ability to ensure remote pilots are aware of the key requirements that affect them, address new or changed requirements in part 107 as a result of subsequent rulemakings, and highlight the tools and resources available to remote pilots. Such training would ensure remote pilots stay current and aid in their decision-making so they can continue to operate safely within the boundaries part 107 has established. The table below shows the hourly savings in terms of the annual information collection burden.

Table 10: 3-Year Burden Estimate -- Savings from Eliminating Recurrent Testing (Hours)

Year	Pages Per Application	Applicant Time (Hours)	Low Case Pages	Low Case Hours	Base Case Pages	Base Case Hours	High Case Pages	High Case Hours
1	70	3	915,692	39,244	1,039,015	44,529	2,264,918	97,068

2	70	3	1,673,944	71,740	1,899,440	81,405	4,140,494	177,450
3	70	3	2,164,218	92,752	2,868,812	122,949	8,362,221	358,381
Total	70	3	4,753,854	203,737	5,807,267	248,883	14,767,633	632,899

Rows and Columns may not sum to total due to rounding. Recurrent testing is not required until 2018.

Table 11: 3-Year Burden Estimates for Relief from Recurrent Testing ($Millions)

Year	Hourly Value of Time	Savings ($Millions) - by Scenario		
		Low	Base	High
1	$25.40	$1.0	$1.1	$2.5
2	$25.40	$1.8	$2.1	$4.5
3	$25.40	$2.4	$3.1	$9.1
Total		$5.2	$6.3	$16.1

Rows and Columns may not sum to total due to rounding.

Individuals and organizations may send comments on the information collection requirement to the address listed in the ADDRESSES section at the beginning of this preamble by [INSERT DATE 60 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER]. Comments also should be submitted to the Office of Management and Budget, Office of Information and Regulatory Affairs, Attention: Desk Officer for FAA, New Executive Office Building, Room 10202, 725 17th Street, NW, Washington, DC 20053.

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 reviewed the corresponding ICAO Standards and Recommended Practices and has identified no differences with 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 notice of proposed rulemaking action qualifies for the categorical exclusion identified in paragraph 5-6.6 of FAA Order 1050.1F and involves no extraordinary circumstances.

IX. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism.[111] The agency has determined this action would 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 would not have Federalism implications.

B. Executive Order 13211, Regulations that Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this proposed rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use.[112] The agency has

[111] 64 FR 43255 (Aug. 4, 1999).
[112] 66 FR 28355 (May 18, 2001).

determined this rule would not be a "significant energy action" under the executive order and would not be 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,[113] 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 proposed rule under the policies and agency responsibilities of Executive Order 13609, and has determined this proposal would have no effect on international regulatory cooperation.

D. Executive Order 13771, Reducing Regulation and Controlling Regulatory Costs

This proposed rule is expected to be an Executive Order 13771 deregulatory action. Details on the estimated cost savings of this proposed rule can be found in the rule's economic analysis.

X. Tribal Outreach

Consistent with Executive Order 13175, Consultation and Coordination with Indian Tribal Governments,[114] and FAA Order 1210.20, American Indian and Alaska Native Tribal Consultation Policy and Procedures,[115] the FAA ensures that Federally Recognized Tribes

[113] 77 FR 26413 (May 1, 2012).
[114] 65 FR 67249 (Nov. 6, 2000).
[115] FAA Order No. 1210.20 (Jan. 28, 2004), available at http://www.faa.gov/documentLibrary/media/1210.pdf.

(Tribes) are given the opportunity to provide meaningful and timely input regarding proposed Federal actions that have the potential to affect uniquely or significantly their respective Tribes. At this point, the FAA has not identified any unique or significant effects, environmental or otherwise, on tribes resulting from this proposed rule. As the FAA contemplated in the 2016 final rule, the FAA has conducted outreach to tribes and responded to those tribes seeking information about small UAS operations conducted within their territory.

The FAA continues to evaluate how it might address such concerns within the broader UAS integration effort.[116] In particular, the FAA is currently engaged in steps to fulfill the President's recent direction to the Secretary to establish a pilot program under which State, local, and tribal governments can submit proposals to the Secretary to test and evaluate the integration of civil and public UAS operations into the low-altitude NAS.[117] The pilot program involves cultivating relationships with State, local, and tribal jurisdictions to promote the safe operation of UAS and enable the development of UAS technologies and their use in agriculture, commerce, emergency management, human transportation, and other sectors.

The FAA has also conducted outreach to tribes to ensure they are familiar with the provisions of part 107 and how they might apply in Indian country, and that they are aware of FAA's plans for additional rulemakings to integrate UAS into the NAS. As part of that outreach, the FAA has:

[116] 81 FR 42064, 42189.
[117] 82 FR 51903 (Nov. 8, 2017); Presidential Memorandum for the Secretary of Transportation (Oct. 25, 2017), available at https://www.whitehouse.gov/the-press-office/2017/10/25/presidential-memorandum-secretary-transportation.

- Provided material on the 2016 final rule to participants at the mid-year conference of the National Congress of American Indians (Spokane, Washington, June 27-30, 2016);
- Presented at a workshop at the National Tribal Transportation Conference (Anaheim, California October 4, 2016);
- Responded to inquiries from the Shoshone-Bannock Tribes and Muscogee (Creek) Nation regarding use of UAS (September and October 2016);
- Presented information on UAS at a meeting of the Tribal Transportation Self-Governance Program Negotiated Rulemaking Meeting (Shawnee, Oklahoma, October 18, 2016); and
- Provided information to The Choctaw Nation of Oklahoma, which is participating in the UAS Integration Pilot Program.[118] Through this program, the FAA will work with The Choctaw Nation to ensure safe UAS operations for the purposes of agriculture, public safety, and infrastructure inspections. Such operations may include operations over people and operations at night.

The FAA will continue to respond to tribes that express interest in or concerns about UAS operations, and will engage in government-to-government consultation with tribes as appropriate, in accordance with Executive Orders and FAA guidance.

[118] Federal Aviation Administration, UAS Integration Pilot Program (May 7, 2018), available at https://www.faa.gov/uas/programs_partnerships/uas_integration_pilot_program/. See also

XI. Additional Information

A. Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The agency also invites comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, commenters should send only one copy of written comments, or if comments are filed electronically, commenters should submit only one time.

The FAA will file in the docket all comments it receives, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. Before acting on this proposal, the FAA will consider all comments it receives on or before the closing date for comments. The agency may change this proposal in light of the comments it receives.

B. Proprietary or Confidential Business Information

Commenters should not file proprietary or confidential business information in the docket. Such information must be sent or delivered directly to the person identified in the FOR FURTHER INFORMATION CONTACT section of this document, and marked as proprietary or confidential. If submitting information on a disk or CD ROM, mark the outside of the disk or CD ROM, and identify electronically within the disk or CD ROM the specific information that is proprietary or confidential.

Under 14 CFR 11.35(b), if the FAA is aware of proprietary information filed with a comment, the agency does not place it in the docket. It is held in a separate file to which the public does not have access, and the FAA places a note in the docket that it has received it. If the FAA receives a request to examine or copy this information, it treats it as any other request under the Freedom of Information Act (5 U.S.C. 552). The FAA processes such a request under Department of Transportation procedures found in 49 CFR part 7.

C. Availability of Rulemaking Documents

An electronic copy of rulemaking documents may be obtained from the Internet by—

1. Searching the Federal eRulemaking Portal (http://www.regulations.gov);
2. Visiting the FAA's Regulations and Policies web page at http://www.faa.gov/regulations_policies or
3. Accessing the Government Publishing Office's web page at http://www.fdsys.gov

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 notice number of this rulemaking.

All documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, may be accessed from the Internet through the Federal eRulemaking Portal referenced above.

D. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) 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 online, visit http://www.faa.gov/regulations_policies/rulemaking/sbre_act/.

List of Subjects in 14 CFR Part 107

Aircraft, Airmen, Aviation safety, Reporting and recordkeeping requirements, Security measures, Signs and symbols, Small unmanned aircraft, Unmanned aircraft.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend chapter I of title 14, Code of Federal Regulations as follows:

PART 107—SMALL UNMANNED AIRCRAFT SYSTEMS

1. The authority citation for part 107 is revised to read as follows:

Authority: 49 U.S.C. 106(f), 40101 note, 40103(b), 44701(a)(5), 46105(c), 46110, 44807.

2. Amend § 107.1 by revising paragraphs (a) and (b)(3) to read as follows:

§ 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. This part also applies to the qualification of civil small unmanned aircraft systems to operate over human beings in the United States.

(b) * * *

(3) Any operation that the holder of an exemption under section 333 of Public Law 112-95 or 49 U.S.C. 44807 elects to conduct pursuant to the exemption, unless otherwise specified in the exemption.

3. Amend § 107.3 by adding the definitions of "Casualty" and "Declaration of Compliance" in alphabetical order to read as follows:

§ 107.3 Definitions.

* * * * *

Casualty means an Abbreviated Injury Scale level 3 or greater injury.

* * * * *

Declaration of Compliance means a record submitted to the FAA that certifies the small unmanned aircraft system conforms to the Category 2 or Category 3 requirements under subpart D of this part.

* * * * *

4. Amend § 107.5 by revising paragraphs (b)(2) and (b)(3) and by adding paragraph (b)(4) to read as follows:

§ 107.5 Falsification, reproduction or alteration.

* * * * *

(b) * * *

(2) Denial of a Declaration of Compliance;

(3) Suspension or revocation of any certificate, waiver, or Declaration of Compliance issued or accepted by the Administrator under this part and held by that person; or

(4) A civil penalty.

5. Amend § 107.7 by revising paragraph (a) and by adding paragraphs (c) and (d) to read as follows:

§ 107.7 Inspection, testing, and demonstration of compliance.

(a)(1) A remote pilot in command, owner, or person manipulating the flight controls of a small unmanned aircraft system must present his or her remote pilot certificate with a small UAS rating and identification that contains the information listed at § 107.67(b) for inspection upon a request from:

(i) The Administrator;

(ii) An authorized representative of the National Transportation Safety Board;

(iii) Any Federal, State, or local law enforcement officer; or

(iv) An authorized representative of the Transportation Security Administration.

(2) 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 any document, record, or report required to be kept under the regulations of this chapter.

* * * * *

(c) Any person holding an FAA-accepted Declaration of Compliance under subpart D of this part must, upon request, make available to the Administrator:

(1) The Declaration of Compliance required under subpart D of this part; and

(2) Any other document, record, or report required to be kept under the regulations of this chapter.

(d) Any person holding an FAA-accepted Declaration of Compliance under subpart D of this part must, upon request, allow the Administrator to inspect its facilities, technical data, and any manufactured small UAS and witness any tests necessary to determine compliance with that subpart.

6. Amend § 107.19 by revising paragraph (c) to read as follows:

§ 107.19 Remote pilot in command.

* * * * *

(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 small unmanned aircraft for any reason.

* * * * *

7. Amend § 107.29 by revising paragraph (a) to read as follows:

§ 107.29 Operation at night.

(a) No person may operate a small unmanned aircraft system at night unless:

(1) The remote pilot in command of the small unmanned aircraft has completed an initial knowledge test or training, as applicable, under § 107.73 or § 107.74, after [the effective date of a subsequent final rule]; and

(2) 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, but may not extinguish, 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.

* * * * *

8. Revise § 107.35 to read as follows:

§ 107.35 Operation of multiple small unmanned aircraft.

A person may not manipulate flight controls or act as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time.

9. Revise § 107.39 to read as follows:

§ 107.39 Operation over human beings.

No person may operate a small unmanned aircraft over a human being unless:

(a) That human being is directly participating in the operation of the small unmanned aircraft;

(b) That human being is located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft; or

(c) The operation meets the requirements of at least one of the operational categories specified in subpart D of this part.

10. Amend § 107.49 by revising paragraphs (d) and (e) and adding paragraph (f) to read as follows:

§ 107.49 Preflight familiarization, inspection, and actions for aircraft operation.

* * * * *

(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;

(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; and

(f) If the operation will be conducted over human beings under subpart D of this part, ensure that the aircraft meets the requirements of § 107.110, § 107.115(a) or § 107.120(a), as applicable.

11. Amend § 107.61 by revising paragraph (d) to read as follows:

§ 107.61 Eligibility.

* * * * *

(d) Demonstrate aeronautical knowledge by satisfying one of the following conditions, in a manner acceptable to the Administrator:

(1) Pass an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73; 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 training covering the areas of knowledge specified in § 107.74.

12. Revise § 107.65 to read as follows:

§ 107.65 Aeronautical knowledge recency.

A person may not exercise the privileges of a remote pilot in command with small UAS rating unless that person has accomplished the following in a manner acceptable to the Administrator within the previous 24 calendar months:

(a) Passed an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73;

(b) Completed recurrent training covering the areas of knowledge specified in § 107.73; 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, completed training covering the areas of knowledge specified in § 107.74.

(d) A person who has passed a recurrent aeronautical knowledge test in a manner acceptable to the Administrator or who has satisfied the training requirement of paragraph (c) prior to [the effective date of a subsequent final rule] within the previous 24 calendar months is considered to be in compliance with the requirement of paragraph (b) or paragraph (c), as applicable.

13. Revise § 107.73 to read as follows:

§ 107.73 Knowledge and training.

An initial aeronautical knowledge test and recurrent training covers the following areas of knowledge:

(a) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(b) Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation;

(c) Aviation weather sources and effects of weather on small unmanned aircraft performance;

(d) Small unmanned aircraft loading;

(e) Emergency procedures;

(f) Crew resource management;

(g) Radio communication procedures;

(h) Determining the performance of the small unmanned aircraft;

(i) Physiological effects of drugs and alcohol;

(j) Aeronautical decision-making and judgment;

(k) Airport operations;

(l) Maintenance and preflight inspection procedures; and

(m) Operation at night.

14. Revise § 107.74 to read as follows:

§ 107.74 Small unmanned aircraft system training.

Training for pilots who hold a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meet the flight review requirements specified in § 61.56 covers the following areas of knowledge:

(a) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(b) Effects of weather on small unmanned aircraft performance;

(c) Small unmanned aircraft loading;

(d) Emergency procedures;

(e) Crew resource management;

(f) Determining the performance of the small unmanned aircraft;

(g) Maintenance and preflight inspection procedures; and

(h) Operation at night.

Subpart D--Waivers

15. Redesignate subpart D as subpart E.

16. Add subpart D to read as follows:

Subpart D—Operations Over Human Beings

Sec.

§ 107.100 Applicability.

This subpart prescribes the eligibility standards and operating requirements for small unmanned aircraft systems that may conduct operations over human beings, in addition to those permitted by §§ 107.39(a) and (b).

§ 107.105 Prohibition on operations over moving vehicles.

No person may operate a small unmanned aircraft over a human being located in a moving vehicle.

§ 107.108 Limitations on operations over human beings.

Except as provided in §§ 107.39(a) and (b) of this part, a remote pilot in command may conduct operations over human beings only as Category 1, 2, or 3 operations authorized by §§ 107.110, 107.115, and 107.120 of this subpart.

§ 107.110 Category 1 operations.

To conduct Category 1 operations, a remote pilot in command must use a small unmanned aircraft that weighs 0.55 pounds or less on takeoff and throughout the duration of each operation under this category, including everything that is on board or otherwise attached to the aircraft.

§ 107.115 Category 2 operations.

(a) *Remote pilot in command requirements.* To conduct Category 2 operations, a remote pilot in command must use a small unmanned aircraft system that is qualified and labeled for Category 2 operations pursuant to paragraph (b) of this section.

(b) *Eligibility.* To be qualified to conduct Category 2 operations, the small unmanned aircraft system must:

(1) Be designed, produced, or modified such that it:

(i) Will not cause injury to a human being that is equivalent to or greater than the severity of injury caused by a transfer of 11 foot-pounds of kinetic energy upon impact from a rigid object;

(ii) Does not contain any exposed rotating parts that could lacerate human skin upon impact with a human being; and

(iii) Does not contain any safety defects identified by the Administrator.

(2) Display a label indicating eligibility to conduct Category 2 operations. The label must be in English and be legible, prominent, and permanently affixed to the small unmanned aircraft.

(3) Have current remote pilot operating instructions that apply to the operation of the small unmanned aircraft system. The person who designed, produced, or modified the small unmanned aircraft system must make available the instructions upon sale, transfer, or use of the aircraft by someone other than the person who designed, produced, or modified the small unmanned aircraft system. Such instructions must address, at a minimum:

(i) A system description that includes the required small unmanned aircraft system components, any system limitations, and the declared category or categories of operation;

(ii) Modifications that will not change the ability of the small unmanned aircraft system to meet the requirements for the category or categories of operation the small unmanned aircraft system is eligible to conduct; and

(iii) Instructions for how to verify and change the mode or configuration of the small unmanned aircraft system, if they are variable.

(4) Be subject to a product support and notification process. Anyone who designs, produces, or modifies a small unmanned aircraft system under this paragraph must maintain product support and notification procedures to notify the public and the FAA of:

(i) Any defect or condition that causes the small unmanned aircraft system to no longer meet the requirements of this subpart, and

(ii) Any identified safety defect that causes the small unmanned aircraft system to exceed a low probability of casualty.

(5) Operate only after the person who designed, produced, or modified the small unmanned aircraft system has received notification that the FAA has accepted the Declaration of Compliance for that small unmanned aircraft system in accordance with § 107.135.

§ 107.120 Category 3 operations.

(a) *Remote pilot in command requirements.* To conduct Category 3 operations, a remote pilot in command:

(1) Must use a small unmanned aircraft system that is qualified and labeled for Category 3 operations pursuant to paragraph (b) of this section;

(2) Must not operate the small unmanned aircraft over open air assemblies of human beings; and

(3) May only operate the small unmanned aircraft above any human being if the operation meets one of the following conditions:

(i) The operation is within or over a closed- or restricted-access site, and any human being located within the closed- or restricted-access site is on notice that a small unmanned aircraft may fly over them; or

(ii) The small unmanned aircraft does not maintain sustained flight over any human being not directly participating in the operation of the small unmanned aircraft or located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft.

(b) *Eligibility.* To be qualified to conduct Category 3 operations, the small unmanned aircraft system must:

(1) Be designed, produced, or modified such that it:

(i) Will not cause injury to a human being that is equivalent to or greater than the severity of the injury caused by a transfer of 25 foot-pounds of kinetic energy upon impact from a rigid object;

(ii) Does not contain any exposed rotating parts that could lacerate human skin upon impact with a human being; and

(iii) Does not contain any safety defects identified by the Administrator.

(2) Display a label indicating eligibility to conduct Category 3 operations. The label must be in English and be legible, prominent, and permanently affixed to the small unmanned aircraft.

(3) Have current remote pilot operating instructions that apply to the operation of the small unmanned aircraft system. The person who designed, produced, or modified the small unmanned aircraft system must make available the instructions upon sale, transfer, or use of the aircraft by someone other than the person who designed, produced, or modified the small unmanned aircraft system. Such instructions must address, at a minimum:

(i) A system description that includes the required small unmanned aircraft system components, any system limitations, and the declared category or categories of operation;

(ii) Modifications that will not change the ability of the small unmanned aircraft system to meet the requirements for the category or categories of operation the small unmanned aircraft system is eligible to conduct; and

(iii) Instructions for how to verify and change the mode or configuration of the small unmanned aircraft system, if they are variable.

(4) Be subject to a product support and notification process. Anyone who designs, produces, or modifies a small unmanned aircraft system under this paragraph must maintain product support and notification procedures to notify the public and the FAA of:

(i) Any defect or condition that causes the small unmanned aircraft system to no longer meet the requirements of this subpart, and

(ii) Any identified safety defect that causes the small unmanned aircraft system to exceed a low probability of fatality.

(5) Operate only after the person who designed, produced, or modified the small unmanned aircraft system has received notification that the FAA has accepted a Declaration of Compliance for that small unmanned aircraft system in accordance with § 107.135.

§ 107.125 Means of Compliance.

(a) To meet the requirements of § 107.115(b)(1) for operations in Category 2, or the requirements of § 107.120(b)(1) for operations in Category 3, the means of compliance must consist of test, analysis, or inspection that the Administrator has determined is acceptable. The means of compliance may include consensus standards.

(b) An applicant requesting FAA acceptance of a means of compliance must submit the following information to the FAA in a manner specified by the Administrator:

(1) Detailed description of the means of compliance; and

(2) Justification, including any substantiating material, showing the means of compliance establishes achievement of or equivalency to the safety level identified in §§ 107.115(b)(1) and 107.120(b)(1).

§ 107.130 Variable mode and variable configuration of small unmanned aircraft systems.

A small unmanned aircraft system may be eligible for one or more categories of operation over human beings under this subpart, as long as a remote pilot in command cannot inadvertently switch between modes or configurations.

§ 107.135 Declaration of Compliance.

(a) *Required information.* Prior to declaring a small unmanned aircraft system to be compliant with the requirements of this subpart for Category 2 or 3 operations, an applicant must submit a Declaration of Compliance for acceptance by the FAA, in a manner specified by the Administrator, that includes the following information:

(1) Applicant's name;

(2) Applicant's physical address;

(3) Applicant's email address;

(4) The small unmanned aircraft system make and model name;

(5) The small unmanned aircraft system serial number or range of serial numbers that are the subject of the Declaration of Compliance;

(6) Whether the Declaration of Compliance is an initial declaration or an amended declaration;

(7) If the Declaration of Compliance is an amended declaration, the reason for the re-submittal;

(8) Certification that the applicant:

(i) Has demonstrated that the small unmanned aircraft, or specific configurations of that aircraft, satisfies §§ 107.115(b)(1)(i) and 107.115(b)(1)(ii), or §§ 107.120(b)(1)(i) and 107.120(b)(1)(ii), or both, through an accepted means of compliance;

(ii) Has satisfied § 107.115(b)(4) or § 107.120(b)(4), or both; and

(iii) Will, upon request, allow the Administrator to inspect its facilities, technical data, and any manufactured small unmanned aircraft system and witness any tests necessary to determine compliance with this subpart.

(9) Other information as required by the Administrator.

(b) *FAA acceptance.* If the FAA determines the applicant has demonstrated compliance with the requirements of this subpart, it will notify the applicant that it has accepted the Declaration of Compliance. If the FAA determines the applicant has not provided sufficient evidence to demonstrate compliance, the FAA will notify the applicant that it has not accepted the Declaration of Compliance.

(c) *Notification of a safety issue.* Prior to initiating rescission proceedings pursuant to paragraph (d)(1) through (3) of this section, the FAA will notify the applicant if a safety issue has been identified for the Declaration of Compliance.

(d) *Rescission*. (1) No person may operate a small unmanned aircraft system identified on a Declaration of Compliance that the FAA has rescinded pursuant to this subpart while that Declaration of Compliance is rescinded.

(2) The FAA may rescind a Declaration of Compliance if any of the following conditions occur:

(i) A small unmanned aircraft system for which a Declaration of Compliance was accepted no longer complies with § 107.115(b)(1) or § 107.120(b)(1);

(ii) The FAA finds a Declaration of Compliance is in violation of § 107.5(a); or

(iii) The Administrator determines an emergency exists related to safety in accordance with the authority in 49 U.S.C. 46105.

(3) If a safety issue identified under paragraph (c) of this section has not been resolved, the FAA may rescind the Declaration of Compliance as follows:

(i) The FAA will issue a notice proposing to rescind the Declaration of Compliance. The notice will set forth the agency's basis for the proposed rescission and provide the holder of the Declaration of Compliance with 10 business days from the date of issuance of the proposed notice to submit evidentiary information to refute the proposed notice.

(ii) The holder of the Declaration of Compliance must submit information demonstrating how the small unmanned aircraft system meets the requirements of this subpart within 10 business days from the date of issuance of the proposed notice.

(iii) If the FAA does not receive the information required by paragraph (d)(3)(ii) of this section within 10 business days from the date of the issuance of the proposed notice, the FAA will issue a notice rescinding the Declaration of Compliance.

(4) If the Administrator determines that an emergency exists in accordance with paragraph (d)(2)(iii) of this section, the FAA will exercise its authority under 49 U.S.C. 46105(c) to issue an order rescinding a Declaration of Compliance without initiating the process in paragraph (d)(3) of this section.

(e) *Petition to reconsider the rescission of a Declaration of Compliance*. A person subject to an order of rescission under paragraph (d)(3) of this section may petition the FAA to reconsider the rescission of a Declaration of Compliance by submitting a request to the FAA in a manner specified by the Administrator within 60 days of the date of issuance of the rescission.

(1) A petition to reconsider the rescission of a Declaration of Compliance must demonstrate at least one of the following:

(i) A material fact that was not present in the original response to the notification of the safety issue and an explanation for why it was not present in the original response;

(ii) The FAA made a material factual error in the decision to rescind the Declaration of Compliance; or

(iii) The FAA did not correctly interpret a law, regulation, or precedent.

(2) Upon consideration of the information submitted under paragraph (e)(1) of this section, the FAA will issue a notice either affirming the rescission or withdrawing the rescission.

(f) *Inapplicability of part 13 subpart D.* Title 14 CFR part 13 subpart D does not apply to the procedures of paragraphs (d) and (e) of this section.

§ 107.140 Previously manufactured small unmanned aircraft systems.

A remote pilot in command may operate a small unmanned aircraft system manufactured prior to [the effective date of a subsequent final rule] over human beings under the following circumstances:

(a) *Category 1 operations.* The small unmanned aircraft weighs 0.55 pounds or less on takeoff, including everything that is on board or otherwise attached to the aircraft; or

(b) *Category 2 and 3 operations.* (1) The FAA has accepted a Declaration of Compliance in accordance with § 107.135; and

(2) The small unmanned aircraft is labeled for the appropriate category of operations in English such that the label is legible, prominent, and permanently affixed to the small unmanned aircraft.

§ 107.145 Record retention.

A person who submits a Declaration of Compliance or means of compliance under this subpart must retain the following substantiating data:

(a)(1) For the Declaration of Compliance, the holder of the Declaration of Compliance must store the detailed description of the means of compliance and justification, including any substantiating material, for two years after the cessation of production of the small unmanned aircraft system to support the Declaration of Compliance, and

(2) Any accompanying data must contain detailed information on the type of means of compliance and the results or justification used to demonstrate the small unmanned aircraft system meets §§ 107.115(b) and 107.120(b), as applicable.

(b) For a means of compliance used to satisfy any of the following §§ 107.115(b)(1)(i), 107.115(b)(1)(ii), 107.120(b)(1)(i), and 107.120(b)(1)(ii):

(1) The information described in paragraph (a) of this section must be stored for as long as the means of compliance is accepted by the FAA, and

(2) Accompanying data or information must contain:

(i) Test procedures that outline the test methodology, if applicable; and

(ii) Justification, including any substantiating material, showing the means of compliance establishes achievement of or equivalency to the safety level identified in §§ 107.115(b)(1) and 107.120(b)(1), as applicable.

§ 107.150 Relabeling by remote pilot in command for Category 2 and 3 operations.

If a Category 2 or Category 3 label affixed to a small unmanned aircraft is damaged or destroyed such that it is no longer legible, a remote pilot in command must relabel the aircraft in English such that the label is legible, prominent, and will remain on the small unmanned aircraft for the duration of the operation before conducting operations over human beings. The label must correctly identify the category or categories of operation over human beings that the small unmanned aircraft is qualified to conduct in accordance with subpart D of this part.

17. Amend § 107.205 by revising paragraph (b) and adding paragraph (j) to read as follows:

§ 107.205 List of regulations subject to waiver.

* * * * *

(b) Section 107.29(a)(2) and (b)—Anti-collision light required for operations at night and during periods of civil twilight.

* * * * *

(j) Section 107.105—Prohibition on operations over moving vehicles.

Issued under the authority provided by 49 U.S.C. 106(f), 40101 note; and 44807, in Washington, DC on

Elaine L. Chao,

Secretary,

Department of Transportation.

Daniel K. Elwell,

Acting Administrator,

Federal Aviation Administration.