UNITED STATES DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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Petition for Rulemaking	)
to Adopt 14 C.F.R. Part 107	)
to Implement Operational Requirements	)
for Micro Unmanned Aircraft Systems	)
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PETITION OF UAS AMERICA FUND, LLC ("UAS FUND") TO ADOPT 14 C.F.R. PART 107 TO IMPLEMENT OPERATIONAL REQUIREMENTS FOR MICRO UNMANNED AIRCRAFT SYSTEMS

Dated: December 18, 2014

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In order to promote a framework for the safe operation of very light weight unmanned aircraft in the United States, and to address the huge economic opportunities and growing demand for unmanned aircraft systems ("UAS") technologies across many industries, UAS America Fund, LLC ("UAS Fund") hereby petitions the Federal Aviation Administration ("FAA") pursuant to 14 CFR §§ 11.17, 11.25(a)(5), 11.39(c), and 11.61 through 11.75 to adopt 14 C.F.R. part 107 (and amend other parts requiring conforming amendments) so as to implement operational requirements for micro unmanned aircraft ("mUA"). The specific regulation and amendments proposed by UAS Fund are set out in Attachment A.

In light of the national interest in assuring American leadership in this field, promoting economic development, and providing a safety framework for UAS operation in what is currently an absence of specific regulation, UAS Fund petitions that its proposed rules be implemented immediately, by final direct rule, rather than by notice of proposed rulemaking. A final direct rule is permitted by 14 C.F.R. §§ 11.29 and 11.31, and was also expressly authorized by Congress in Section 333 of the 2012 FAA Modernization and Reform Act which contemplates that the FAA would designate specific "types of unmanned aircraft systems" for operation in the national airspace system *in advance of* the lengthy ongoing notice of proposed rulemaking (NPRM) process for other categories of unmanned aircraft systems, based on criteria including "their size, weight, [and] speed." Public Law 112-95 at § 332(b)(1).[1] The FAA certainly can proceed with a direct

[1] The FAA has treated Section 333 as a waiver-granting directive although it is entitled "special rules for certain unmanned aircraft systems." The provision contemplates that the Administrator can determine "*whether* a certificate of waiver" is needed (emphasis added). In other words, the FAA is empowered to identify types of UAS that may be operated immediately and establish rules for them without requiring operators to seek individual case-by-case waivers.

rule when lengthy notice and comment procedures are "contrary to the public interest."[2] In the 2012 statute, Congress specifically asked for rules to be put into place immediately with respect to certain "types" of UAS.

I. Statement of Interest of UAS America Fund, LLC

UAS America Fund, LLC is a privately-financed platform working to unlock the benefits of the commercialization of unmanned aircraft systems, including economic development, technical research, innovation, and job creation in the United States. The UAS Fund was established in early 2014 by NEXA Capital Partners, LLC ("NEXA Capital"). NEXA Capital, established in 2007, is an investment banking and financial advisory firm focusing predominantly in the aerospace sector. Its staff includes a range of professionals with significant experience and expertise across all of aviation including air traffic control and airspace issues, infrastructure finance and banking, the legislative process, rulemaking, and governmental oversight. NEXA Capital's staff includes former FAA officials as well as professionals with broad experience across government, finance, the aerospace supply chain, and national infrastructure, all focused on aviation.

NEXA Capital and its staff have a long history of successfully investing in aerospace and infrastructure companies and projects, and bring all this knowledge and expertise together to support UAS Fund and, more broadly, furthering commercialization of the UAS industry in the United States. The UAS America Fund was incorporated specifically to provide infrastructure financing to the emerging commercial UAS industry. UAS Fund is partnering with major aerospace companies, and state and local governments, to accelerate UAS development and

[2] 5 U.S.C. § 553(b)(3)(B).

deployment nationwide. UAS Fund also expects to partner with the FAA to ensure that new UAS infrastructure serves the national interest as it supports the broad economic and job creation benefits of UAS commercialization across the United States.

This Petition is the first phase of a segmented approach to UAS regulation that UAS Fund plans to propose to the FAA. As shown in Attachment B, UAS Fund has developed a reasonable and logical market segmentation for UAS operations that is risk-based and will allow for an incremental regulatory framework to be applied so as not to overly burden the safest types of operation, while also ensuring adequate regulatory, technical, and certification requirements for more complex operations. This Petition covers only the regulatory requirements and environment concerning commercial and other non-recreational unmanned aircraft ("UA") flights for the lightest category of UAS, deemed Category 1A in our segmentation model or "micro" unmanned aircraft (mUA). The framework would govern close-proximity operations with the pilot operating the micro UA within visual line of sight. (Such close-in operations are useful for aerial photography, infrastructure inspection, precision agriculture, mapping/photogrammetry, and, perhaps most importantly, operator training and certification, among many others.) UAS Fund expects to lead further commercialization efforts by driving the industry forward with proposing additional regulatory actions, with supporting safety and technical analysis, to further unlock the full benefits of commercial UAS applications in a thoughtful risk-based approach to regulation across a full segmentation of the market.

UAS Fund has coordinated with parties across all segments of the UAS industry including FAA, legislators, university and other academic institutions, private companies, industry associations, and civilian governmental agencies, all of whom are in agreement that some

segments of the UAS market are appropriate for a minimally-burdensome regulatory environment. One such segment is the one we present here: micro UA weighing 3 pounds or less.

II. Summary of Petition

This Petition and its attachments establish a comprehensive operational framework and pilot qualification standard for UAS that are extremely light weight (3 pounds or less, what we refer to as a "micro" class), move at relatively low speed, are operated at low altitudes (below 400 feet AGL), outside of controlled airspace, at least 5 nautical miles from airports, and operated by pilots with a demonstrated level of aeronautical knowledge. These operations present not just an equivalent, but better level of safety compared to current operations. The Petition is strongly in the public interest because it unlocks the benefits of one class of UAS technology while presenting virtually no safety risk to the national airspace system.

This Petition is supported by an aviation safety study prepared by subject matter expert Dr. Adam Dershowitz of Exponent Engineering P.C. concluding that operation of UAS within the proposed parameters will not pose a significant increase in risk to manned aircraft. Dr. Dershowitz's analysis, based upon decades of the FAA's own bird strike data, establishes that there is virtually no risk of an injury-causing or fatal mid-air collision when an mUA weighing 3 pounds or less is operated below 400 feet and at least 5 miles from airports.

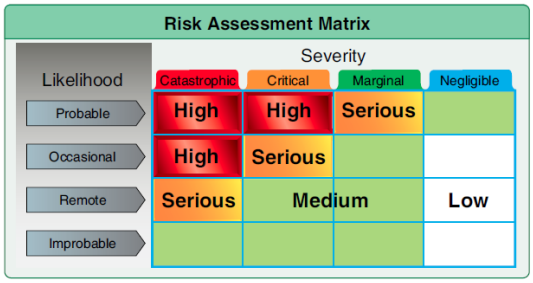
III. The Safety Study

We submit with this Petition, as Attachment C, the expert report of Dr. Adam Dershowitz, Managing Engineer in Exponent's Thermal Sciences practice where he specializes in aeronautical and astronautical engineering. Dr. Dershowitz is a licensed pilot and certified flight instructor, and has expertise in manned and unmanned aircraft and spacecraft systems,

instrumentation, and failure analysis, and he has investigated accidents involving a wide range of aerospace vehicles.

Dr. Dershowitz has undertaken an analysis that we believe has not been done previously by anyone, namely studying the actual risks posed to both general aviation and commercial air traffic of airborne objects three pounds or less that are located at least five miles from airports and below 400 feet above ground level. Dr. Dershowitz observes that, in those locations, despite the presence of an estimated 10 billion birds in the United States, there has never been a reported injury or death attributed to a bird strike involving small or medium birds (3.8 pounds and under). Indeed, in the past 25 years there have been are only two cases of any damage to aircraft from bird strikes in these locations, both reported as "moderate." When "en route" reports (which do not specify an airport distance) are included in the data analysis on the assumption that those flights may be greater than five miles from an airport, the result remains remarkably small: only six injuries and no fatalities. Thus, according to the risk assessment matrix often utilized by the FAA and other agencies, both the *likelihood* of an occurrence, and the *severity* of an occurrence are extraordinarily low, even in the absence of the additional regulatory safeguards that we have included in our proposal. *See* FAA Risk Management Handbook (FAA-H-8083-2) (2009) at Figure 1-5.[3]

[3] Available at http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/faa-h-8083-2.pdf



We believe this is the only study of its kind that provides the FAA with actual safety data, rather than conjecture, concerning the risks of very light-weight UA to existing airspace users in the United States.

IV. Main Operational Safety Parameters

With this understanding that a lightweight UA flown at low altitudes and at significant distances from airports poses no significant increase in risk to manned aircraft, UAS Fund has created a regulatory framework consisting of main operational parameters, as well as an added layer of safety provided by secondary operational standards. Together, these standards set out in our proposed Part 107 provide for the safe operation of micro UA in the United States, and that can and should be implemented immediately.

A. Weight

UAS Fund proposes 3 pounds maximum takeoff weight or (MTOW) as the upper limit for this proposed category, which we refer to as "micro" UA or "mUA." The safety of such a lightweight UA is established in a number of different ways.

First, as set out above, the safety of a 3-pound UAS for other airspace users is supported by Dr. Dershowitz's study establishing that small and medium birds of the same weight as a micro UA pose little hazard to manned aircraft.

Second, three pounds is less than the weight of 2 kilograms (4.4 pounds) that civil aviation authorities in peer countries have identified as a very low risk category for UAS warranting a permissive regulatory approach. *See* Australian Civil Aviation Safety Authority NPRM 1309OS - Remotely Piloted Aircraft Systems; Transport Canada Advisory Circular No. 600-004 (Nov. 27, 2014). France's DGAC also makes a distinction at the 2 kilogram threshold, and the United Kingdom's CAA has a regulatory threshold at 7 kilograms. (UAS Fund views its three-pound weight parameter as conservative and has no objection to modification of its proposal to increase the parameter to 2 kilograms (4.4 pounds) to match the emerging international standard.)

Third, current FAA regulations allow any person to operate an ultralight vehicle weighing up to 254 pounds (plus the person's weight) at or even above 10,000 feet above ground level. 14 CFR 103. Those airborne vehicles, with a life on board, are not required to meet airworthiness certification standards nor are operators of ultralight vehicles required to meet any aeronautical knowledge, age, or experience requirements to operate those vehicles or to have airman or medical certificates. *See* 14 CFR 103.7.

Fourth, the FAA has for decades not imposed airworthiness or pilot certification requirements upon operators of recreational model aircraft even though they may weigh 55 pounds (or more), nearly 20 times heavier than UAS Fund's proposed "micro" category. Since 1981, the FAA has recommended that model aircraft operators operate below 400 feet and at least three miles from airports (or contact the airport manager). *See* Advisory Circular 91-57. Those basic operational parameters have been established as safe for decades, with no known collisions

between manned aircraft and model aircraft operated pursuant to them. UAS Fund's proposal offers a far more conservative approach than operations long permitted by the FAA.

B. Altitude

UAS in this category shall be operated below 400 feet AGL, which will provide for a 100 foot buffer between 14 CFR 91.119 minimums and mUA operations. Ceilings of 400 feet have been shown to be safe by the FAA since 1981 guidance in AC 91-57 concerning model aircraft, particularly when coupled with the proposed distance requirements for flights from airports (see below). This ceiling requirement limits micro UA operations to low-risk altitudes and is consistent with restrictions imposed by other civil aviation authorities. Furthermore, FAA regulations allow for kites and moored balloons to be operated up to 500 feet AGL, even though those devices are far more difficult for the operator to control or land in the limited period of time available in the event that the operator observes an approaching manned aircraft. *See* 14 CFR § 101.13.

C. Distance from Airports

UAS in this category shall be operated at least 5 nautical miles from the geographical center of towered and non-towered airports, as shown on current FAA charts. Commercial micro UA flights near any airports defined on then-current FAA charts as Abandoned and/or Closed will be allowed as long as all other relevant regulatory requirements are met. Under the proposal, mUA flights are prohibited from operating in any class of controlled airspace, and therefore only allowed to operate in uncontrolled (Class G) airspace, unless there is prior authorization.

Restricting mUA operation to sufficient distances from airports (absent authorization) is practical and a necessary step to ensure the safety of manned aircraft. Integration of commercial UAS into controlled airspace, especially that surrounding airports, needs further study and analysis. UAS Fund is in the process of further analyzing these issues as it relates to additional more complex categories (as shown in Attachment B). The restrictions noted above for micro UA flight away from airports coupled with the 400 foot hard ceiling requirement will constrain those mUA operations to areas with extremely low probability of conflicts with other air traffic, as concluded in Attachment C.

D. Visual line of sight

Under our proposal, micro UA shall be flown at all times in locations and a manner that allows for unaided (apart from corrective lenses) visual contact of the UAS such that operational control of the UAS can be maintained and its position and location known. The pilot must be able to and actively scan airspace to see and avoid other air traffic. Regardless of visual acuity, micro UA shall not be flown beyond one half mile from the pilot at any time.

V. Additional Safety Operational Parameters

The above basic operational parameters already provide a high degree of safety simply by virtue of the low weight and operational locations of the micro UA. To these basic parameters UAS Fund has added various additional safety requirements, including a pilot knowledge requirement. Many of these additional parameters are common-sense, non-burdensome requirements that prudent commercial operators would likely adopt on their own as good business practices. By codifying these in the FARs, our proposal sets a high but reasonably attainable safety standard for commercial micro UA operators.

A. Pilot Qualification / Certification

The UAS Fund agrees that even micro UA operators who are engaged in commercial or other non-recreational activities should be required to obtain and demonstrate basic aeronautical knowledge. However, as set out below, UAS Fund disagrees that existing private pilot license or commercial pilot license schemes are the appropriate certification standard for this category of UA. Below we discuss some legal and policy issues relating to pilot certification, and then present our proposal for a micro UA pilot certification requirement.

1. Legal and policy matters

The FAA has suggested in various recent exemption documents that 49 U.S.C. § 44711 requires UAS operators (other than hobbyists) to obtain a pilot's certificate. UAS Fund disagrees that the existing types of pilot certificates are a legally mandated requirement for future UAS regulation or that such a requirement is a sound policy position for either the Department of Transportation or the United States as a whole, for a variety of reasons.

First, the statute only requires certificates for "air commerce" which has a specific definition that does not apply to UAS operations conducted under the parameters in this Petition.[4]

[4] Section 40102 defines "air commerce" to mean "foreign air commerce, interstate air commerce, the transportation of mail by aircraft, the operation of aircraft within the limits of a Federal airway, or the operation of aircraft that directly affects, or may endanger safety in, foreign or interstate air commerce. In turn, "interstate air commerce" means "the transportation of passengers or property by aircraft for compensation, the transportation of mail by aircraft, or the operation of aircraft in furthering a business or vocation— (A) between a place in— (i) a State, territory, or possession of the United States and a place in the District of Columbia or another State, territory, or possession of the United States; (ii) a State and another place in the same State through the airspace over a place outside the State; (iii) the District of Columbia and another place in the District of Columbia; or (iv) a territory or possession of the United States and another place in the same territory or possession; and (B) when any part of the transportation or operation is by aircraft." The line-of-sight operations addressed herein will not cross state lines, do not involve the transportation of mail or passengers, do not take place in Federal airways, and do not endanger the safety of those types of operations.

Second, Congress in 49 U.S.C. § 44701(f) permitted the FAA discretion to grant exemptions from any requirements in sections 44702 through 44716 of Title 49, including the pilot certificate requirement in Section 44711, in its discretion.

Third, it is abundantly clear that pilot certificates already are not required for operation of certain types of "aircraft," even when operated for commercial purposes. The operation of amateur rockets, moored balloons, kites and unmanned free balloons are all permitted, for commercial or any other purpose, without any pilot certificate at all. *See* 14 CFR § 101. Ultralight vehicles (used for recreation) and powered parachutes are similarly not subject to FAA pilot certification requirements, see parts 103 and 105, although they arguably could "endanger safety" of air commerce for purposes of applying 49 USC § 40102. The FAA has taken the position, and the NTSB Board recently ruled in a penalty adjudication case, that all of these devices fall into the statutory definition of "aircraft" under Title 49.[5] If the FAA is correct that no aircraft may be operated for a business purpose without a private or commercial pilot certificate, the decades-long license-free operation of devices listed in Part 101 is incomprehensible. The better explanation is that not every operation of an "aircraft" requires a pilot certificate and that the FAA is not mandated by statute to impose a pilot "certificate" requirement for the new category of devices known as unmanned aircraft systems, but is free to waive the requirement.

Fourth, in the 2012 FAA Modernization and Reform Act, Congress directed the FAA to implement rulemaking for unmanned aircraft systems but did not refer to a pilot certificate requirement. Rather, the rulemaking that is contemplated instructed the FAA to "(iii) establish

[5] *Administrator v. Pirker*, Docket CP-217 (NTSB Order No. EA-5730, Nov. 18, 2014) at 10 ("Though they are subject to special operating rules, the unmanned devices covered under part 101 nonetheless are 'aircraft.'")

standards and requirements for the operator and pilot of a civil unmanned aircraft system, including standards and requirements for registration and licensing." Public Law 112-95 § 332. By asking the FAA to "establish" standards and requirements, Congress signaled that the existing certification framework does not apply. Indeed, the statute does not even refer to pilot certificates, but to the more general concepts of "registration and licensing."

Fifth, although the existing pilot certification process involves security screening by the Department of Homeland Security, such screening does not enhance national security interests in the context of mUA because any person who seeks to use an mUA for purposes that could adversely impact national security can do so simply by obtaining and operating the same type of device without regard to FAA regulations. Moreover, recreational hobbyists are not required to be security-screened in this manner, so it makes little sense to impose such a requirement upon American businesses just because the purpose of their operation is commercial rather than recreational. A pilot licensing requirement for micro UA will not enhance national security.

Sixth, the private pilot and commercial pilot certificates currently available involve substantial expense and hours of time learning actual flying skills within a passenger aircraft cockpit, but those skills do not have relevance to UAS operations, particularly for the micro UA category. Micro UA are operated from the ground, looking up. Skills learned inside an aircraft cockpit including those for in-flight maneuvers, aircraft systems, emergency procedures, and navigation are of minimal utility but impose significant burdens. The financial burden associated with micro UA pilots obtaining and maintaining a private pilot or commercial license would significantly impact business operations and will drastically reduce profits expected when forming

a business, with no measurable benefit. There also will be a substantial burden on the FAA in issuing and maintaining pilot records for UA operators who will never fly a manned aircraft.

Seventh, imposing upon micro UA operators the existing pilot certification standards is unnecessarily discriminatory against Americans with disabilities because it would, for example, preclude persons who cannot maneuver themselves into or out of an airplane cockpit, or who do not have leg functionality sufficient to operate rudder pedals, from obtaining the needed certificate. Yet such persons are fully capable of operating a micro UA using a ground station or radio control, which typically involves control by moving sticks or buttons using hands and fingers. A certificate requirement involving time spent flying a manned aircraft would exclude persons with irrelevant disabilities from these new jobs and economic opportunities in the UAS field, in the absence of any rational basis for doing so.

2. Proposed certification standard

Notwithstanding the ability of the FAA to forego a micro UA pilot certification requirement, the UAS Fund agrees that UA operators even in the "micro" category, should obtain and demonstrate basic aeronautical knowledge prior to commercial (or other non-recreational) operations. Such knowledge will allow the UAS pilot to be familiar with airspace configuration, read and interpret aeronautical charts to determine airspace classification, understand NOTAM reports, meteorological conditions, fundamentals of aerodynamics, and the operation of the national airspace system in general. It is proposed, therefore, that pilots of micro UA be required only to pass the written FAA Private Pilot Knowledge Test, also known as "ground school."

The FAA written exams actually cover far more information than is relevant to UAS operations, but they do cover the key topic areas important to UA operations. Until such

time as streamlined UA-specific pilot certification programs are established by the FAA, the successful passing of a written "ground school" exam should be more than adequate for micro UA pilots to gain the aeronautical knowledge needed to ensure their safe operation of micro UA in harmony with existing airspace users.

Under our proposal, this "certificate" will be subject to suspension or revocation in the same manner as a pilot certificate, so that the FAA may exercise enforcement in the event of regulatory violations.

B. Distance from Uninvolved Persons

We understand that the FAA is also concerned about the safety of persons on the ground. Although those risks are often mitigated by state tort laws, reckless endangerment statutes, and use restrictions put into place by municipalities and other legislative bodies, we have incorporated into our framework for micro UA parameters intended to address the safety of persons on the ground.

It is proposed that operators of micro UA shall operate at least 100 feet from persons who are not involved in the specific UAS operation. Additionally, no person may operate a micro UA over an open-air assembly of persons.

Additionally, micro UA flights are only to be conducted over the operator's own property or over the property of others where either express or implicit consent has been granted by the property owner or tenant. This enhances safety as well as protecting privacy interests.

UAS Fund has incorporated the same standard as found in 14 CFR § 91.13 concerning careless or reckless operation. In our proposal, the standard has been made enforceable by Part 13, including civil penalties and suspension or revocation of the micro UA pilot certificate.

C. Use of Aural Cues

A micro UA operator has an additional sense that can be used to avoid other air traffic: hearing. In contrast, pilots of manned aircraft in either open or enclosed cockpits are never able to use sound to detect and avoid other air traffic because of their own engine noise, radio headsets, and the cockpit enclosure (hence the term "*see* and avoid" – reflecting a limitation in the senses available to a conventional pilot). Our proposal recognizes that a person on the ground operating a micro UA within visual line of sight can and should use auditory cues to detect and avoid other air traffic.

D. Meteorological Conditions

All UAS flights in this "micro" category shall be conducted in Visual Meteorological Conditions ("VMC") and may not be operated less than 500 feet below, less than 2,000 feet horizontally from, or above, a cloud or when visibility is less than 3 statute miles from the operator. These are the same operational parameters allowed for kites weighing 5 pounds or more.

All UAS flights shall be conducted during daylight (defined as between the hours of local sunrise and sunset at the time of the UAS flight), unless the UAS is equipped with an operating anti-collision light visible for at least 3 statute miles, in which case the UAS may be operated during the twilight periods 30 minutes before official local sunrise and 30 minutes after

official local sunset at the time of the UAS flight, or, in Alaska, during the period of civil twilight. This is the same parameter used for ultralight vehicles.

E. Medical

Because of the lack of persons on board whose lives would be endangered by a pilot's unexpected medical issue, and the extremely limited flight time of UAS in the micro UA category, UAS Fund proposes that no medical certificate be required for operation of this category of UAS.

Unlike a manned aircraft that, upon a pilot's medical emergency, must be navigated back to an airport potentially a long distance away or dangerously ditched in water, a field, or a roadway, a micro UA pilot operating within line of sight can very easily land the UA in seconds, in the operating area, in the event of emergent medical issues. Additionally, operation of a micro UA does not require significant physical strength as these UAS are typically controlled using remote-control sticks or buttons, and many are equipped with "auto-hover," "return to home," or "autoland" features that further mitigate risks relating to medical contingencies or in low-battery states.

Micro UA pilots shall not operate the UAS under the influence of any drug or alcohol.

F. Age requirement

In order to operate an mUA for commercial purposes, the primary pilot shall be at least 18 years' old on the date of the operation.

G. Experience with Equipment

Operators of micro UAs are required to gain experience and confidence with their specific UA equipment before conducting for-hire operations, as reflected in our proposal to require at least 5 hours of flight time and 25 takeoff-and-landing sequences. This step requires that persons familiarize themselves with their equipment while not unduly burdening experienced operators who are simply switching from one type of micro UA to another.

VI. Insurance Requirement

In order to assure the public about the safety of micro UA operations, the ability of operators to provide compensation in the event of damage or injury, and to encourage the insurance industry to develop its own safety standards for UAS operation based on underwriting principles and risk modeling, UAS Fund proposes that micro UA operators who are engaged in commercial operations be required to obtain liability insurance covering bodily injury and property damage.

In consideration of the minimal risk posed by micro UA, we propose that, initially, the very minimum level of insurance coverage required by regulation correspond to the minimum liability coverage required by law for the operation of a motor vehicle in the state(s) in which the UAS operation takes place. However, to ensure the appropriate terms and conditions for this type of operation, as well as the appropriate minimum insurance levels for the type of intended UA operation, the insurance policy must be issued specifically for UA operation by an aviation insurance carrier. The carriers may, of course, offer their own minimum policy levels that exceed the regulatory minimum. UAS Fund plans to work with the aviation insurance industry and UAS operators to develop industry-standard insurance minimums, terms, and conditions.

VII. Privacy Considerations

Issues surrounding individuals' privacy and the potential violations made possible through the use of unmanned aircraft cannot be ignored. It will be important for commercial UAS users to be respectful of others and to comply with laws protecting individuals from illegal surveillance and other violations of civil liberties.

It is expected that individual state and local governments will continue to set the legal framework for acts involving physical invasions of privacy, and should be the primary enforcement mechanism given the FAA's primary role as an aviation safety body. Further, we understand that the National Telecommunications and Information Administration and Department of Commerce are anticipated to craft federal privacy guidelines for commercial UAS in the near future.

VIII. Economic Benefits

Micro UA applications are prevalent in key industries pushing for the growth and adoption of transformational UAS technologies capable of generating direct and immediate benefits to domestic businesses, including immediate opportunities in industries, such as the following: aerial photography, real estate, news gathering and reporting, small-scale farming inspections and monitoring, infrastructure inspections, search and rescue, firefighting response, training and certification, among others. With the focus of many micro UA applications being to either increase efficiencies through cost savings or reducing risk to people and property, commercial interests fall in direct alignment with the FAA's position on public safety and risk aversion, alleviating the need for burdening regulation and associated costs.

The new business opportunities and economic development enabled by micro UA technologies will only be realized in an accommodating commercial environment that encourages adoption by limiting the placement of overburdening regulation. Liberating a micro UA class of operations from unnecessary regulatory burdens will favorably accelerate benefits by fast-tracking pathways to operationally-compliant and low-risk applications under minimal regulation, while upholding and emphasizing the FAA's primary mission of ensuring public safety.

The current void of regulations for UAS operations (notwithstanding a handful of individual "Section 333" exemptions that each take months to issue) significantly influences the decisions of UAS operators in such a way that the market size and economic impact of the business activity falling under the proposed micro UA regulation is difficult to quantify. However, with the industries mentioned above, the market impact, both with and without regulation, can be estimated as a fraction of the overall industry, amounting to billions of dollars of lost economic development. For example, if UAS were to represent only 2% of 2013 GDP for selected NAICS Code categories (i.e., agriculture, forestry, mining, secondary education, insurance, and motion picture/video industries) the economic impact attributable to UAS would be over $12.6 billion.

Further, substantial cost savings throughout the FAA can be realized with the adoption of micro UA regulations such as that proposed herein. Absent regulation allowing commercial and other non-recreational UAS operations, such as the current environment set forth by the FAA in its recent "Interpretation of the Special Rule for Model Aircraft," presents an environment where operators skirt safety considerations and present FAA with a significant enforcement challenge. By opening up this low weight and operationally-restricted segment of the market, FAA safety inspectors, attorneys, and other staff will be freed from the burden of pursuing

persons who are operating pursuant to a clear set of safety regulations. Related, there should be significant savings by introducing risk-based rules, starting with the smallest, safest operations and progressing to more complex operations requiring more complicated and restrictive regulatory frameworks in due course, and these savings will be bolstered by enormous economic benefits afforded at little cost to the government. Additional information relative to the economic benefits expected through the adoption of micro UA regulations can be found in Attachment D.

IX. Statement Pursuant to 14 CFR § 11.71

We set out the following information with regard to 14 CFR § 11.71(a):

(1) The name and mailing address of petitioner is indicated on the first page of the petition.

(2) Petitioner proposes to add to and amend the federal aviation regulations in the manner set out in Attachment A. The purpose is to establish a regulatory framework for the operation of a specified category of unmanned aircraft in the United States.

(3) The language petitioner proposes for the new rule is set out in Attachment A.

(4) As set out in detail above as well as Attachment D, the proposed action is in the public interest because it unlocks the tremendous economic benefits of lightweight unmanned aircraft systems, provides a specific safety framework for commercial operators to comply with (compared to the absence of specific safety parameters today), and relieves the FAA to focus on rulemaking for larger and more complicated unmanned aircraft systems.

(5) Information and arguments supporting petitioner's proposed action are set out above in detail, and include the UAS Safety Analysis performed by Dr. Adam Dershowitz annexed

as Attachment C and the economic impact analysis annexed as Attachment D. We also note recent testimony at Congressional committee hearings in which lawmakers and witnesses testified to the tremendous benefits to the nation that will be realized by the operation of commercial unmanned aircraft systems.

(6) We have set out above specific facts and circumstances supporting and demonstrating the need for this proposed rulemaking action. We highlight here the fact that other countries are moving forward with less stringent regulation of smaller unmanned aircraft as well as the tremendous demand across countless industries for access to this technology within a clearly defined and reasonable set of safety parameters (that do not currently exist). The current framework, in which the FAA requires case-by-case waiver applications requiring at least 4 months to be processed as well as specific COA approval for airspace thereafter, is insufficient to support the economic needs of the nation and creates an unnecessary administrative burden on the FAA along with substantial budgetary requirements. The fact that the FAA's notice of proposed rulemaking for UAS up to 55 pounds is estimated to take at least 18 months to two years to be finalized is a specific circumstance calling for immediate implementation of our proposal by final direct rule.

We set out the following information with regard to 14 CFR § 11.71(b):

(1) The benefits of our proposed action to society in general are enormous. We have included an economic impact study as Attachment D. The proposal will also offer environmental benefits in applications involving agriculture, wildlife monitoring and environmental studies. The costs to society are zero because operation of micro unmanned aircraft pursuant to the parameters we propose adds no significant risk to airspace users, protects persons

on the ground, and includes an insurance requirement. On the contrary, by providing a safety framework for commercial operations, our proposal reduces existing costs to society by creating a specific safe operating framework as well as reducing the burden on government to investigate or take enforcement action.

(2) The regulatory burden of our proposed action on small businesses, small organizations, small governmental jurisdictions, and Indian tribes was specifically designed to be minimal while maintaining conservative safety standards. For example, we have addressed micro UA pilot certification standard so as to keep the cost and burden minimal and therefore within reach of small businesses. The insurance requirements track what is required by states for automobile drivers and is therefore a reasonable burden.

(3) There are minimal recordkeeping and reporting burdens. A log book of training as well as operational flights is a straightforward and familiar requirement. Once an operator is qualified by possessing the written-test micro UA license, reporting is only required in the event of significant third-party property damage or serious injury.

(4) The proposed action will benefit natural and social environments. Battery-powered micro UA can achieve many important, valuable tasks with no impact on the environment, particularly compared with noisy, fuel-consuming manned aircraft operations (if such operations are even possible). The proposal also is beneficial for social environments by establishing safety parameters for micro UA operations at social and sporting events or near other gatherings of people.

X. Considerations under 14 C.F.R. § 11.73

The UAS Fund's petition satisfies all criteria set out in 14 C.F.R. § 11.73 with respect to regulations of amendments based on a petition for rulemaking.[6]

A. The immediacy of the safety or security concerns

Currently, there are no specific regulations focused upon or applicable to unmanned aircraft systems. A notice of proposed rulemaking has been drafted, but finalization is not anticipated to occur until 2016 at the earliest. In the interim, countless individuals and businesses have proceeded with UAS operations for commercial, scientific, research and other purposes because of the extraordinarily compelling benefits of the technology as applied. In the absence of specific regulations, these operators lack any specific operational guidance or safety standards to aspire to. This Petition provides one such standard, expressly establishing a framework for UAS operations in a 3-pound or below category, requiring that pilots obtain a reasonable and demonstrated level of aeronautical knowledge, and insurance prior to operation, among other requirements, in very controlled and limited conditions. This Petition also addresses concerns voiced recently by the FAA Administrator and Members of Congress[7] that the lack of any specific UAS regulatory framework poses an immediate safety concern for users of the national airspace system.

[6] UAS America Fund requests that this Petition be treated as a separate action from the current NPRM process concerning small unmanned aircraft systems because, we believe, that rulemaking concerns regulations pertaining to UAS below 55 pounds and is subject to lengthy notice and comment procedures. This Petition requests adoption of a direct final rule concerning UA that weigh 3 pounds or less.

[7] Hearing of the House Committee on Transportation, December 10, 2014.

B. The priority of other issues the FAA must deal with

Among its many other obligations, the FAA is occupied with the task of establishing a regulatory framework for UAS that are 55 pounds and below. UAS Fund agrees that as UAS weight and altitude increase, additional regulatory safeguards are called for. Those ought to be the focus of the agency's rulemaking attention. The operation of very lightweight UAS at very low altitudes and away from airports are a relatively low priority for the FAA because those operations pose such little risk compared to other UAS operations at higher altitudes or closer to airports where conflicts with general and commercial aviation air traffic are more likely.

C. The resources the FAA has available to address these issues

The Petition is designed to conserve FAA resources by segmenting the UAS regulatory framework based on risk. Exemption applications under FMRA Section 333 have already created a significant burden on commercial companies seeking the ability to operate in the U.S., as well as a large burden on the FAA in order to review, respond to, and ultimately grant operations to take place. The category addressed by this Petition is the one requiring the least oversight by the FAA, conserving agency resources (with respect to rulemaking, pilot certification and enforcement). Not only will opening up this segment to commercial operations relieve the significant on the FAA such as the efforts necessary to maintain the Section 333 exemption program, but it will importantly allow FAA to redirect those resources to further define and focus activities around other more complex segments of the market. Moreover, UAS Fund has enclosed a safety study establishing the low risk posed by very small UAS.

XI. Conclusion

As noted throughout this Petition, the implications for allowing commercial operations of micro UA weighing no more than three pounds operating below 400 feet and well-clear of airports, other air traffic, and uninvolved persons/property on the ground, along with the other restrictions and considerations stated throughout, is reasonable and a practical first step for opening up the United States to UAS opportunities for commercial users, and in a safe manner. Implementation of an incremental-based rule-making environment will allow for consideration of more complex operations and operating environments to be complemented with appropriate technical, regulatory, and certification requirements, but there should be no delay in allowing commercial UAS operations to proceed immediately.

In addition, the ability for non-recreational UAS operations specifically for research, development, and product innovation is critical to UAS Fund's ability to make investments, along with other capital partners, in such a manner as to significantly drive the industry forward. These operations, as restricted as noted herein, pose no little to no additional threat to aircraft or persons and property on the ground compared to small and medium sized birds that are already present in the airspace system today. The ability for governments, companies, and individuals to utilize UAS for non-recreational purposes will create considerable economic development even at this very small micro UA segment of the full market.

Industry, academia, and most importantly the U.S. Congress have been demanding quicker action on the FAA's part relative to regulation of UAS, and only a portion of the items required by Congress of the FAA in the 2012 FAA Modernization and Reform Act have been achieved on the schedule defined in that legislation. Delays by the FAA and its uncertainty

disseminated to the industry on rules governing UAS operations is causing tens of millions of dollars in lost economic development for our nation's economy, an inability for citizens to benefit from the impacts that UAS can bring such as those in law enforcement and public safety as well as the risks to the public from non-sanctioned commercial operators flying in the absence of specific regulations, and a real slippage in the United States' position as the industry leader in aerospace research, development, and technological innovation, a pathfinder role the USA has held since the birth of aviation itself.

UAS Fund plans to work closely with FAA to continue to assist in developing a rulemaking process to continue to allow further commercial applications and uses of UAS while promoting a safe environment for all and leveraging technological improvements and advancements to ensure public safety. The market segmentation offered by UAS Fund and shown in Attachment B highlights one method for incremental risk-based legislative action.

Filed: December 18, 2014

ATTACHMENT A

PROPOSED REGULATIONS FOR MICRO UNMANNED AIRCRAFT

PROPOSED 14 CFR Part 107

UAS America Fund LLC
Micro Unmanned Aircraft
Proposed Part 107

§107.1 Applicability.

This part prescribes rules governing the operation of micro unmanned aircraft in the United States. For purposes of this part, a micro unmanned aircraft means a device capable of sustaining its own powered flight in the air, that is operated without the possibility of direct human intervention from within or on the device, and that:

(a) weighs 3 pounds or less gross takeoff weight, including power source and payload;

(b) is powered by an electric battery or other non-combustion power source;

(c) is operated for a business, commercial, scientific, academic, research or other non-recreational purpose; and

(d) is not a "model aircraft" subject to Public Law 112-95 § 336.

§107.3 Waivers.

No person may conduct operations that require a deviation from this part except under a written waiver issued by the Administrator.

§107.5 Careless or reckless operations.

(a) No person may operate a micro unmanned aircraft in a careless or reckless manner so as to endanger the life or property of another.

(b) No person may allow an object to be dropped from a micro unmanned vehicle if such action creates a hazard to other persons or property.

§107.7 Certification, registration and other requirements.

(a) Notwithstanding any other section pertaining to certification of aircraft or their parts or equipment, micro unmanned aircraft and their component parts and equipment (including ground station or radio control systems) are not required to meet the airworthiness certification standards specified for aircraft or to have certificates of airworthiness.

(b) Notwithstanding any other section pertaining to registration and marking of aircraft, micro unmanned aircraft are not required to be registered or to bear markings of any type, except that the name, address, and telephone number of the owner or operator

shall be affixed to at least two externally visible locations on the micro unmanned aircraft.

(c) Notwithstanding any other section, micro unmanned aircraft operated pursuant to this part are not subject to any other federal aviation regulation, including any provision of parts 21, 45, 47, 61, or 91.

§107.9 Daylight operations.

(a) No person may operate a micro unmanned aircraft except between the hours of sunrise and sunset.

(b) Notwithstanding paragraph (a) of this section, micro unmanned aircraft may be operated during the twilight periods 30 minutes before official sunrise and 30 minutes after official sunset, or, in Alaska, during the period of civil twilight as defined in the Air Almanac, if:

(1) The micro unmanned aircraft is equipped with an operating anticollision light visible for at least 3 statute miles; and

(2) All operations are conducted in uncontrolled airspace.

§107.11 Operation near aircraft; right-of-way rules.

(a) Each person operating a micro unmanned aircraft shall continually maintain vigilance so as to see and avoid aircraft and shall yield the right-of-way to all manned aircraft.

(b) No person may operate a micro unmanned aircraft in a manner that creates a collision hazard with respect to any aircraft.

(c) Each person operating a micro unmanned aircraft, upon hearing engine, rotor, or propeller sounds from an aircraft uninvolved in the operation, shall take precautionary steps to identify the altitude and flight direction of the uninvolved aircraft and yield right of way.

§107.13 Operating limitations: altitude, airspace and locations.

(a) No person may operate a micro unmanned vehicle at an altitude greater than 400 feet above ground level (AGL).

(b) No person may operate a micro unmanned vehicle within Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport, unless that person has prior authorization from the ATC facility having jurisdiction over that airspace.

(c) No person may operate a micro unmanned aircraft within 5 nautical miles of the geographic center of an airport as denoted on a current FAA-published aeronautical chart unless that person has prior written authorization from that airport's management. This restriction does not apply to airports that are closed or abandoned.

(d) No person may operate a micro unmanned aircraft beyond his or her visual line of sight (VLOS). During the flight operation, the operator must be able to view the micro unmanned aircraft at all times using his or her own natural vision (which includes the use of vision corrected by standard eyeglasses or contact lenses but excludes the use for flight navigation purposes of vision-enhancing devices such as binoculars, night vision goggles, powered vision magnifying devices, or video glasses designed to provide a "first person view" from a camera mounted on the micro unmanned aircraft), and must visually scan the surrounding airspace to see and avoid other air traffic. The maximum operating distance of a micro unmanned aircraft system from the operator under this subsection is 2,640 feet, regardless of the visual acuity of the operator.

(e) No person may operate a micro unmanned aircraft closer than 100 feet from any persons uninvolved in the operation.

(f) No person may operate a micro unmanned aircraft over an open-air assembly of persons.

(g) No person may operate a micro unmanned aircraft in special use airspace designated under Part 73 unless that person has permission from the using or controlling agency, as appropriate.

(h) No person may operate a micro unmanned aircraft over privately-owned property without the express or implied permission from the property owner, tenant in possession, or an authorized representative thereof.

(i) No person may operate a micro unmanned aircraft system within 5 nautical miles of any forest fire without authorization from the incident commander.

(j) Prior to operating a micro unmanned aircraft under this part, the operator shall become familiar with all pertinent information concerning the proposed operational location, including but not limited to review of relevant NOTAMs.

(k) Any person intending to operate a micro unmanned aircraft within one mile of any active emergency shall first check for any NOTAMs with respect to restrictions on operations in that location.

§ 107.15 Meteorological conditions.

All flights under this part must be conducted under visual meteorological conditions. A micro unmanned aircraft may not be operated under this part less than 500

feet below, or less than 2,000 feet horizontally from, a cloud, or when visibility is less than 3 statute miles from the operator.

§107.17 Operating limitations: ground speed.

No person may operate a micro unmanned aircraft in excess of 40 knots ground speed.

§107.19 Operator qualifications.

(a) An operator of a micro unmanned aircraft system under this part must be at least 18 years of age.

(b) No person may operate a micro unmanned aircraft system under this part without first passing the FAA private pilot written airman knowledge test administered by an FAA-accredited pilot school or test center. Prior to any operation under this part, the operator shall send written notification to the FAA evidencing the test results together with the operator's name and contact information, which submission the Administrator will acknowledge in writing as constituting the operator's micro unmanned aircraft pilot certificate for purposes of 49 USC § 44711. This subsection shall not apply to micro unmanned aircraft systems operated as public aircraft.

(c) The FAA may pursue investigation and enforcement procedures set out in part 13 with respect to the operator of a micro unmanned aircraft systems, including potential suspension or revocation of a micro unmanned aircraft pilot certificate held by its operator.

(d) Any other FAA pilot certificate that has as a requisite a written airman knowledge test may, if said certificate is current and in good standing, serve as a micro unmanned aircraft pilot certificate under subsection (b) even if the operator is unable to provide evidence of his or her written test results. Such pilot certificates will constitute the operator's micro unmanned aircraft pilot certificate for purposes of 49 USC § 44711 and part 13.

(e) No person shall operate a micro unmanned aircraft for hire or for a commercial purpose (other than research and development activates relating to the micro unmanned aircraft or its related systems and components), without first undertaking and documenting the following steps to gain experience and proficiency with the micro unmanned aircraft model:

(1) Review of the micro unmanned aircraft manufacturer's operating manuals and any instructional videos provided by the manufacturer;

(2) at least 5 hours of total operating flight time; and

(3) at least 25 takeoff-and-landing sequences.

(f) All operations under this part (including training) shall be documented and recorded in a permanent place such as a log book. For the purposes of meeting the minimum requirements of this subsection, each person must record the following information for each micro unmanned aircraft flight:

(1) Date and time
(2) Micro unmanned aircraft type, make, model
(3) Route and boundaries of flight
(4) Total duration of flight
(5) Weather conditions of flight
(6) Number of landings
(7) Total flight time and/or lesson time
(8) Remarks or other pertinent details

§107.21 Alcohol or drugs.

(a) No person may operate a micro unmanned aircraft —

(1) Within 8 hours after the consumption of any alcoholic beverage;

(2) While under the influence of alcohol;

(3) While using any drug that affects the person's faculties in any way contrary to safety; or

(4) While having an alcohol concentration of 0.04 or greater in a blood or breath specimen. Alcohol concentration means grams of alcohol per deciliter of blood or grams of alcohol per 210 liters of breath.

§107.23 Insurance.

(a) No person shall operate a micro unmanned aircraft for hire or for a commercial purpose (other than for research and development of the micro unmanned aircraft or its systems and components) unless he or she has in effect liability insurance coverage that at a minimum meets or exceeds the minimum motor vehicle insurance coverages for both property damage and bodily injury required in the state in which the operation occurs, and that has been issued specifically to insure against risks of the operation of the micro unmanned aircraft.

(b) Insurance coverage to meet the requirements of this part shall be obtained from one or more of the following:

(1) An insurer licensed to issue aircraft accident liability policies in any State, Commonwealth, or Territory of the United States, or in the District of Columbia; or

(2) Surplus line insurers named on a current list of such insurers issued and approved by the insurance regulatory authority of any State, Commonwealth, or Territory of the United States or of the District of Columbia.

(c) All person who have operated micro unmanned aircraft under this part must present their logbook, proof of insurance, and evidence of submission to the FAA Administrator their written test results or their valid pilot certificate, or any other record required by this part for inspection upon a reasonable request by—

(1) The Administrator;

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

(3) Any Federal, State, or local law enforcement officer.

§107.25 Accident reporting.

In connection with any operation under this part, any incident involving $1,000 or more in third-party property damage, and any accident involving any bodily injury, must be reported to the nearest FAA Flight Standards District Office within three business days. Accidents involving a serious injury or death shall be reported to the NTSB pursuant to 49 CFR § 830.

ATTACHMENT B

UAS AMERICA FUND MARKET SEGMENTATION FOR UNMANNED AIRCRAFT SYSTEMS

Initially, reasonable and logical market segmentations, and their associated regulatory requirements, are possible

	Regulatory Requirements														Technical Requirements					Certification Requirements			
Example Applications	**Low Altitude (below 400' AGL)**	**High Altitude (above 400')**	**Micro UA (< 3 lbs)**	**Small/Large (>3 lbs)**	**Non-populated Area**	**Populated Area**	**Public Property**	**Private Property with Permission**	**Line of Sight**	**Beyond Line of Sight**	**Daytime VFR**	**Nighttime**	**IFR**	**Insurance Necessary**	**Geo-fencing**	**Return to Orgin / Fix**	**Collision Avoidance System**	**Constant Position Reporting**	**Descent Control**	**Pilot (UAS-specific)**	**Aircraft (UAS-specific)**	**Operator (UAS-specific)**	**Incremental characteristics of each category**
Recreational Flights: Minimal Regulations																							
Hobbyist and recreational flights	●		●		●	●	●	●	●		●												Base hobby / recreation category
Recreational Flights: Certification & Technical Requirements																							
Hobbyist and recreational flights	●		●		●	●	●	●	●	●	●					●			●	●			Adds FPV / BLOS
Commercial Flights - Category 1A (Micro Unmanned Aircraft): Minimal Regulations																							
Close-proximity and Line-of-Sight commercial operations such as: - Training & certification - Aerial photography - Infrastructure inspection - Small-scale precision agriculture - Firefighting, discrete-area SAR - Insurance investigation	●		●		●		●	●	●		●			●						●			**Base commercial Category 1A - Micro Unmanned Aircraft** Additional commercial categories (1B, 1C,etc) expected to be added incrementally, over time and with sufficient supporting information to justify economic impacts and safety concerns. Anticipated future categories: - Increased weight thresholds (5#, 10#, 25#, etc) - Higher tiered altitude limits (floor of Class E or D) - Increasingly robust Pilot certification requirements UAS-specific pilot certificate will be required
Commercial Flights - Category 2: Minimal Certification / Regulation and Technical Requirements																							
Aerial imaging, Surveys, Photogrammetry, Agriculture, etc	●		●		●	●	●	●	●		●	●		●	●	●				●			Adds allowance for flights over **populated areas**, with geo-fencing and return technology, and **nighttime** flights
Commercial Flights - Category 3: Pilot, Aircraft, & Operating Certifications Necessary and Technical Requirements																							
Dispersed-area operations such as long-distance BLOS flights for - Search & Rescue - Infrastructure inspection - Agriculture monitoring, etc	●		●	●	●	●	●	●	●	●	●	●		●	●	●		●	●	●	●	●	Adds allowance for **BLOS** when pilot, aircraft, and operator obtain UAS-specific certification; Adds **large aircraft** operations when obtaining UAS-specific aircraft certification; Adds requirement for on-board constant position reporting and descent control
Commercial Flights - Category 4: Full Certification Necessary and full suite of Technical Requirements required																							
No restrictions - governed by Operating Certificate(s) and aircraft limitations	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Adds **high altitude** and **IFR** allowances; NAS integration necessary if flying in controlled airspace

Across all categories, the following are assumed:
- **Common-sense operating rules**
- **No careless or reckless flight**
- **Fly in good weather conditions**
- **Respect others' privacy**
- **No-fly restrictions: near airports, over crowds, etc.**

UAS AMERICA FUND
A PPP FOR AEROSPACE PROGRESS

ATTACHMENT C

UAS SAFETY ANALYSIS

Exponent®

UAS Safety Analysis

December 16, 2014

Exponent Project No. 1408989.EX0

Exponent®

December 16, 2014

Mr. Matthew Bieschke
UAS America Fund, LLC
2020 K St. NW, Suite 520
Washington, DC 20006

Mr. Brendan Schulman
Kramer Levin Naftalis & Frankel LLP
1177 Avenue of the Americas
New York NY 10036

Subject: UAS Safety Analysis
Exponent Project No. 1408989.EX0

Dear Mr. Bieschke and Mr. Schulman:

Attached please find the UAS Safety Analysis report, prepared at the request of UAS America Fund, LLC and Kramer Levin Naftalis & Frankel, LLP.

Sincerely,

Adam Dershowitz

Adam Dershowitz, Ph.D., P.E.
Managing Engineer

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Introduction

At your request, Exponent Failure Analysis Associates (Exponent) has conducted a preliminary analysis of some of the risks related to micro Unmanned Aerial Vehicles (UAVs) operating in the National Airspace System (NAS). While currently there is little data available for any impacts that might have occurred, there is significant data available on bird strikes on aircraft. Accordingly, birds were used as an analog to UAVs for the purposes of this analysis. This report sets forth the conclusions reached from the analysis.

Background

UAVs, commonly referred to as "drones," are unmanned flying vehicles. The FAA is currently going through the process of developing new regulations for the use of these vehicles in the NAS. However, there is a dearth of data about the risks posed by the operation of these vehicles. As the vehicles, by definition, do not have anyone on board, there is no risk to any passengers. However, there is potential risk to others that might be presented by Unmanned Aerial Systems (UASs[1]). One of the large concerns relates to the interactions between UAVs and manned aircraft in the NAS, and the risk posed by these interactions.

It is common for aerospace vehicles to be segregated by weight for analysis and regulation. In many countries that have adopted or proposed regulations for UASs, the regulations are governed by weight category. For the purpose of this report, a weight of three (3) pounds and below is used to define this category of vehicle (micro UAVs).

In order to assess the risk to existing manned aircraft posed by micro UAVs, some data is required. Data is currently lacking as to damage caused by micro UAVs; however, there is a large FAA Wildlife Strike Database (http://wildlife.faa.gov/). The full FAA database includes both military and civilian reports. While this database does not include every bird strike, the FAA estimates that it represents 39% of all bird strikes.[2] It is likely that less significant events are more highly under-reported. No attempt was made to adjust for any such potential bias that might occur in the database. The database was downloaded in August of 2014, and includes bird strike data going back to 1990. Since the inception of the bird strike database, the FAA has encouraged reporting of wildlife aircraft strikes. On 12/22/04 it issued Advisory Circular 150/5200-32A which "explains the importance of reporting collisions between aircraft and wildlife". On 5/31/2013 it was updated as 150/5200-32B which states, "Studies have shown that strike reporting has steadily increased over the past two decades."

As birds are similar in weight to micro UAVs, Exponent decided to assess whether birds could be used as a surrogate for UAVs in evaluating collisions, and then to use the birdstrike database to analyze the risk presented to aircraft by micro UAVs until better data becomes available. Using birdstrike data is reasonable because while there are many factors involved in the detailed impact dynamics between two objects, the most important is kinetic energy. The kinetic energy (KE) of an impact is defined as:

$$KE=1/2*m*V^2$$

Where m is the mass of the incoming object, and V is the closing velocity. The specifications of several current micro UAVs were reviewed and found to have a maximum speed of approximately 35 MPH. Maximum bird speeds are generally higher, although like UAVs they have a very wide range depending on the species[3] and do not often fly at maximum speed.

[1] A "UAS" represents the system made up of components including such things as the vehicle (UAV), the operator and the radio control system

[2] http://www.nbaa.org/ops/safety/20120921-dot-asks-faa-to-do-more-to-reduce-bird-strikes.php

[3] https://web.stanford.edu/group/stanfordbirds/text/essays/How_Fast.html

While specific collision geometry is important, the closing speed of these impacts is dominated by aircraft flight speed. Similar sized birds and UAVs are thus likely to have similar impact kinetic energy. The details of the impact can be relevant, but the primary determination of damage is the KE.

The Wildlife Strike Database divides birds by size into three categories. Instead of providing strict weight divisions, the FAA presents examples of each. A sparrow is considered small, a gull is considered medium, and a vulture is considered large. As gulls can weigh up to 3.8 pounds, the small and medium birds in the database were used to represent the micro UAVs of interest, with a maximum weight of 3 pounds.

While the FAA has not yet released proposed rules for UAS operation, several options for proposed rules have been discussed. For this analysis, it was assumed that initial regulations would require that micro UAVs, at or below 3 pounds., would operate 5 miles or more from airports and would remain at or below 400 feet. Most civilian airplanes operate at or above 500 feet from the ground.

It should be noted that some aircraft types have certification requirements for safety against bird strikes. Transport category turbine powered aircraft are certified to continue flying safely after receiving an 8 lb bird strike to the tail and a 4 lb bird strike to the windshield or other structure at specified velocities. The engines must not have a "hazardous engine effect" after ingesting up to an 8.03 lb bird (the specific bird weight depends on engine inlet throat area).[4] Recent transport category rotorcraft are certified for at least a safe landing after impact with a 2.2 lb bird[5]., Most General Aviation aircraft and helicopters do not have any bird strike resistance or testing as part of their certification basis. They are not required to have engines or canopies/windshields resistant to any particular size, weight, or closing velocity of birds.

[4] Federal Aviation Regulations 25.571, 25.631, 25.775 and 33.76

[5] Federal Aviation Regulation 29.631

Analysis

The FAA Wildlife Strike Database was found to contain a total of 151,305 strike reports for the 24.5 years catalogued from 1990 to the present. Of these, 136,624 (90%) included small or medium sized birds. There are 13,906 (9%) reports where there was an indication of damage to an aircraft and there are 230 (0.15%) reports with an injury or a fatality involved.

The database was used to analyze the number of collisions reported in the database that occurred where UAVs would be allowed to operate under the proposed regulations discussed above. The initial database searches were for to small- and medium-size birds strike reports that occurred 5 or more miles from airports and at or below 400 ft. Using those parameters, no injuries or fatalities were caused by small or medium birds in the database. That same search shows two cases of damage to aircraft, both reported as minor ("simple repairs or replacements"). In one of the instances with damage, there was a hole in the chin bubble of a helicopter, and in the other there was delamination of the radome of an airplane.

For completeness the search was also repeated with a reduced exclusion area of three miles from airports, and reproducing the altitude threshold of 400 ft. For small- and medium-size birds, there are no fatalities and no injuries. This search finds five reports of damage to aircraft, all minor . (Note that these five include the two listed above for the five-mile radius search.) There are 15 reports of any impacts, with or without damage, occurring 3 or more miles from airports and at or below 400 feet, and 3 for the 5 mile threshold. This demonstrates both that the database does include non-damaging impacts, and additionally that a large portion of reported impacts include some damage.

The above searches include only records that indicate both an altitude and a distance from an airport. Many entries have one or both of those fields blank, and a manual review of the data revealed that some of those contained bird strikes for such things as pipeline patrols, helicopters ferrying personnel to oil rigs, or law enforcement activities over a city. Even though many of these incidents may be within a few miles of an airport, an additional search was run to include them as if they were all far away from an airport.

Searching for records that indicate an altitude at or below 400 ft, AND that have a phase of flight of "En Route" when no distance is available, to the 3 mile results above gives a total of 37 reports of damage to aircraft, 6 with injuries, and no fatalities. For a 5 mile threshold, this expanded search gives a total of 34 reports of damage to aircraft, 6 with injuries and no fatalities.

Finally, the database was searched to locate all fatalities associated with small- or medium-size birds in any location. This very broad search returned three reports. However, two of those reports were cases in which witnesses reported birds near the aircraft, but the NTSB was not able to confirm that there were in fact bird strikes[6]. The above results are summarized in Table 1.

[6] NSTB numbers: FTW94FA158, NYC98FA073, and CEN09MA117

Table 1 Summary of database query results

Threshold	#Events with Damage	#Events with Injuries	#Events with Fatalities	#Events w/o Damage
400 ft/5 miles	2	0	0	1
400 ft/3 miles	5	0	0	10
400 ft/5 miles or enroute	34	6	0	
400 ft/3 miles or enroute	37	6	0	
All reports	13906	230		
All small/medium birds in any location			3	

Additionally, the NTSB Aviation Accident Database was searched for fatal bird strikes prior to 1990. Only three fatal accidents were found that could be potentially small or medium sized birds, in addition to those mentioned above. In these three the bird size was not listed, so it was not possible to determine if any of them were a good surrogate for micro UAV impact. All three occurred prior to 1990, so would not have been included in the FAA Wildlife Database[7].

There are some limitations in this analysis. The analysis assumes that UAVs and birds will operate in the same way, and will be distributed in the NAS the same way. Birds tend not to fly at high altitudes, and thus the database would be expected to show more strikes at low altitude. Additionally, it assumes that any impact severity is primarily governed by velocity and mass. In fact, the specific structure and density of the objects involved will play a part in the details of any collision. This analysis is also based on the assumption that UAVs will not be intentionally operated near manned aircraft, such as those conducting law enforcement and news related activities. Despite these limitations, until better data is available bird effects may serve as an approximation of the effects of UAVs on the NAS. Birds and micro UAVs can both operate over a very wide speed range, so a general-impact speed cannot be assumed for either one.. UAVs will probably fly much less frequently than birds do so simply comparing populations and extrapolating numbers may not lead to reliable conclusions.

[7] NTSB numbers: MIA67A0043, LAX80FA005, and ATL82FLJ03

Conclusions

It is estimated that there are 10 billion birds in the United States[8]. While these birds do not fly at all times, they do spend a large amount of their time in the air. The extreme rarity of any collisions between birds and aircraft away from airports and at low altitude, despite the population of 10 billion birds, suggests that unintentional impact between UAVs and manned aircraft away from airports and low altitude will always remain extremely unlikely.

Analysis of the full 24.5 years of available FAA data using the proposed UAV regulations of 400 ft. and 5 miles from airports (including "en route" operations of unreported distance from airport), with small- and medium-size birds as a surrogate for UAVs, shows that there were 34 cases of damage to aircraft in collisions with small and medium size birds. This search found only 6 collisions resulting in injuries and none resulting in fatalities within these parameters. Based on the FAA Wildlife Strike database there is no indication that allowing UAVs of three pounds or less to operate at least 5 miles from airports and at or below 400 feet will pose a significant increase in risk to manned aircraft.

[8] *See, e.g.*, http://www.nytimes.com/2011/01/18/science/18birds.html?_r=0 and http://www.motherjones.com/kevin-drum/2011/03/how-many-birds. For a collection of sources concerning this estimate, *see* http://birdstuff.blogspot.com/2002/07/how-many-birds-are-there.html

Limitations

The study presented in this report is intended for use by UAS America Fund, LLC and its counsel Brendan Schulman to assist with a proposal for rulemaking related to operations of micro UASs, and is not intended to address all issues with respect to operation of micro UASs. Application of this report requires recognition and understanding of the limitations of both the scope and methodology of the study. Any use of the conclusions in this report is at the sole risk of the reader.

The scope of the study was the analysis of the FAA Wildlife Strike Database using birds as surrogates to UAVs to assess some of the risk posed by micro UASs.

The risk assessment methodology forming the basis of the results presented in this report is based on mathematical and statistical modeling of physical systems and processes as well as data from third parties. Given the nature of these evaluations, significant uncertainties are associated with the various hazard and loss computations. These uncertainties are inherent in the methodology and subsequently in the generated hazard and loss results. These results are not facts or predictions of the loss that may occur as a result of future events or any specific event; as such, the actual losses relevant to this study may be materially different from those presented in this study. Furthermore, the assumptions adopted in determining these loss estimates do not constitute the exclusive set of reasonable assumptions, and use of a different set of assumptions or methodology could produce materially different results.

If you have any questions or require additional information, please do not hesitate to contact me at (212) 895-8105 or adershowitz@exponent.com.

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Dr. Adam Dershowitz is a Managing Engineer in Exponent's Thermal Sciences practice. Dr. Dershowitz specializes in aeronautical and astronautical engineering. He has expertise in aircraft and spacecraft systems and instrumentation. Dr. Dershowitz studies the interactions of complex systems, including human in the loop systems; airplane and helicopter icing; manned and unmanned space vehicles; cockpit displays; control of vehicles; decision making; safety critical software; and software failures. He models and analyzes vehicles, systems, and their accidents, and analyzes and presents high dimensionality and complex data.

Prior to joining Exponent, Dr. Dershowitz worked at Johnson Space Center for United Space Alliance. There, he worked in NASA's Mission Control Center on the motion control system of the International Space Station, designed and researched advanced technology solutions for Mission Control, and served as a member of the orbital debris analysis team for the Shuttle Columbia accident investigation. Dr. Dershowitz has significant teaching experience, both in the classroom and as a certified flight instructor.

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M.S., Aeronautics and Astronautics, Massachusetts Institute of Technology, 1991
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NASA Certificate of Recognition from Inventions and Contributions Board, 2005; Nominated NASA Software of the year, 2003; NASA Spaceflight Awareness Award, 2002; Recipient Best Paper Award at AIAA Guidance, Navigation and Controls Conference, 2002; USA Superior Achievement Recognition Award for Technical Achievement, 2001; USA Employee of the month for Technical Achievement, August 2001; NASA Astronaut Selection Finalist, 2000; Nominated to be one of M.I.T. Aero/Astro XVI sixteen "whose innovation and vision for the future will help to create a future of opportunity," NASA Certificate of Recognition and cash award "For the creative development of a technical innovation which has been proposed for publication as a NASA Technical Brief, "August 1996; Distinguished Contributor, B.F. Goodrich Collegiate Inventors Program, April 1992; Hunsaker Teaching Fellowship at M.I.T., awarded 1991

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Dershowitz A, Reza A, Schroeder S. What happened? How an engineering laboratory can help you figure it out!" 2006 Winter Meeting of the California Conference of Arson Investigators, San Luis Obispo, CA January 30–February 1, 2006.

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ATTACHMENT D

MICRO UAS – ECONOMIC IMPACT IMPLICATIONS

Micro UA - Economic Impact Implications

Overregulation of industries and markets, particularly growing emerging markets, induces consequential effects for individual stakeholders and on the economy and country as a whole. Micro UA applications are in key industries pushing for the growth and adoption of transformational UAS technologies capable of generating direct and immediate benefits to domestic businesses, including immediate opportunities in the following industries: aerial photography, real estate, news gathering and reporting, small-scale farming inspections and monitoring, infrastructure inspections, search and rescue, firefighting response, training and certification. With the focus of many micro UA applications being to either increase efficiencies through cost savings or reducing risk to people and property, commercial interests fall in direct alignment with the FAA's position on public safety and risk aversion, alleviating the need for burdening regulation and associated costs.

The new business opportunities and economic development enabled by micro UA technologies will only be realized in an accommodating commercial environment that encourages adoption by limiting the placement of overburdening regulation. Liberating a micro UA class of operations will favorably accelerate benefits by fast-tracking pathways to operationally-compliant and low-risk applications under minimal regulation, while upholding and emphasizing FAA's primary mission of ensuring public safety.

The current void of regulations for UAS operations (notwithstanding individual "Section 333" exemptions) significantly influences the decisions of UAS operators in such a way that the market size and economic impact of the business activity falling under the proposed micro UA regulation is difficult to quantify. However, with the industries mentioned above the market impact, both with and without regulation, can be estimated as a fraction of the overall industry.

NAICS Codes	Sample Micro UA Industry Descriptions	2013 GDP ($MM)	Market growth from new UAS operations (illustrative)			Over-regulation
			2%	5%	10%	
115000	Support activities for agriculture and forestry	$20,902	$418	$1,045	$2,090	$0
21311A	Other support activities for mining	$59,384	$1,188	$2,969	$5,938	$0
611A00	Junior colleges, colleges, universities, and professional schools	$205,018	$4,100	$10,251	$20,502	$0
524200	Insurance agencies, brokerages, and related activities	$216,172	$4,323	$10,809	$21,617	$0
512100	Motion picture and video industries	$130,288	$2,606	$6,514	$13,029	$0
		TOTAL UAS IMPACT	**$12,635**	**$31,588**	**$63,176**	**$0**

AUVSI, the unmanned industry trade body, has produced an oft-cited report on the economic impact of the commercial UAs industry. This report is based primarily on precision agriculture applications. If

other industry applications (inspection, aerial photography, etc.) even closely approach similar magnitudes of opportunity, there would be significant economic and employment impact lost to overregulation at the smallest and safest segment of the industry.

Year	Total Economic Impact (US$ billion)	Total Employment Impact
2015	$2.28	23,413
2016	$4.55	46,826
2017	$6.83	70,240
2018	$7.17	73,752
2019	$7.53	77,439
2020	$7.90	81,311
2021	$8.30	85,377
2022	$8.72	89,645
2023	$9.15	94,128
2024	$9.61	98,834
2025	$10.09	103,776
Total	**$82.12**	**844,741**

Regulatory Flexibility Analysis

By statute, Federal agencies must perform a review to determine whether a proposed or final rule would have a significant economic impact on a substantial number of small entities. The FAA should assess a *Disproportionality Analysis* (whether small entities will be disadvantaged relative to large entities due to disproportionate impacts) and an *Affordability Analysis* (the degree to which small entities can afford the reduction in revenue resulting from the final rule is predicated on the availability of financial resources.

The entirety of nascent business contemplating commercial micro UA operation, all of which would be affected by any proposed UAS Rule, are currently well below existing “small business” standards as determined by the Small Business Administration (see below).

NAICS Codes	NAICS Industry Description	Size Standards ($MM)
541922	Commercial Photography	$7.5
115116	Farm Management Services	$7.5
541350	Building Inspection Services	$7.5
531210	Offices of Real Estate Agents and Brokers	$7.5
531312	Nonresidential Property Managers	$7.5
524210	Insurance Agencies and Brokerages	$7.5
541360	Geophysical Surveying and Mapping Services	$15.0
611512	Flight Training	$27.5
213112	Support Activities for Oil and Gas Operations	$38.5

Regulatory Flexibility Analysis - Costs of Regulation

There are currently approximately 225,000 manned aircraft registered with the FAA, requiring many millions of dollars in public sector financial resources to support regulatory administration. The FAA currently estimates as many as 7,500 small commercial UAS may be in use by 2018 (three years from expected - but unlikely to hold - deadline for the small UAS final rule), with this number expected to grow dramatically over the next decade.

Cost	Cost Incurred by Public Sector	Cost Incurred by Private Sector	Sample Cost Areas
Certification Costs	X	X	Pilot certification (approx.. $10,000), aircraft certification FAA DARs/DERs, Medical exams
Compliance Costs		X	Maintenance program, pilot currency requirements,
Government Administration Costs	X		Aircraft registry maintenance, harmonization, Advisory circulars
Regulatory Enforcement	X		FAA inspectors or other (police), warning letters, tracking
Litigation	X	X	Legal fees, judicial docket bandwidth
Fines and Penalties		X	

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 (adjusted annually for inflation) 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." Rulemaking requirements that treat UAS as aircraft and operators as manned aircraft pilots will significantly increase the costs of compliance for both public and private sector, which could easily approach this benchmark due to undetermined costs for enforcing expansive regulations

By segmenting the smallest and safest portion of the commercial UAS market to focus primarily on safe operating environment parameters and operator education (as used by the historically safe model aircraft today), these costs could be dramatically avoided to allow public sector resources to focus on larger and more complex unmanned aircraft and use operating applications.

Regulatory Flexibility Analysis - International Trade Impact Assessment

The Trade Agreements Act of 1979 (Public Law 96-39) prohibits Federal agencies from establishing any standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

Due to lagging regulatory movement domestically, the foreign commerce of the Unites States will be irreparably harmed with a sweeping FAA standards program that is both late relative to other countries and overly burdensome for an entire portion of the commercial UAS industry. Each new jobs and dollar of economic activity will develop either in the United States or internationally. Indeed, many industry leaders and have been publically vocal regarding their needs to move research and development and operations out of domestic markets due to burdensome regulations in this country. In addition to established commercial entities, it is likely that a new generation of entrepreneurs – composed from a highly skilled workforce – will opt to establish headquarters outside of the borders of the United States. Each of these decisions harms the United States economic viability.

Further, per the statute, the FAA should consider the current regulatory developments occurring globally. Other countries have established basic operating parameters, which should be considered as at least potential standards. Australia, Canada, and, most recently, New Zealand have all established guidelines to enable commercial UAS operations. Each of these frameworks that could potentially contribute FAA rulemaking and should be explored.