MEMORANDUM

April 24, 2015

TO: Docket Operations, M-30
U.S. Department of Transportation
1200 New Jersey Ave, SE
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Washington, D.C. 20590-0001

FROM: **Association of Public and Land-grant Universities**
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Re: Comments of Association of American Universities and Association of Public Land-Grant Universities to *Notice of Proposed Rulemaking for Operation and Certification of Small Unmanned Aircraft Systems*, Docket No. FAA-2015-0150; Notice 15-01

To Whom it May Concern:

The Association of American Universities ("AAU") and the Association of Public and Land-grant Universities ("APLU") appreciate the opportunity to share our perspectives with the Federal Aviation Administration ("FAA") regarding efforts to integrate small unmanned aircraft systems ("UAS") into the National Airspace System ("NAS").

AAU is a non-profit organization that represents 62 leading public and private research universities in the United States and Canada. Founded in 1900 to advance the international standing of U.S. research universities, AAU focuses on issues that are important to research-intensive universities, including funding for research, research policy issues, and graduate and undergraduate education. AAU's member universities are on the leading edge of innovation, scholarship, and solutions that contribute to the nation's economy, security and well-being.

APLU is a research, policy, and advocacy organization representing 238 public research universities, land-grant institutions, state university systems, and affiliated organizations. Founded in 1887, APLU is North America's oldest higher education association with member institutions in all 50 states, the District of Columbia, four U.S. territories, Canada, and Mexico. Annually, its 196 U.S. member campuses enroll 3.9 million undergraduates and 1.2 million graduate students, award 1 million degrees, employ 1 million faculty and staff, and conduct $40.2 billion in university-based research.

Together, APLU and AAU represent over 200 higher education institutions in the United States, which provide education to a substantial number of undergraduate and graduate students and conduct most of the nation's basic research.

Our institutions have a strong interest in taking advantage of the significant extant benefits of UAS, as well as in researching the potential of UAS to increase America's competitiveness and enhance the social good. Across the country, our universities are seeking to utilize UAS to improve research and development efforts, inspect infrastructure, and teach students. The use of UAS can aid in our universities' research in the fields of animal health, plant toxicology, entomology, engineering, architecture, aviation, sustainable nutrient management, soil science, biochemistry, and aerospace engineering, among others.

Our universities' research on these issues supports – and, indeed, is often conducted on behalf of - federal agencies, including NASA, the Department of Agriculture, the Department of Defense, the Department of Energy, and the National Science Foundation, along with state agencies and localities. In addition to utilizing UAS to conduct research, our universities' faculty experts are studying UAS-related issues particularly relevant to the emerging public debate on the use of UAS, ranging from aviation safety to privacy.

For these reasons, we have urged the expeditious fulfillment by the FAA of its Congressional mandate, established in the FAA Modernization and Reform Act of 2012, to develop a plan to safely integrate UAS into the NAS. Although safety must be paramount in the proposed rules, AAU and APLU are concerned that the current proposal places too many restrictions and administrative burdens on small UAS operators that are not justified by an appropriate safety analysis.

I. THE FINAL RULE SHOULD ALLOW LOWER-RISK UAS OPERATIONS TO BE CARRIED OUT BEYOND VISUAL LINE OF SIGHT AND ESTABLISH STANDARDS FOR SUCH OPERATIONS

The proposed rule strictly limits commercial UAS operation to those conducted within the operator's visual line of sight (VLOS). See NPRM § 107.31. Although the VLOS restriction is appropriate for many small UAS operations, the proposed rule is overly narrow in scope since it completely precludes beyond line of sight operations (BLOS). Such a blanket prohibition is unwarranted, in light of the currently available technological and regulatory mechanisms that, in combination, are fully capable of rendering certain BLOS operations equally safe as VLOS operations. AAU and APLU recommend that the Final Rule be broadened to permit UAS BLOS operations under certain conditions, subject to regulatory requirements that will ensure the safety of other aircraft, persons, and property.

A. Regulatory Safeguards for BLOS Operations

The current ban on BLOS flight unnecessarily handicaps a range of beneficial commercial UAS operations. There are numerous safeguards, including those described below, that can be implemented immediately to mitigate any risks associated with allowing BLOS operations.

1. Locational Restrictions

The Final Rule should be expanded to address and allow BLOS operations in uninhabited areas, where there is minimal risk to persons or property on the ground. The Final Rule should distinguish different types of locations for purposes of permitting BLOS operations. It does not make sense to treat open and sparsely inhabited areas in the same manner as urban or suburban areas. Although the Federal Aviation Regulations already utilize the terms "congested" versus "non-congested" to describe different areas in the context of regulating aviation activity, this concept should be further refined in the Final Rule to include a definition of sparsely populated or unpopulated areas suitable for a wide range of commercial BLOS UAS operations. See, e.g., 14 C.F.R. § 91.119.

The potential cost savings and safety advantages of permitting UAS operations in sparsely populated areas cannot be fully realized if such operations can only be conducted within VLOS. It is simply not practicable to undertake large-scale patrols of remote areas while keeping the aircraft within the operator's unaided VLOS. For instance, the VLOS limitation is neither necessary nor appropriate in unpopulated wilderness areas.

BLOS operations can be carried out with minimal associated risks in largely uninhabited areas, for a wide range of economically beneficial purposes. For example, UAS afford a safe, efficient alternative for monitoring critical infrastructure in remote areas, such as pipelines, electrical transmission lines, and rail lines. UAS are likewise extremely well suited for research into commercially beneficial applications in areas such as forestry, fish and wildlife management, agricultural management, natural resource exploration, and aerial surveying. The Final Rule should address how best to approach larger scale BLOS operations in sparsely inhabited areas, and set forth a definitional and regulatory framework that is flexible enough to accommodate such operations. Without such provisions and standards, development and expansion of many of the most obviously beneficial commercial uses for UAS will be unduly hampered.

2. Technological and Performance-Based Standards for BLOS Operations

The proposed rule does not impose any aircraft certification standards or technological requirements for UAS. This approach is adequate for VLOS operations, but fails to address the many technologies that can enable limited BLOS operations to be safely undertaken without further, needless delay. Technology has already advanced to the point where BLOS UAS operations can commence within the confines of a thoughtful regulatory framework. Technological features and/or onboard equipment, including the examples summarized below, can be used to enhance the safety and reliability of BLOS UAS operations. In addition to providing guidance on minimum technology suitable for BLOS flights, the Final Rule should include performance-based standards, to provide manufacturers and operators with guidance that will play a key role for research and development programs that are contributing to a critically important emerging industry.

a. First Person View

Readily available technologies currently exist to ensure the safety and reliability of BLOS UAS operations. For example, first person view (FPV) technology has been employed in UAS hobbyist operations for years, without significant safety issues. FPV technology allows the operator to view on a display the same perspective an operator would see from onboard the aircraft, in real time. FPV images can be displayed to the operator along with a "Heads Up" Display that provides details on the aircraft's performance. This tool enhances the operator's ability to see and avoid obstacles and monitor performance of the aircraft. Requiring a minimum field of view for the operator could mitigate issues involving situational awareness from FPV technology.

b. Telemetry Transmission

Robust telemetry transmission is another technological capability already available to commercial grade UAS and high quality model aircraft. Telemetry can be transmitted back to the operator, containing information such as the location, altitude, and speed of the aircraft. Like the automated navigation and flight control systems installed in many manned aircraft currently used in commercial aviation, telemetry transmission provides the operator with a system of waypoints or reference points. Based on this data, the operator can fly the aircraft and intervene in the control as appropriate. Telemetry, in combination with an FPV system, allows a BLOS operator to safely fly the aircraft while monitoring the aircraft's performance as well as any obstacles or hazards.

c. Lost Link/ Emergency Technologies and Onboard Equipment

The Final Rule should set forth specific, performance-based standards for the capabilities of a UAS authorized to conduct BLOS operations. These standards should address the required capabilities for responding to a lost-link or other anomaly resulting in a loss of positive control of the aircraft. Numerous viable options exist to address this type of scenario, and can be used independently or in combination to achieve the required threshold for safety and predictability in BLOS UAS operations. For example, dual autopilot modes can permit a UAS to "return to home," "auto land" or "fly in orbit," depending on what is most appropriate for the operation. These and similar types of fail-safe systems and equipment can be employed to assure safety in BLOS flights. Additional safety features include anti-collision systems employing sonar, LIDAR, or other sensor technology for short-range collision avoidance. Other technological features can also be utilized, such as geo-fencing capabilities and redundant control frequencies for use in the event of a communication interruption. Performance-based standards for how to respond to lost-links and other emergencies will encourage further technological innovation and improvement in this area, while establishing a clear baseline standard for safety and reliability in BLOS operations. Safety in BLOS operations can also be enhanced by providing performance standards for certain onboard equipment such as transponders, radio location beacons, and aircraft identification lights.

d. Performance Characteristics

To the extent the FAA deems necessary, one option to accommodate at least some BLOS operations would be to set different weight and performance standards for aircraft engaged in BLOS flight, such as a lower maximum gross take-off weight or lower maximum speed. The rule could also, if necessary, include guidance on the types of material the UAS should be constructed out of and its frangibility.

3. BLOS Flight Restrictions

Risks associated with BLOS operations can also be mitigated through imposition of appropriate flight limitations, such as maximum altitude restrictions, and airspace restrictions. For example, BLOS operations should be barred outside of Class G Airspace. Other mitigating provisions could include minimum distances from airports and populated areas. Rather than simply prohibit all BLOS operations, the FAA could consider the use of an ATO COA process to coordinate airspace issues similar to the one employed as part of the Section 333 Exemption process, or otherwise increase the involvement of the Flight Standards District Offices.

B. BLOS Rating

While AAU and APLU acknowledge that BLOS operations are inherently more complicated from a regulatory standpoint than VLOS operations, the complexities are not insurmountable, and are not significant enough to warrant complete exclusion of BLOS operations from the Final Rule. In addition to the foregoing recommendations, AAU and APLU propose that the UAS Operators Certificate under § 107.63 be expanded to include a BLOS rating. The requirements for this certificate should include further training and proficiency checks specifically with regard to distinctions between BLOS and VLOS flights.

C. Addressing BLOS Flights in the Final Rule Will Facilitate Long-Term Integration

As drafted, the NPRM lacks sufficient flexibility to integrate emerging technologies that are continuously expanding the range and types of operations that can safely be conducted by UAS. If BLOS operations are not specifically addressed in the Final Rule, in at least a limited fashion, proposed BLOS operations will be relegated to a future exemption process, which will be subject to exhaustive and time consuming individualized review. This will result in substantial delays in integrating BLOS operations into the NAS.

Conversely, if the Final Rule addresses and permits BLOS operations under limited, specified circumstances, this will pave the way for the FAA to develop Advisory Circulars, Technical Standard Orders or Notices, and other policy statements regarding BLOS technology and procedures, thereby promoting and addressing the ongoing development of safety-related technology and improvements in the UAS industry. In the long run, it will be more efficient to begin the process of integrating limited BLOS flights into the NAS now, rather than wait to commence a separate, full-scale notice and comment rulemaking process.

II. VISUAL OBSERVER AND COMMUNICATIONS WITH THE UAS OPERATOR

The NPRM contains the following provisions with regard to the use of visual observers in conjunction with UAS operations. The visual observer is defined as "a person who assists the small unmanned aircraft operator to see and avoid other air traffic or objects aloft or on the ground." 14 C.F.R. § 107.3. The use of a visual observer is not mandatory. 14 C.F.R. § 107.33. The primary purpose of the visual observer, as proposed, is to relieve the UAS operator of the requirement to fly solely based on his or her vision of the aircraft so long as the visual observer is fulfilling the operator's see-and-avoid responsibilities, and so long as the operator still has the capability to see the UAS if she or he chooses. See 14 C.F.R. § 107.3.31.

A. The Use of Visual Observers as Part of BLOS Operation

AAU and APLU commend the FAA for its decision to provide for the optional use of a visual observer and guidance concerning how the visual observer can safely perform his or her duties. However, AAU and APLU object to these proposed regulations to the extent that this system still requires the operator to maintain the capability to fly VLOS at all times. Also unwarranted is the FAA's rejection, without explanation, of the concept of using multiple visual observers to "daisy-chain" the UAS as part of BLOS operations. <u>See</u> RIN 2120–AJ60, FAA Docket FAA-2015-0150 at 14.

As set forth above, BLOS flight can be performed safely and reliably using technology that is currently available. The use of visual observers as part of BLOS operations, where appropriate, can further augment a robust sense and avoid system. For example, if a given BLOS operation will involve transiting to a location far from the operator, the operator could employ a visual observer on the remote site as additional backup. The visual observer could then relay information by radio or telephone to the operator to provide additional information about how the operation is proceeding. The visual observer should be viewed by FAA as a valuable tool to ensure safe operation, whether it is conducted under VLOS or BLOS conditions, and not limited merely to someone whose presence allows the operator to occasionally look down while flying the UAS. <u>See</u> 14 C.F.R. § 107.33.

B. Minimum Distance Between the Observer and the Operator

The FAA requested input as to whether the visual observer should maintain a certain minimum distance from the operator at all times to ensure the ability to communicate. The rule as currently drafted is flexible, only requiring that the "visual observer and operator maintain effective communication with each other at all times." We are far beyond the point where the only way two people can maintain reliable communications is by being close enough to talk. Cell phones and reliable radios are ubiquitous and are used in a wide range of commercial activities.

In addition, hands-free devices provide a way for an operator to communicate without interfering with his or her ability to control the UAS.

Requiring that the visual observer remain within a certain distance of the operator may, in fact, be less safe. There are situations where it would be advantageous for the visual observer to have a different perspective from the operator. For example, if the UAS is maneuvered in close proximity to an obstacle, a visual observer who is closer to the obstacle can provide additional real-time guidance that would not be available if he or she were essentially tethered to the operator's location.

At its core, the entire purpose of the Federal Aviation Regulations is safety. The UAS operator cannot perform any action that is careless or reckless and must use his or her best judgment at all times. See 14 CFR § 91.13. The visual observer has the potential to be a valuable tool to ensure safe and reliable VLOS and BLOS flight, but only if the FAA gives operators the flexibility to use their best judgment as appropriate. Accordingly, AAU and APLU respectfully request that the FAA revise the rules pertaining to visual observers to allow their optional use, as the operator deems necessary, to create a system that will enhance both the safety and utility of UAS in the NAS.

III. PROPOSAL TO CREATE A CLASS OF MICRO UAS

The NPRM provides a great deal of flexibility to operators. However, Part 107's operational limitations apply equally whether one is flying a UAS that weighs 2 pounds or one that weighs 55 pounds. This "one size fits all" approach does not adequately account for the relative risks associated with different size UAS.

The primary danger from unsafe UAS operation is a collision between the UAS and an object or person. The extent of damage or injury that can result from such a collision, however, is dependent primarily on the amount of energy that can be transferred. In particular, both an object's momentum and its kinetic energy are proportional to its mass. As a result, the energy that can be imparted by the UAS to another object is directly proportional to its weight.

It is undeniable that a 50-pound object in flight is inherently more dangerous than a two-pound object in flight. To mitigate risks associated with the operation of a large UAS, greater flight restrictions and distances from persons or objects are appropriate, and the level of skill of the operator must be higher. But applying this same restrictive regime to micro UAS flight is unnecessary and destroys much of the benefit that can be achieved from micro UAS operations.

AAU and APLU also believe that the requirement for a certain amount of frangibility is also important. In a collision, damage results when energy is transferred from one object to the other. A frangible structure allows energy to be dissipated by damaging the structure of the UAS rather than transmitting that energy to the struck object. The same principles apply to the hardness of the material from which the UAS is made. The softer the structure, the less efficiently energy is transmitted to the other object.

Based on these considerations, the creation of a class of micro UAS is clearly appropriate and desirable. AAU and APLU agree with much of the FAA's proposed modifications of Part 107 that would apply to micro UAS. See RIN 2120–AJ60, FAA Docket FAA-2015-0150 at 55-57. However, to the extent that hobbyists are currently permitted to fly UAS without certification, imposing an additional operator certificate requirement on the operation of micro UAS would not be justified. It would needlessly add to the cost of compliance without producing any noticeable corresponding increase in safety. This is especially true in an academic setting, where university students are not flying for compensation or hire, but rather are operating to further research, development, and education.

AAU and APLU also take issue with the position that micro UAS are inherently unsuited to BLOS operation. As set forth in Section I, supra, the safety of BLOS operation depends on the supporting technology employed. To the extent these technologies can be used to meet the performance based standards that should govern BLOS flight, micro UAS should also be permitted to conduct these operations. Moreover, if the FAA is not inclined to permit all UAS that can meet these requirements to fly BLOS, the FAA should at a minimum permit such operations for micro UAS. By their very nature, micro UAS are less capable of doing substantial damage to persons or property in the unlikely event of a mishap. Indeed, the FAA's position that micro UAS are completely safe to operate in congested areas and directly over persons, at an altitude of up to 400', is not consistent with a position that micro UAS are inherently unsafe to fly BLOS. See RIN 2120–AJ60, FAA Docket FAA-2015-0150 at 58. In fact, this position compels the opposite conclusion.

Similarly, AAU and APLU believe that there should be no restrictions on the use of automated systems to control the flight path of the UAS. Currently, many UAS that would meet the micro UAS threshold have sophisticated electronic systems that can use waypoints or other systems to guide the path of the UAS. Trading that computer-assisted control for a command and control system reliant on manual inputs from the operator is not inherently safer. Human manual control is not infallible. A system that employs computer-assisted systems that are monitored by the operator would provide an additional level of redundancy and help avoid inadvertent mistakes in control.

In sum, AAU and APLU believe there is great merit to the creation of micro UAS standards. However, the current proposal, as drafted, is too conservative and places too many restrictions on micro UAS operation to allow them to realize their full potential. The micro UAS rules should acknowledge the lower risks associated with their operation and use that as a solid foundation to expand the UAS flight envelope, not further restrict it. Imposing a lower regulatory burden on micro UAS operations would also have the benefit of freeing FAA resources that could be better spent on oversight of larger and more dangerous UAS or in oversight of a BLOS system.

IV. NUMERICAL LIMITATION ON THE VISUAL LINE OF SIGHT BOUNDARY

The NPRM limits all UAS operations to VLOS flight. See 14 C.F.R. § 107.31. The FAA has invited comment on whether the horizontal boundary should be further limited by a numerical value. See RIN 2120–AJ60, FAA Docket FAA-2015-0150 at 75-76. For example, the proposed micro UAS system would place an absolute numerical limit of 1500 feet on the distance between the UAS and the operator. Id. at 55-58.

AAU and APLU oppose the implementation of a hard limit on the horizontal operational boundary. To the extent that flight is to be conducted based on VLOS, then the determination of the distance at which the UAS can be safely controlled should depend on many factors, such as the size of the UAS, its lighting system, whether its color is high contrast, and the prevailing atmospheric conditions.

In light of all of these variables, the decision should be left to the operator, consistent with the requirements of 14 C.F.R. § 91.13, to maintain a safe distance. The imposition of an arbitrary numerical value could easily be detrimental to safety. If an operator is told that he or she can operate up to a specific distance, then that may provide a false sense of confidence that flight is appropriate at a distance that the prevailing conditions might not warrant. As a result, AAU and APLU believe that the proposed standard provides an appropriate level of flexibility.

V. CREATION OF A STUDENT OPERATORS CERTIFICATE

The NPRM requires all persons flying a UAS for non-recreational purposes to obtain a UAS operators certificate with a small UAS rating. See 14 C.F.R. 107.53, et seq. Although this requirement may be appropriate for persons engaging in commercial activities, it is too cumbersome and expensive for broad use in an educational setting at an institution of higher education.

The FAA has taken the position that it does not have the statutory authority to completely do away with the requirement for an operators certificate. See RIN 2120–AJ60, FAA Docket FAA-2015-0150 at 59. AAU and APLU do not endorse this interpretation, but we recognize that this position is unlikely to change. Consequently, AAU and APLU propose the creation of a Student UAS Operators Certificate that would ease some of the burden on students who wish to use UAS as part of their education.

The Student UAS Operators Certificate would require classroom training provided by the institution of higher education. The class would be taught by a faculty member who possesses a UAS operators certificate. At the conclusion of the class, the institution of higher education would provide the FAA with a signed statement that the student is familiar with all of the areas of knowledge that are assessed on the initial aeronautical knowledge test that is proposed under part 107.

This system would be very similar to the one proposed by the FAA for use in conjunction with micro UAS operation. While the Student UAS Operators Certificate would not be weight limited to micro UAS flight, an additional level of safety would be provided by restricting operations under a Student UAS Operators Certificate to those conducted in furtherance of a student's education under the supervision of a faculty member who possesses a UAS Operators certificate.

AAU and APLU believe this proposal will enable institutions of higher education to make UAS operations a broader part of their educational missions, while at the same time preserving the safety of persons, property, and the national airspace system.

VI. CONCLUSION

AAU and APLU commend the FAA for creating a draft of Part 107 that preserves a great deal of flexibility while maintaining safety. However, the blanket prohibition on all BLOS operations is unjustified given the host of safety-enhancing technologies and procedures that are available to small UAS operators. This is particularly true in the context of micro UAS operations, which the FAA has already found safe enough to be conducted in congested areas and over persons.