U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 20, 2015

Exemption No. 11626
Regulatory Docket No. FAA–2015–0537

Mr. Cameron R. Cloar
Associate
Nixon Peabody, LLP
One Embarcadero Center, 18th Floor
San Francisco, CA 94111-3600

Dear Mr. Cloar:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

By letter dated February 20, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Olsson Associates (hereinafter petitioner or operator) for an exemption. The exemption would allow the petitioner to operate an unmanned aircraft system (UAS) to conduct aerial inspection, documentation, survey, mapping, photography, videography and data collection.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner. However, the FAA received one comment in support of the petition made to the docket.

Airworthiness Certification

The UAS proposed by the petitioner are the Draganfly Innovations X4-ES, Draganflyer, 3D Robotics Aero-M, and 3D Robotics X8+.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112−95 in reference to 49 U.S.C. § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Olsson Associates is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

In this grant of exemption, Olsson Associates is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the Draganfly Innovations X4-ES Draganflyer, 3D Robotics Aero-M, and 3D Robotics X8+ when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

2. Operations for the purpose of closed-set motion picture and television filming are not permitted.

3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.

4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.

5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.

6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents,

the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS−80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.

9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.

10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.

11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.

12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal Government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.

16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.

17. The UA may not be operated 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 PIC.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.

19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least 5 minutes or with the reserve power recommended by the manufacturer if greater.

21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (N−Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

24. The UA must remain clear and give way to all manned aviation operations and activities at all times.

25. The UAS may not be operated by the PIC from any moving device or vehicle.

26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
    b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.

28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS−80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.

30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
    a. Dates and times for all flights;
    b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
    c. Name and phone number of the person responsible for the on-scene operation of the UAS;
    d. Make, model, and serial or N−Number of UAS to be used;
    e. Name and certificate number of UAS PICs involved in the aerial filming;
    f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
    g. Signature of exemption holder or representative; and
    h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.

31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on May 31, 2017, unless sooner superseded or rescinded.

Sincerely,

/s/
John S. Duncan
Director, Flight Standards Service

Enclosures

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February 20, 2015

U.S. Department of Transportation
Docket Management System
1200 New Jersey Ave, SE
Washington, DC 20590

RE: Exemption Request Under Section 333 of the FAA Reform Act and Part 11 of the Federal Aviation Regulations

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act" or "Section 333"), Subsection (f) of 49 U.S.C. § 44701, and 14 C.F.R. Part 11, Olsson Associates ("Olsson") seeks an exemption from the Federal Aviation Regulations ("FARs") listed below and discussed in **Appendix A** to allow it to operate three different small Unmanned Aircraft Systems (collectively, the "sUAS"): the Draganfly Innovations X4-ES Draganflyer, the 3D Robotics Aero-M, and the 3D Robotics X8+. Olsson is a successful engineering and design firm that offers solutions for public and private infrastructure projects.[1] Olsson plans to use the sUAS for aerial inspection and documentation services for its projects located across the United States. The services include aerial surveys and mapping, inspections and obtaining still photographs, video and other data collected via onboard sensors.

The safety and public benefits of using sUAS for commercial surveying and mapping, project documentation, and inspection services are significant. The sUAS reduce the need to operate manned aircraft in unconventional operations, provide more accurate data in a manner that is more safe, economical and efficient, and with a reduced impact on the environment. Because Olsson plans to utilize the sUAS in many of its public infrastructure and related projects, the operations will also directly translate to measurable savings for local, state and federal agencies and ultimately, taxpayers.

[1] Olsson's design and consulting services touch upon numerous industries and subject matters, including: water/wastewater, water resources, land development, landscape architecture, urban planning, environmental resources and compliance, transportation, technology, municipal, geotechnical, and mechanical and electrical.

Operations pursuant to the exemption will be subject to strict operating requirements and conditions to ensure at least an equivalent level of safety to currently authorized operations using manned aircraft and under conditions as may be modified by the FAA as required by Section 333. At 5.5 pounds for the Draganfly X4-ES, 7.9 pounds for the 3D Robotics Aero-M, and 7.3 pounds for the X8+, including payload, the proposed sUAS are small in size and are powered electrically via small, rechargeable, lithium batteries. The sUAS have extensive automated control features, redundant systems, and integrated fail-safes, and will be operated under controlled conditions and at low altitudes in airspace that is limited in scope.

Though the sUAS may safely be operated by one person, flight operations performed pursuant to this exemption will consist of at least two people: a pilot-in-command (the "PIC") and visual observer. The PIC is responsible for the direct and safe operation of the sUAS, monitoring its status and flight dynamics while maintaining visual line of sight and keeping the flight within the manufacturer's specified limits in terms of wind, flight range, battery life, etc. The observer will be responsible for monitoring the airspace for other aircraft and hazards, advising the PIC before and during flight of all such observed risks, and monitoring the controlled operating area. Individuals acting as the PIC will complete manufacturer-approved training specific to the sUAS. The PIC will be a certificated airman with private pilot privileges and limitations, and maintain a current third-class medical certificate.

Because the sUAS will be used in lieu of comparatively higher risk operations now conducted with fixed wing and rotary manned aircraft, the FAA can have confidence that Olsson's operations will achieve at least an equivalent level of safety and fulfill the Secretary of Transportation's responsibilities under Section 333(c) of the Reform Act to "establish requirements for the safe operation of such aircraft systems in the national airspace system."

Applicant Information

The name of the applicant is:

Olsson Associates

The primary contact for this application is:

Jonathan Harris
Unmanned Systems Program Director
Olsson Associates
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Exemptions Requested

Olsson respectfully requests exemptions from the following regulations:[2]

14 C.F.R. Part 21, Subpart H;
14 C.F.R. § 91.7;
14 C.F.R. § 91.9(b)(2);
14 C.F.R. § 91.113;
14 C.F.R. § 61.113(a), (b);
14 C.F.R. § 61.133(a);
14 C.F.R. § 91.119(c);
14 C.F.R. § 91.151;
14 C.F.R. § 91.203;
14 C.F.R. § 91.405(a) and (b);
14 C.F.R. § 91.407(a)(1);
14 C.F.R. § 91.409(a)(1)-(2); and
14 C.F.R. § 91.417(a).

THE APPLICABLE LEGAL STANDARD UNDER SECTION 333

Grant of this exemption application for use of the sUAS in precision aerial surveys, mapping and inspection operations will advance the Congressional mandate in Section 333 of the Reform Act to accelerate the introduction of UAS into the national airspace system ("NAS") if it can be accomplished safely. This law directs the Secretary of Transportation to consider whether certain UAS may operate safely in the NAS before completion of the rulemaking required under Section 332 of the Reform Act. In making this determination, the Secretary is required to determine which types of UAS do not create a hazard to users of the NAS or the public, or pose a threat to national security in light of the following:

- The UAS's size, weight, speed, and operational capability;
- Operation of the UAS in close proximity to airports and populated areas; and
- Operation of the UAS within visual line of sight of the operator.

[2] As set forth in Appendix C, Olsson will operate under similar operating conditions as those required in the other grants of exemption, in which exemptions for certain FARs was deemed by the FAA as "not necessary." Accordingly, Olsson does not request FAA exemption from 14 C.F.R. 45.23(b), 91.103, and 91.109(a). Should the FAA determine that relief from these or any other regulation is required for the operations proposed herein, Olsson will be happy to submit an amendment to this request and include justifications for those necessary additional exemptions.

Reform Act § 333(a)(1). If the Secretary determines that such vehicles "may operate safely in the national airspace system, the Secretary shall establish requirements for the safe operation of such aircraft in the national airspace system." *Id.* §333(c) (emphasis added).[3]

The Federal Aviation Act expressly grants the FAA the authority to issue exemptions. This statutory authority, by its terms, includes exempting civil aircraft, as the term is defined under §40101 of the Act, from the requirement that all civil aircraft must have a current airworthiness certificate and those regulations requiring commercial pilots to operate aircraft in commercial service:

> The Administrator may grant an exemption from a requirement of a regulation prescribed under subsection (a) or (b) of this section or any of sections 44702-44716 of this title if the Administrator finds the exemption is in the public interest.

49 U.S.C. §44701(f). *See also* 49 USC §44711(a); 49 USC §44704.

The grant of the requested exemption is in the public interest based on the clear direction in Section 333 of the Reform Act; the additional authority in the Federal Aviation Act, as amended; the strong equivalent level of safety surrounding the proposed operations; and the significant public benefit, including enhanced safety and cost savings associated with transitioning to UAS for aerial surveys, mapping and inspections. Olsson therefore respectfully requests that the FAA grant the requested exemption without delay.

Airworthiness of the sUAS

One element of the exemption application involves evidence of the airworthiness of the sUAS. Olsson and the manufacturers of the sUAS – 3D Robotics and Draganfly Innovations – believe that the sUAS have been shown to be airworthy and compliant with a significant level of safety. Indeed, as discussed more fully in Draganfly Innovations own exemption request, Docket No. FAA-2014-0963, numerous public agencies and organizations have received FAA permission to operate X4 models including, without limitation, the Mesa County (CO) Sheriff's Office, Illinois State Police, University of North Dakota, Texas A&M University and the Northern Plains UAS Test Site, just to name a few. In Canada, moreover, the X4 models have been operating since 2008 under the authority of Transport Canada and Special Flight Operations

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[3] This provision places a duty on the Administrator to not only process applications for exemptions under Section 333, but for the Administrator, if he deems the conditions proposed herein require modification in order to allow approval, to supply conditions for the safe operation of the UAS. Olsson welcomes the opportunity to consult with FAA staff to address any issues or concerns that this proposal may raise that they believe may require modification.

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Certificates issued by that federal agency to federal and state law enforcement agencies, universities and for various commercial operations in Canada.

To enhance safety, it is also important to note that the sUAS are equipped with automated features which enhance safe takeoff, flight, and landing in many conditions, further details of which are provided in the descriptions of both aircraft (**Appendices C-E**), the X4-ES, Aero-M and X8+ manufacturer manuals, and in the Olsson General Operations Manual ("GOM").[4]

To maintain airworthiness, Olsson will follow a strict inspection and maintenance program. That program is enhanced by several automatic checks performed by the sUAS. Malfunctions that occur during flight will be detected by the sUAS fault detection systems, which communicate a fault warning to the PIC to take necessary action. For certain malfunctions and faults (i.e., lost communications), the sUAS may be preprogrammed to automatically respond and land either at a designated location (e.g., a return-to-home or point of take-off) or in-place. In addition, Olsson will maintain emergency checklists for proper and safe malfunction responses that will be used by the PIC during operation of the sUAS. In the event of any malfunction, the sUAS will undergo all maintenance required by the manufacturer and undergo flight testing before recommencing commercial operations.

Proposed Operations and Associated Conditions

Olsson intends to use the sUAS that weigh significantly less than 55 pounds for the purpose of conducting aerial surveys and mapping of land, as well as aerial inspection and documentation of its projects. In the survey and mapping context, for example, the sUAS will be used to acquire photogrammetric datasets for use in land development and vertical infrastructure design. Similarly, Olsson plans to provide engineering-related inspection services with the sUAS to a number of industries. This includes, without limitation, the inspection of transportation infrastructure, such as rail and automotive bridges, the inspection of utility infrastructure, including wind turbines and transmission lines, and the inspection of proposed future building sites for overall project feasibility.

All of the sUAS operations will occur under tightly controlled conditions on public or privately owned land at the owner's request and consent, solely during daylight hours, and at altitudes well below that which would pose a risk to other aircraft. The operations will take place in areas away from people, crowds and airports. Moreover, due to the nature and purpose of the operations, Olsson anticipates that it will fly the sUAS at relatively low altitudes and speeds. The risk of interference with another aircraft is therefore minimal.

Grant of the exemptions to Olsson will be subject to the conditions listed in **Appendix B**, which are based upon the operating conditions required by the FAA's previous grants of exemptions.

[4] At the request of the FAA, Olsson will be pleased to provide, under confidentiality, its General Operations Manual.

In terms of the specific aircraft Olsson will use for its operations, all are characterized by a high degree of pre-programmed control and various built-in technical capabilities that limit the potential for operation outside of the conditions set forth in **Appendix B**. They were also designed with internal functional and safety features to assist the operator in safe and reliable operation. With pre-programmed flights and manual control, operators can easily maintain separation from manned aircraft operations and avoid other hazards. In the controlled environment under the operations conditions in **Appendix B**, operations will remain within visual line-of-sight (VLOS) and below 400 feet AGL. In addition, Olsson will obtain a Certificate of Waiver or Authorization from the FAA Air Traffic Organization to address airspace requirements and provide notification by a Notice to Airman (NOTAM).

Operator Requirements

Olsson will use a dedicated staff for the sUAS operations. As a condition to the grant of the exemptions, Olsson will require that the PIC hold a private pilot's certificate and a valid third-class medical certificate. The PIC will have accumulated and logged a minimum number of flight cycles and hours for daytime operations, as necessary. The PIC will also be subject to the flight review requirements pursuant to the Federal Aviation Regulations ("FARs").

In addition, the PIC must complete a manufacturer-approved training program for the sUAS that he or she will operate. This training is specific to each sUAS and familiarizes the PIC to the operations and limitations of each sUAS. Training will also include discussions on the basic fundamentals of UAS aerodynamics and technical limitations, as well as the more general topics of weather, the National Airspace System, and the legal and regulatory framework.

Olsson does not believe that certified airmen, medical certificates, and the related operating conditions, are necessary or required to operate the sUAS. However, Olsson will accept these requirements as a condition to the grant of the exemptions. If, and when, the FAA finds such conditions unnecessary for operations conducted pursuant to Section 333 exemptions, Olsson respectfully reserves the right to amend its operating conditions and request exemptions from the relevant FARs to operate without such conditions.

Public Interest

The use of the sUAS in lieu of comparatively hazardous operations currently conducted with conventional fixed wing and rotary aircraft offers a net safety benefit and will achieve an enhanced level of safety, as mandated under Section 333(c) of the Reform Act. Approval of this application will also benefit the public interest by allowing better, safer, and more cost efficient information for Olsson and the public.

Conventional aerial survey and inspection operations using manned aircraft involve heavy aerial aircraft that must transit from airports to the operational location, carrying significant amounts of combustible fuel, and a multi-person crew. The nature of surveying and inspection operations magnify the dangers of using conventional aircraft, as the aircraft fly in unconventional operations under FAA waivers and at dangerous altitudes in populated and developed areas. Aerial inspection and analysis by traditional manned aircraft is also often times impractical because the required altitudes for safe flight can reduce the operative visibility below levels necessary to obtain meaningful data.

By contrast, use of the sUAS is safe, economical and efficient. The X4-ES weighs a mere 5.5 lbs, the Aero-M weighs 7.9 lbs., and the X8+ weighs 7.3 lbs., including payload, they operate on battery power, are carried (not flown) to and from the area of activity, remove the need for an airborne crew, and pose less risk to people and infrastructure on the ground, as well as other aircraft. sUAS operations also avoid the need for inspection personnel to risk their lives on buildings, bridges and other structures to perform inspections. If more detailed in-person inspections are required, planners can use preliminary sUAS data and target areas of concern without putting inspectors and other individuals at risk in hazardous areas. More frequent, safer, and cost-efficient inspections by sUAS will also increase safety to the public. In addition, the sUAS can map the conditions and problem areas of Olsson projects, assisting personnel to determine areas of potential hazard and the need for heightened safety measures. Increased inspections will also help to maintain buildings and other structures, keeping the public safe from building deterioration and improved building responses during significant weather events.

No national security issue is raised by the grant of the requested exemptions. Given the size, load-carrying capacity, speed at which the sUAS operate (the X4-ES at 30 mph, the Aero-M at 56 mph, and the X8+ at less than 15 mph), and the fact that they do not carry explosives or other dangerous materials, the use of the sUAS pose no threat to national security. In fact, the threat of causing damage to critical national infrastructure is significantly reduced with the extremely low sUAS weights and limited operating areas. Any other security concerns are ameliorated by the fact that all individuals holding a private pilot certificate are subject to a security screening by the U.S. Department of Homeland Security.

The grant of the requested exemption is in the public interest based on the clear direction in Section 333, the Federal Aviation Act,[5] the high and equivalent level of safety of the proposed operations, and the significant public benefit, including enhanced safety and cost savings to be realized as a result of the use of sUAS for aerial inspection and mapping services. Accordingly, Olsson respectfully requests that the FAA grant the requested exemption without delay.

[5] The Federal Aviation Act ("FAAct") expressly grants the FAA the authority to issue exemptions: The Administrator may grant an exemption from a requirement of a regulation prescribed under subsection (a) or (b) of this section or any of sections 44702-44716 of this title if the Administrator finds the exemption is in the public interest. 49 U.S.C. § 44701(f).

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Very truly yours,
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Cameron R Cloar

CRC

APPENDIX A

EXEMPTION REQUEST AND EQUIVALENT LEVEL OF SAFETY SHOWINGS UNDER APPLICABLE RULES SUBJECT TO EXEMPTION

14 C.F.R. Part 21, Subpart H: Airworthiness Certificates 14 CFR § 91.203(a)(1)

Section 91.203(a)(1) requires all civil aircraft to have a certificate of airworthiness. Part 21, Subpart H, entitled Airworthiness Certificates, establishes the procedural requirements for the issuance of airworthiness certificates as required by FAR § 91.203(a)(1). Given the very small size of the aircraft and the limited operating area associated with their utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H to achieve or exceed current safety levels.[6]

Such an exemption meets the requirements of an equivalent level of safety under Part 11 and Section 333 of the Reform Act. The Federal Aviation Act and Section 333 of the Reform Act both authorize the FAA to exempt aircraft from the requirement for an airworthiness certificate, upon consideration of the size, weight, speed, operational capability, and proximity to airports and populated areas of the UAS involved.

In this case, an analysis of these criteria demonstrates that the sUAS operated without an airworthiness certificate, under the conditions proposed herein, will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) with an airworthiness certificate. The X4-ES weighs 5.5 lbs., the Aero-M weighs 7.9 lbs., and the X8+ weighs 7.3 lbs., including payload. The sUAS do not carry a pilot or passenger, will not carry flammable fuel, and will operate exclusively within an area pre-disclosed and in compliance with conditions set forth herein. Operations under this exemption will be tightly controlled and monitored by the operator, pursuant to the conditions set forth in **Appendix B**, the Olsson GOM, the manufacturers' manuals, and by local public safety requirements.

The FAA will have advance notice of all operations through the filing of NOTAMs. Receipt of the prior permission of the land owner (or lessee), the size of the aircraft, the lack of flammable fuel, and the fact that the aircraft is carried to the location and not flown there all establish the equivalent level of safety. The sUAS provide at least an equivalent level of

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[6] The FAA has stated that no exemption is needed from this section if a finding is made under the Reform Act that the sUAS provide an equivalent level of safety when compared to aircraft normally used for the same application. These criteria are satisfied and therefore no exemption is needed. *See, e.g.*, Grant of Exemption to Astraeus Aerial, Docket No. FAA-2014-0352 at 13-14, 22. Should the FAA determine that some characteristics of the sUAS fail to meet the requirements of the Reform Act, Olsson respectfully requests an exemption.

safety to that of such operations being conducted with conventional manned aircraft that would be orders-of-magnitude larger and would be carrying passengers, cargo, and flammable fuel. The safety features including the redundant sensor systems, as described in **Appendices C-E**, the manufacturers' manuals, and throughout this document, underscore the importance placed on safety and reliability in the design and manufacture of the sUAS.

14 C.F.R. § 91.7(a)-(b); Civil Aircraft Airworthiness

Section 91.7(a) requires that a civil aircraft must be in airworthy condition to be operated. The FAA has concluded that no exemption is required under 14 C.F.R. § 91.7(a) to the extent that the requirements of Part 21 are waived or otherwise found inapplicable. *See* FAA Grant of Exemption to Astraeus Aerial, Docket No. FAA-2014-0352, Exemption No. 11062, pp. 14-15, 19, 22. Olsson therefore respectfully requests that the FAA find the requirements for section 91.7(a) in accordance with the agency's determination on 14 C.F.R. Part 21, Subpart H, discussed *supra*.

The agency similarly found that relief from section 91.7(b) is not warranted, which places responsibility on the PIC to ensure an aircraft is in a condition safe for flight. *See* Grant of Exemption to Astraeus Aerial, Docket No. FAA-2014-0352, Exemption No. 11062, p. 19. To the extent, an exemption is required under section 91.7(a) or (b), Olsson respectfully requests that the FAA find compliance with the manufacturer's manuals, the Olsson GOM, and requirements of the grant of exemption, a sufficient means for ensuring the sUAS are and remain in an airworthy condition.

14 C.F.R. § 91.113; Right-of-Way Rules

Section 91.113 requires that vigilance be maintained by each person operating an aircraft to see and avoid other aircraft. Unlike manned aircraft, the sUAS pilot is not on-board the aircraft to observe and avoid other aircraft, operating the sUAS from the ground.

Olsson's proposed operating conditions will achieve an equivalent or greater level of safety. All operations will involve two individuals—one certificated private pilot as the PIC and one visual observer who will monitor the immediate and surrounding airspace of the sUAS operation for potential obstruction hazards and other possible intrusions. The sUAS will also be limited to designated areas below 400 feet AGL and within a virtual fence. Olsson will notify the FAA and other pilots of the sUAS operations by NOTAM.

14 C.F.R. § 61.113(a) & (b); 61.133(a): Private Pilot Privileges and Limitations; Pilot in Command; Commercial Pilot Privileges and Limitations.

Section 61.113(a) & (b) limit private pilots to non-commercial operations. Unlike a conventional aircraft that carries a pilot, passengers, and cargo, the sUAS in this case are remotely controlled with no passengers or property of others on-board. Section 61.133(a) requires an individual with a commercial pilot's license to act as pilot in command of an aircraft for compensation or hire.

Olsson respectfully proposes that operator requirements should take into account the characteristics of the particular UAS. Here, the sUAS have a high degree of pre-programmed control and various built-in technical capabilities that strictly limit the potential for operation outside of the operating conditions set forth in **Appendix B** and the exemption application. The small size, endurance, range and payload capacities of the sUAS mean that no passengers and/or cargo will ever be carried by the aircraft. Rather, commercial operations will be strictly limited to conducting aerial surveys and mapping, inspections and acquiring aerial imagery.

Considering these conditions, operating limitations and restrictions, an equivalent level of safety will be provided by allowing operation of the sUAS by Olsson with individuals who possess a valid FAA private pilot certificate and Class III medical certificate. The risks associated with the operation of the sUAS (given their small size, speed, operational capabilities and limitations, and lack of combustible fuel) are so diminished from the level of risk associated with commercial operations (and even operations permitted with a private pilot certificate) contemplated by Part 61 with manned aircraft, that allowing operations of the sUAS as set forth in **Appendix B** meets and exceeds the present level of safety provided under 14 C.F.R. § 61.113(a)-(b), and does not call for a commercial pilot certificate as set forth in § 61.133.

14 CFR § 91.119: Minimum Safe Altitudes

Section 91.119 establishes safe altitudes for operation of civil aircraft. Specifically, 91.119(c) limits aircraft flying over areas other than congested areas to an altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

As set forth herein, the sUAS will not operate at higher than 400 feet AGL. The sUAS will, however, be operated to avoid congested or populated areas. Because aerial survey work must be accomplished at relatively low altitudes and at altitudes less than 500 feet AGL, an exemption from Section 91.119(c) is needed.

The equivalent level of safety will be achieved given the size, weight, speed, and material with which the sUAS are built. Also, no flight will takeoff or land without the permission of the land owner or those who control the land. Because of the advance notice to the landowner, all affected individuals will be aware of the flights.

Compared to operations conducted with aircraft or rotorcraft weighing far more than the sUAS, and carrying flammable fuel, any risk associated with these operations will be significantly less than those currently allowed with conventional aircraft operating at or below 500 feet AGL. Indeed, the low-altitude operations of the sUAS will maintain separation from operations of conventional aircraft that must comply with Section 91.119.

14 C.F.R. § 91.151(a): Fuel Requirements for Flight in VFR Conditions

This regulation prohibits an individual from beginning "a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed – (1) During the day, to fly after that for at least 30 minutes; or (2) At night, to fly after that for at least 45 minutes."

The X4-ES is powered by a removable, rechargeable, lithium-polymer battery that provides approximately 20 minutes of powered flight. Without an exemption from § 14 CFR 91.151, the X4-ES flights by Olsson would not be permissible. The Aero-M is also powered by a lithium-polymer battery that provides up to 40 minutes of powered flight. Without an exemption from 91.151 for it, flights would be limited to 10 minutes in duration. Given the limitations on the proposed operations and their locations, a longer time frame for flight in daylight VFR conditions is reasonable. Similarly, the battery on the 3DR Robotics X8+ provides up to 15 minutes of powered flight. Without an exemption from 91.151 for it, flights would be impossible.

An exemption from 14 CFR § 91.151(a) is safe and within the scope of a prior exemption. *See* Grant of Exemption to Lockheed Martin Corporation, Docket No. FAA-2014-10673 (allowing operations without compliance with 91.151(a). Operating the sUAS, without 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was meant to prevent given the size and speed at which the sUAS operate. The fact that they carry no pilot, passenger, or cargo also enhances their safety. As does the fact that the operations will be conducted within the VLOS of the PIC and in a strictly controlled location. In the unlikely event that the sUAS should run out of fuel, each aircraft is designed to land on its own (e.g., an auto-land function is initiated upon a critical battery warning). Given their design, weight and construction material, the risks are less than contemplated by the current regulation.

For the X4-ES, an equivalent level of safety can be achieved by maintaining **5** minutes of reserve fuel, which would be more than adequate to return the UAS to its planned landing zone from anywhere in its operating area given that the systems are designed to be flown within direct VLOS of the PIC.

For the Aero-M, an equivalent level of safety can be achieved by maintaining **10** minutes of reserve fuel, which would be more than adequate to return the aircraft to its planned landing zone from anywhere in its operating area, particularly since it must be flown within direct VLOS of the PIC.

For the X8+, an equivalent level of safety can be achieved by maintaining **5** minutes of reserve fuel, which would be more than adequate to return the aircraft to its planned landing zone from anywhere in its operating area, particularly since it must be flown within direct VLOS of the PIC.

Similar exemptions have been granted to other operators and systems. *See* Docket Nos. 2689F, 5745, and 10673.

14 C.F.R. §§ 91.9(b)(2); 91.203(a)-(b); Carriage of Civil Aircraft Airworthiness Certificate and Registration

Sections 91.9(b) and 91.203(a)-(b) require an aircraft operator to carry airworthiness documents and other aircraft manuals onboard the aircraft at all times. Because the sUAS are small in size and contain no cabin or flight deck, carriage of such documents and manuals is impossible.

The intent of these regulations is to ensure that the PIC has access to important documents during flight. Here, an equivalent level of safety is achieved if the PIC has access to the applicable sUAS manual(s), registration certificate and other required documents from the Ground Control Station from which he or she is operating the sUAS. This is consistent with a prior opinion of the FAA Office of the Chief Counsel, and other grants of exemptions for commercial UAS operations. *See* Memorandum from Mark Bury, FAA Assistant Chief Counsel for International Law, Legislation and Regulation, to John Duncan, FAA Flight Standards Service (Aug. 8, 2014); *see also* FAA Grant of Exemption to Astraeus Aerial, Docket No. FAA-2014-0352, Exemption No. 11062, pp. 16-18.

14 C.F.R. §§ 91.405(a); 407(a)(1); 409(a)(2); 417(a): Maintenance Inspections

Section 91.405(a) requires that an aircraft operator or owner "shall have that aircraft inspected as prescribed in subpart E of this part and shall between required inspections, except as provided in paragraph (c) of this section, have discrepancies repaired as prescribed in part 43 of this chapter...." Section 91.407 similarly makes reference to requirements in Part 43; Section 91.409(a)(2) requires an annual inspection for the issuance of an airworthiness certificate. Section 91.417(a) requires the owner or operator to keep records showing certain maintenance work that has been accomplished by certificated mechanics, under Part 43, or licensed pilots and records of approval of the aircraft for return to service.

An equivalent level of safety will be achieved because the sUAS are small in size, will solely operate in restricted predetermined areas and are not complex mechanical devices. Olsson will perform all maintenance and inspections in accordance with the manufacturers' manuals and any required manufacturer Safety or Service Bulletins. In addition, the PIC will conduct a pre-flight inspection of the sUAS and all associated equipment to account for all discrepancies

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and/or inoperable components, pursuant to the Olsson GOM. Maintenance will be performed and verified to address any conditions potentially affecting safe operation of the sUAS and no flights will occur unless and until all flight critical components of the sUAS have been found to be airworthy and in a condition for safe operation. A functional flight test will be conducted following the replacement of any flight-critical components. As required by the Olsson GOM, the PIC who conducts the functional test flight will make an entry for the flight in the aircraft records.

The Olsson GOM also includes requirements to follow the manufacturer's aircraft/component, maintenance, overhaul, replacement, inspection, and life limit requirements for all applicable components identified by each manufacturer. In addition, the GOM includes procedures to document and maintain a record of sUAS maintenance under this grant of exemption. Finally, Olsson will incorporate any additional required high-time component maintenance and replacement requirements into its GOM that is requested by Draganfly, 3D Robotics and/or the FAA.

APPENDIX B

OLSSON OPERATING RESTRICTIONS AND LIMITATIONS

1) Operations shall be limited to the following aircraft described in the Olsson General Operations Manual ("GOM"): the Draganfly Innovations X4-ES Draganflyer model aircraft, and the 3D Robotics Aero-M and X8+ (collectively "sUAS"). All three of the aircraft weigh less than 10 pounds. Proposed operations of any other aircraft will require a new petition or a petition to amend this grant.

2) The sUAS shall not be flown at a ground speed exceeding 100 mph or no more than the maximum permissible operating speed required by the manufacturer, whichever is less.

3) Above Ground Level ("AGL") altitude shall be restricted to 400 feet, as indicated by the procedures specified in the GOM. All altitudes reported to Air Traffic Control ("ATC") shall be in feet AGL.

4) The sUAS shall be operated within Visual Line-of-Sight ("VLOS") of the pilot-in-command ("PIC") and visual observer at all times. The PIC must use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued medical certificate.

5) All operations must utilize a visual observer. The visual observer may be used to satisfy the VLOS requirement as long as the PIC maintains VLOS capability. The observer and PIC must be able to communicate verbally at all times. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must confirm that the visual observer can perform the functions prescribed in the GOM.

6) Any and all additional requirements identified in the exemption grant by the FAA shall be added to the GOM. The GOM must be maintained and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in the granted exemptions and the GOM, the conditions and limitations in the granted exemptions shall take precedence and must be followed. Otherwise, the operator must follow the procedures outlined in the GOM.

   The operator may update or revise its GOM. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator upon the request. The operator must also present updated and revised documents if it petitions for an extension or amendment of the granted exemptions. If the operator determines that any update or revision would affect the basis upon which the FAA granted the exemptions, then the operator must petition for amendment to its exemptions. The

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FAA's UAS Integration Office (AFS-80) may be contacted if questions arise regarding updates or revisions to the GOM.

7) Prior to each flight the PIC must inspect the sUAS to confirm that it is in a condition for safe flight. The PIC shall not operate the aircraft if the inspection reveals a condition that affects the safe operation of the sUAS until the necessary maintenance has been performed and the sUAS is found to be in a condition for safe flight. The Ground Control Station ("GCS") shall be included in the preflight inspection. All maintenance and alternations must be properly documented in the aircraft records.

8) Any sUAS that has undergone maintenance or alterations that affect the sUAS operation or flight characteristics (e.g., replacement of a flight critical component) must undergo a functional test flight in accordance with the GOM. The PIC who conducts the functional test flight must make an entry in the sUAS aircraft records of the flight. The requirements and procedures for a functional test flight and aircraft record entry shall be included in the GOM.

9) Olsson must follow the manufacturer's UAS aircraft/component maintenance, overhaul, replacement, inspection, and life limit requirements, with particular attention to flight critical components that may not be addressed in the manufacturer's manuals.

10) Olsson shall carry out their maintenance, inspections, and record keeping requirements, in accordance with the GOM. Maintenance, inspection, and alterations must be noted in the aircraft logbook, including total flight hours, description of work accomplished, and the signature of the authorized sUAS technician returning the sUAS to service.

11) sUAS technicians must receive and document training referenced in the GOM.

12) sUAS maintenance technicians must make a record entry in the sUAS logbook or equivalent document of the corrective action taken against discrepancies discovered between inspections.

13) The PIC must possess at least a private pilot certificate and at least a current third-class medical certificate. The PIC must also meet the flight review requirements specified in 14 C.F.R. § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14) Olsson will not permit any PIC to operate the sUAS unless and until that PIC has demonstrated through the training and currency requirements set forth in the GOM, that the PIC is able to safely operate the sUAS in a manner consistent with how the sUAS will be operated pursuant to this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from people, vessels, vehicles and structures.

15) Prior to the operation, the PIC must have accumulated and logged a minimum of 1 hour as sUAS pilot operating the sUAS and three take-offs and three landings within the preceding 90 days.[7]

16) Prior to operations, a flight demonstration as set forth in the GOM, administered by an Olsson-approved and qualified-pilot must be successfully completed and documented. This documentation must be available for review upon request by the Administrator. The flight demonstration shall be conducted in accordance with the GOM.

17) The sUAS shall not be operated directly over any person, except authorized and consenting individuals, below an altitude that is hazardous to persons or property on the surface in the event of a sUAS failure or emergency.

18) Operating of the sUAS may be conducted at distances less than 500 feet from participating persons, vessels, vehicles or structures that perform an essential function in connection with these special purpose operations. Operations closer than 500 feet from the PIC, visual observer, operator trainees, and essential persons, are permitted when operationally necessary; but never so close as to present an undue hazard, per § 91.119(a).

19) Operations of the sUAS may be conducted at distances less than 500 feet from vessels, vehicles or structures so long as the owner/controller grants such permission and the operation closer to these objects presents no safety hazard to nonparticipating persons or property.

20) Operation of the sUAS must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures.

21) If the sUAS loses communications or loses its GPS signal, the sUAS must return to a pre-determined location within the security perimeter and land or be recovered in accordance with the GOM.

22) The sUAS must abort the flight in the event of unpredicted obstacles or emergencies in accordance with the GOM.

23) The PIC is prohibited from beginning a sUAS flight unless (considering wind and forecast weather conditions) there is enough power to fly to the intended point of

[7] Training, proficiency, experience-building, and take-off and landing currency flights can be conducted under this grant of exemption to accomplish the required flight time and 90 day currency. During training, proficiency, experience building, and take-off and landing currency flights all persons not essential for flight operations are considered nonparticipants and the operator must operate the sUAS with appropriate distance from nonparticipants in accordance with 91 C.F.R. § 91.119.

landing and, assuming normal cruising speed, to fly after that for at least 5 minutes for the X4-ES and the X8+, and at least 10 minutes for the Aero-M.

24) Olsson shall obtain an Air Traffic Organization (ATO) issued Certificate of Waiver of Authorization (COA) prior to conducting any operation. This COA will also require the filing of the NOTAM not more than 72 hours in advance, but not less than 48 hours prior to the operation.

25) All aircraft operated in accordance with the requested exemption must be identified by serial number, registered in accordance with 14 C.F.R. Part 47, and have identification (N-Number) markings in accordance with 14 C.F.R. Part 45, Subpart C. Markings shall be as large as practicable.

26) Each sUAS must comply with all manufacturer System and Safety Bulletins.

27) The preflight inspection required in the GOM shall account for all discrepancies (i.e., inoperable components, items, or equipment) not covered in the relevant pre-flight inspection sections of the manufacturer's operating manual.

28) The radio frequency spectrum used for operation and control of the sUAS must comply with Federal Communication (FCC) or other appropriate government oversight agency requirements.

29) The documents required under 14 C.F.R. §§ 91.9 and 91.203 shall be available to the operator at the Ground Control Station of the sUAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.[8]

30) The sUAS must remain clear and yield the right of way to all other manned operations and activities at all times (including, without limitation, ultralight vehicles, parachute activities, parasailing activities, hang gliders, etc.).

31) Operations shall occur under Visual Meteorological Conditions (VMC); flights under special visual flight rules (SVFR) shall not be conducted.

32) sUAS shall not be operated from any moving device or vehicle.

[8] This is consistent with an FAA Office of Chief Counsel Opinion, dated August 8, 2014, and prepared by Dean E. Griffith, AGC-220, in which it was acknowledged that the intent of 14 C.F.R. § 91.9(b) and 91.203(a), (b) is met if the PIC of the sUAS has access to the aircraft flight manual, registration certificate, and other required documents from the ground control station from which he or she is operating the sUAS. Memorandum from Mark Bury, FAA Assistant Chief Counsel for International Law, Legislation and Regulation, to John Duncan, FAA Flight Standards Service (Aug. 8, 2014); *see also* FAA Grant of Exemption to Astraeus Aerial, Docket No. FAA-2014-0352, Exemption No. 11062,pp. 16-18.

33) sUAS shall not be operated 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 PIC.

34) Operations shall not occur in congested or densely populated areas. The sUAS may not operate in Class B, C, D or E airspace without written approval from the controlling authority. Operations will not be conducted within a 5 NM range of the geographic center of an airport as denoted on a current FAA-published aeronautical chart unless permission has been obtained from the local control tower or, in the case of a non-towered airport, written notice has been provided to the airport's management, and the operation is conducted in accordance with a NOTAM as required by the grant of this exemption.

35) Take-off and landing operations shall be conducted over private and/or controlled-access property (i.e. no unauthorized persons). Permission from the landowner, controller, manager or authorized representative will be obtained for each flight to be conducted.

36) Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA shall be reported to the FAA's UAS Integration Office (AFS-80) within 24 hours. Accidents shall be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

37) UAS operations may not be conducted during night, as defined by 14 C.F.R. § 1.1. All operations must be conducted under visual meteorological conditions ("VMC"). Flights under special visual flight rules (SVFR) are not authorized.

APPENDIX C

SMALL UNMANNED AERIAL SYSTEM DESCRIPTION

Draganfly X4-ES

Draganfly systems have been approved by the FAA for operational COAs and have a demonstrated safety track record. The Draganfly UAS platforms were the first to officially fly at the first operational the FAA's UAS Test Sites (Northern Plains UAS Test Site, North Dakota). Many customers from emergency services, to education to police and even commercial operations for industrial inspections have been given approval to fly in US, Canada, UK, Australia, Japan, amongst others. As to the X4-ES, the FAA has granted COAs to the Mesa County Sheriff's Office and the Grand Forks Sheriff's Office.

Systems Overview

The Draganflyer X4-ES system can carry payloads up to 1.8 lbs. The X4-ES operates with a maximum wind threshold of 30 mph for sustained winds and wind gusts up to 35 mph. The system contains 11 sensors on-board, including 3 gyros, 3 magnetometers, 3 accelerometers, a barometric pressure sensor and GPS module. This sensor package provides for default of level flight and does not allow the X4-ES to go beyond a 38 degree angle. This eliminates the difficult portion of flying. Meaning that, the operator is only steering the aircraft (controlling the system's latitudinal direction) and adjusting its altitude.

All flight operations are capable of control through GPS, making the system easy to navigate. In the case of lost GPS, a manual user flight mode is enabled which allows the pilot-in-command ("PIC") to provide manual navigation inputs to assist in landing the vehicle. At all times through the ground control station, the PIC is able to monitor the sUAS location through the mapping function and is provided with continuous altitude information. In GPS mode, the aircraft compensates for wind at the altitude the system is operating. The end result is a system capable of gathering high quality aerial data at much higher wind thresholds and is a trait that is imperative for many aerial inspection operations. While GPS Position Hold mode is one available benefit of the system, it is not necessary for operation of the aircraft. When GPS is either not available or has degraded, the PIC may still ensure safe operations.

The X4-ES has an operational range of over 1/2 a mile,[9] but was designed to be flown within the direct Visual Line-of-Sight ("VLOS") of the operator at all times. All flight operations take place as a result of direct input by the PIC. Flight adjustments are made based on a two joystick control system, which allows for very precise movements and makes it extremely

[9] Control transmission signal is rated for in excess of 1/2 mile; however, battery flight endurance limits require the operator to restrict maximum distance to ensure safe return of the sUAS.

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easy to navigate in either Manual or GPS Position Hold. In the Manual mode, flight altitude is maintained based on barometric pressure and can be easily adjusted by the PIC using the left joystick. In the GPS Position Hold mode, the system is designed to hold its GPS position (and altitude and heading) if the PIC is not explicitly commanding the system to move. Camera stability is further enhanced by a 2 axis brushless mount to ensure the most stability and least amount of vibration regardless of the wind speed.

The Draganfly X4-ES provides two semi-autonomous flight modes using a two joystick configuration and video interface. The user controls the aircraft in either a Manual/Altitude (Manual) Hold mode or GPS Position Hold mode to the areas of interest maintaining VLOS of the aircraft at all times. Instrumentation indicating heading, bearing, altitude, climb rate, horizontal speed, GPS position, battery level, data link, and GPS accuracy are additional aids made available to the PIC on the ground control station ("GCS").

Autonomous operations are also available through pre-programmed flight plans, which must be uploaded to the aircraft prior to take-off. After departing the ground, the PIC can execute the preprogramed flight. At any time during the programmed flight, the PIC can provide inputs to abort and/or override the programmed flight to take immediate control of the aircraft. For pre-programmed flight, the PIC may utilize additional navigation settings, including landing zones and flight area (including visual no-fly zones, maximum altitude, and minimum altitude), so that the sUAS operates only within operator-specified flight parameters. In other words, Olsson will set up virtual fencing around the operational area, preventing the X4-ES and the PIC from operating outside the planned flight area, including altitude. This reduces the needed operating area by omitting the need to factor in additional room for PIC operating error.

The ability to fly in both Manual mode and GPS Position Hold, as well as in a GPS deprived environment, makes the X4-ES one of the safest choices for both urban and nonurban environments. Many advanced safety features were also designed into the aircraft, including intelligent fault handling that allows the aircraft to detect a system fault while airborne, and to automatically fly back to its take-off location and land. For example, the X4-ES detects a loss of GPS and warns the PIC of the status. Other faults that can be detected include loss of communication, low battery levels, magnetic anomalies, battery cell imbalances, and temperature fluctuations. Prior to takeoff, the aircraft completes a sensor self-check. If an error is detected in the pitch, roll or yaw gyros between the time motors are engaged and takeoff, the aircraft will abort the takeoff and issue an alarm message. It should also be noted that the PIC can create maximum flight altitudes so the sUAS cannot go above a pre-set maximum altitude.

Physical Characteristics of the X4-ES

Dimensions
- Width: 87cm (34.25in)
- Length: 87cm (34.25in)
- Height: 30cm (12in)

Weight and payload
- Helicopter weight w/battery: 1,670g (3.7lbs)
- Payload capacity: 800g (1.8Ibs)
- Max take-off weight: 2,470g (5.4lbs)

Flight characteristics
- Max climb rate: 2m/s (6.5ft/s)
- Max descent rate: 2m/s (6.5ft/s)
- Max turn rate: 90 degrees/sec
- Approx max air speed: 50km/h (30mph)
- Minimum air speed: 0km/h (0mph)
- Launch type: VTOL
- Max altitude ASL 2,438m (8,000ft)
- Approx sound at 1 meter distance: 72db
- Approx sound at 3 meters distance: 62db

Landing style/type - Autonomous vertical lift

Propulsion System

- Engines - The X4-ES is powered by 4 electric direct drive brushless DC motors.
- Batteries - The X4-ES utilizes a removable, rechargeable, lithium-polymer battery. The charge level status from the battery on the aircraft is continually monitored and real time levels are displayed on the control system used by the PIC. Predefined voltage levels indicate a low battery warning, which provides the PIC with a warning alarm that is both visual and audible. A critical battery warning alarm that is both visual and audible is also provided to the PIC. At the critical battery warning alarm, the aircraft also initiates a safe descent and land at a pre-determined controlled rate. At any time during the battery warnings, full control of the aircraft is maintained. However, ignoring the critical battery warning *and* overriding the descent feature could result in a critical flight system failure at which point the aircraft may crash. The battery is charged using a standard wall charger that is provided with the aircraft.

Maintenance - The X4-ES is nearly maintenance free. The airframe has only 2 ceramic bearings per motor and, thus, has very few moving parts. Maintenance consists of inspections and verification of communications performed by a qualified person prior to each flight.

Preflight checklist includes but is not limited to:

- Visual inspection of the airframe, including the boom and canopy, side arms, landing gear, rotors, motors, and canopy;
- Visual inspections of rotor integrity;
- All payload system connections and components;
- Check charge of all batteries (aerial vehicle, control system, video repeater station).

Reliability – The X4-ES is designed for maximum reliability and to maintain performance over its life. The only components that experience routine wear are rotors, batteries, motors, and legs. Battery and motor conditions are monitored by the system with deviations reported to the operator.

Contact with other objects during flight may cause other components, particularly rotors, and motor arms, to become damaged. Damaged components are likely to be detected during the full visual inspection of the airframe performed before each flight.

TheX4-ES detects numerous conditions which may make flying unsafe, such as reduced GPS accuracy, magnetic anomalies, low battery charge, battery cell imbalances, and temperature fluctuations. Automatic pre-flight calibration checks prevent the aircraft from taking off if such conditions are present. An automatic preflight check also tests the calibrations of the pitch, rolls and yaw gyros, and aborts the takeoff and delivers an alarm message, should an error be detected. During flight, a degradation or loss of communications between the X4-ES and the ground station may initiate a failsafe action of return-to-home, where the aircraft returns to its point of take-off at its current altitude. At that point, the PIC may land the aircraft, or an auto-land is initiated in which the aircraft descends at a controlled rate from its current position. For the failsafe action of Return-To-Home, the X4-ES must be in GPS Position Hold mode. Otherwise, the aircraft is set for a default to auto-land. In the event that the system senses a low battery of the X4-ES during a Return-to-Home action, the aircraft defaults to the auto-land maneuver.

Command and Control Systems - The Draganflyer GCS, which is used by the X4-ES (and several other Draganflyer models), allows the PIC simultaneous control over the aircraft and any payloads. The joysticks, located on the GCS, allow for quick navigation and the display screen provides all essential flight data to the PIC. Telemetry data is transmitted to the GCS at least once per second. The GCS display screen provides all essential data to the operator.

Displayed on GCS:

- Barometric Altitude
- Bearing
- Heading[10]
- Attitude
- Ground Speed
- Climb Rate
- Flight Time
- Data Link
- Position
- GPS Satellite (number of satellites)
- GPS Satellite Precision Dilution of Precision (PDOP)[11]
- GPS satellite errors
- Control system battery level
- X4-ES battery level
- Local time
- UAS failsafe action
- UAS Status

Onboard Flight Instruments - The X4-ES is equipped with an Inertial Navigation System (3-axis gyroscope, 3-axis magnetometer, 3 axis accelerometers, GPS receiver, barometric pressure sensor and GPS module).

On-board computer systems - The X4-ES is equipped with on-board computer systems to monitor (sensors, battery, etc.), control (speeds, altitude, position, etc.), and communicate (control, telemetry, etc.) with the PIC.

On-board Guidance and Navigation Equipment - The X4-Es can operate autonomously. As described, *supra*, autonomous flight first requires the PIC to initiate and complete the takeoff sequence, and then place the aircraft into GPS mode. The PIC also retains the ability to immediately take control of the X4-ES with Manual flight mode.

Frequency Allocations – 900 MHz, 2.4 GHz, and 5.8 GHz.

Flight termination link – A flight termination link is available to the PIC on the GCS to prevent a "fly away" or other potentially dangerous situation.

[10] The X4-ES may be pointed in one direction yet fly towards a completely different direction. In other words, the heading and bearing can be different. Thus, both parameters are displayed on the X4-ES GCS home screen.
[11] This is the accuracy to the real time GPS reading.

Takeoff and Landing – The X4ES has vertical lift autonomous launch. For takeoff, the UAS will takeoff and hover approximately 3-4 feet until further inputs are made by the PIC. Horizontal position of the aircraft is controlled by the PIC using the right joystick.

Navigation System – In most cases, navigation of the aircraft is through the visual line-of-sight of the PIC. However, the X4-ES may also be operated through pre-programmed flight plans, which are uploaded to the aircraft prior to take-off. Once the auto-takeoff is complete, the PIC can execute the programmed flight which is performed through an autopilot function. At any time during the preprogrammed flight, the PIC can override the autopilot, abort the mission, and take immediate control of the aircraft. In preprogrammed flight, there are several navigation settings and/or tools, including landing zones and flight areas (including visual no-fly zones, maximum altitude, and minimum altitude). This has the effect of creating a virtual fencing around the operational area.

Redundant Systems – The X4-ES combines the input from a multitude of sensors. Even though the data from all sensors is required for optimal system performance, dependent on the sensor, a single sensor malfunction is likely to result in degraded performance rather than a fatal response.

Emergency Procedures and System Failures

> *Sensor Failure* – A failure of onboard flight instruments and/or sensors will degrade the X4-ES performance and will result in either a fatal critical response or a non-fatal critical response.[12] The type of response will depend on the nature and severity of the failure. If the aircraft becomes unstable due to sensor failure, this may result in loss of performance or features. In most instances, the aircraft remains in stable flight so that the PIC may initiate a landing, the aircraft itself initiates an auto-land. For instance, a magnetometer failure may lead to a non-fatal critical response. In extreme cases, like an accelerometer failure, a fatal response may result that causes the aircraft a fatal response such as a crash.
>
> *Motor Failure* **–** This will cause a fatal response in flight performance if one or more motors fails.
>
> *Airframe Failure* **–** Depending on the nature and severity, an airframe failure may result in decreased flight performance or a fatal response such as a crash, depending on the nature of the airframe failure.

[12] A fatal response generally references a complete and catastrophic systems failure leading to the loss of control of the aircraft, causing it to enter an uncontrolled descent and ultimately impacting the ground or other object.

Navigation System Failure **–** In a navigation system failure, degraded GPS will result in a response warning to the pilot in which the system would be flown in manual mode. This will result in degraded GPS position performance, but manual flight by the PIC is not affected.

Power Failure **–** A complete battery failure which results in power loss to the aircraft will result in a fatal response and the aircraft may shutdown and crash, if airborne.

Low Battery Condition **–** The PIC/operator is alerted of a low battery condition through both a visual and aural warning. In a critical battery condition, the PIC/operator is again alerted through an aural and visual warning, and the X4-ES will begin an auto-land at a controlled and safe rate of descent.

Line-of-Sight Loss **–** All flight operations will be conducted with the X4-ES within visual sight of the pilot. If the PIC's view becomes obstructed and line-of-sight is lost, the PIC may instruct the aircraft to hover in place until line-of-sight is re-established, return to the takeoff position, or land at the current position.

Security – The X4-ES and communications links are encrypted by the manufacturer's proprietary software.

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APPENDIX D

SMALL UNMANNED AERIAL SYSTEM DESCRIPTION

3D Robotics Aero-M

Systems Overview

The 3D Robotics Aero-M system can carry payloads up to 1.1 lbs. It operates with a maximum wind threshold of 25 mph. The system contains two full Inertial Measurement Unit ("IMU") sensor suites, one acting as the primary flight sensor and the other used as a comparison for monitoring IMU health and full failover functionality, if it becomes necessary. The system also contains two barometer sensors. This eliminates the difficult portion of flying. The pilot-in-command ("PIC") has the ability to control the speed, roll, yaw and pitch of the aircraft.

The Aero-M has an operational range of approximately 250 acres,[13] but was designed to be flown within the direct Visual Line-of-Sight ("VLOS") of the operator at all times. All flight operations take place as a result of direct input by the PIC. Flight adjustments are made based on a two control stick system that is located on the Ground Control Station ("GCS"). Instrumentation indicating heading, altitude, climb rate, horizontal speed, GPS position, battery level, data link, and GPS accuracy are additional aids made available to the PIC through the flight data screen located on the GCS. The aircraft was designed to operate in six different flight modes. In the basic "Manual" operations mode, the PIC controls all axes of the Aero-M without any assistance from the system's autopilot function. The remaining control methods are semi-autonomous in functionality.

An autonomous operations, or "Auto," mode is available through available pre-programmed flight plans, which must be uploaded to the aircraft prior to take-off using the 3D Robotics Mission Planner software application. The PIC may set the Aero-M to either an automatic takeoff or manual takeoff setting. After departing the ground, the aircraft initiates the preprogramed flight. At any time during the programmed flight, the PIC can provide inputs to abort and/or override the programmed flight to take immediate control of the Aero-M. For pre-programmed flight, the PIC may utilize additional navigation settings, including landing zones and flight area (including visual no-fly zones, maximum altitude, and minimum altitude), so that the Aero-M operates only within operator-specified flight parameters. In other words, Olsson will set up virtual fencing around the operational area, preventing the Aero-M and the PIC from operating outside the planned flight area, including altitude. This reduces the needed operating area by omitting the need to factor in additional room for PIC operating error.

[13] Control transmission signal is rated for in excess of $^1/_2$ mile; however, battery flight endurance limits require the operator to restrict maximum distance to ensure safe return of the sUAS.

In a "Fly by Wire" mode, the autopilot manages the control surfaces and navigates the Aero-M based on direction by the PIC. In a "Return to Launch" mode, the Aero-M returns to the position where it acquired GPS lock and enters a circle pattern at an altitude of 100 meters which is programmable by the operator. Similarly, in the "Loiter" mode, the Aero-M enters a circle pattern with a radius of 60 meters at its current altitude, which is again programmable by the PIC. Finally, "Stabilize" mode allows for manual control by the PIC. When the PIC releases the right control stick, however, the Aero-M will automatically return to level flight.

The Aero-M utilizes GPS for many modes of operation, making the system easy to navigate. In the case of lost or degraded GPS signal, the PIC may enable either the Manual or Fly by Wire operations modes to navigate the aircraft to a safe landing point. At all times through the GCS, the PIC is able to monitor the location of the Aero-M through the flight data screen.

Many advanced safety features were also designed into the aircraft, including intelligent fault handling that allows the aircraft to detect a system fault while airborne, and to automatically initiate the Return-to-Launch operations mode. For example, the Aero-M detects a loss of GPS and warns the PIC of the status. Other faults that can be detected include loss of communication, and low battery levels. The PIC can also create maximum flight altitudes so the Aero-M cannot go above a pre-set maximum altitude.

Physical Characteristics of the Aero-M

Dimensions
- Width: 188 cm (74 in) (wingspan)
- Length: 129 cm (51 in)

Weight and payload
- Aircraft weight w/battery: 6.8 lbs
- Payload capacity: 1.1 lbs
- Max take-off weight: 7.9 lbs

Flight characteristics
- Maximum Turbulence Rating: light
- Radio Range: .6 miles[14]
- Flight Time: 40 minutes
- Max Operational Wind Speed: 25 mph (11 m/s)
- Approx max airspeed: 56 mph (90 kmh)
- Approx min airspeed: 22 mph (35 kmh)
- Max altitude ASL: approximately 8,000 feet[15]
- Landing Accuracy: 6.5 feet latitude x 131 feet longitude (2 m x 40 m)

[14] This figure reflects estimated values at ideal operating conditions. Environmental conditions may affect flight time, range, area coverage, and ground sampling distance.
[15] Olsson will not operate the aircraft above 400 ft. AGL.

Landing style/type – Approach and controlled descent / manual or automatic landing available

Propulsion System

- Engines - The Aero-M is powered by 1 Tiger AT2820-7, 830 kV motor that is connected to a Gemfan 11x7 propeller.
- Batteries - The Aero-M utilizes a removable, rechargeable, lithium-polymer battery. The charge level status from the battery on the aircraft is continually monitored and real time levels are displayed on the control system used by the PIC. Predefined voltage levels indicate a low battery warning, which provides the PIC with a warning alarm that is both visual and audible. In such an instance, the aircraft will automatically return to circle above the point of launch/take-off and circle overhead. If the battery reaches 25% of charge, the aircraft will result in an additional low battery alarm that is both visual and audible. At any time during the battery warnings, full control of the aircraft is maintained. Ignoring the critical battery warning could result in a critical flight system failure. The battery is charged using a standard wall charger that is provided with the aircraft.

Maintenance - The Aero-M is nearly maintenance free. The airframe has only 2 ceramic bearings in its motor and, thus, has very few moving parts. Maintenance consists of inspections and verification of communications performed by a qualified person prior to each flight.

Preflight checklist includes but is not limited to:

- Visual inspection of the airframe, including the airframe, tail and tail boom, the servo rods, airspeed sensor, and proper balance of the aircraft;
- All payload system connections and components;
- Check charge of all batteries (aerial vehicle and control system).

Reliability – The Aero-M is designed for maximum reliability and to maintain performance over its life. The only components that experience routine wear are the propeller, batteries, motor, and servos. Battery conditions are monitored by the system with deviations reported to the operator.

Contact with other objects during flight may cause other components, particularly the propeller, wings and servos to become damaged. Damaged components are likely to be detected during the full visual inspection of the airframe performed before each flight.

The Aero-M detects numerous conditions which may make flying unsafe, such as reduced GPS accuracy, low battery charge, and lost-link with the GCS. Automatic pre-flight calibration checks prevent the aircraft from taking off if such conditions are present. During flight, a degradation or loss of communications between the Aero-M and the GCS may initiate a failsafe action of Return-to-Launch. This is displayed visually on the GCS. At that point, the PIC may land the aircraft, or an auto-land is initiated in which the aircraft descends at a controlled rate from its current position.

Command and Control Systems - The GCS allows the PIC simultaneous control over the aircraft and any payloads. The right and left control sticks are located on the GCS and permit quick navigation. The flight data display screen provides all essential flight data to the PIC. The transmission of telemetry data to the GCS is selectable to the PIC at a rate up to 20 hz.

Displayed on GCS:

- Barometric Altitude
- Heading
- Bank Angle
- Attitude
- Ground Speed
- Climb Rate
- Flight Time
- Ground Station Signal
- Position (Latitude and Longitude)
- Mode of Operation
- GPS Satellite (number of satellites)
- GPS Satellite HDOP
- GPS Status
- GCS Battery Status
- Aero-M Battery Status
- Local time
- UAS Failsafe Action (e.g., low battery, etc.)

Onboard Flight Instruments - The Aero-M is equipped with an Inertial Navigation System (3- axis gyroscope, 3-axis magnetometer, 3 axis accelerometers, GPS receiver, barometric pressure sensor and GPS module).

On-board computer systems - The Aero-M is equipped with on-board computer systems to monitor (sensors, battery, etc.), control (speeds, altitude, position, etc.), and communicate (control, telemetry, etc.) with the PIC.

On-board Guidance and Navigation Equipment - The Aero-M can operate autonomously for take-off, inflight operations, and landing. In automatic takeoff, the PIC must set the aircraft to autonomous mode and it then senses direction of movement and launches the aircraft in that direction. For autonomous inflight operations 3D Robotics utilizes the Mission Planner software application. Mission Planner is a computer-based application for the PIC or operator to build a flight plan that is loaded to the Aero-M prior to takeoff. In automatic landing, the PIC must input a pattern of waypoints into a mission prior to takeoff. The waypoints are set at different locations and altitudes so that the aircraft gradually descends in a controlled and gradual manner to land safely. The PIC retains the ability to immediately take control of the Aero-M with a manual flight mode.

The Aero-M has six different operations modes:

- **Auto**: This is used for autonomous missions preprogrammed using the 3D Robotics Mission Planner software application.
- **Fly by Wire**: An assisted manual control where the autopilot system manages the flight control surfaces and navigates the aircraft based on inputs from the PIC.
- **Return-to-Launch**: This mode directs the aircraft tto circle over the takeoff or launch point. The aircraft will enter a circle pattern at an altitude of 100 meters.
- **Loiter**: By selecting this mode, the PIC directs the aircraft to enter a circle pattern with a radius of 60 meters at the current altitude. The PIC may adjust the position of the circle pattern with the right control stick.
- **Stabilize**: This mode consists of manual control by the PIC with an additional safeguard that returns the aircraft to a level flight orientation with release of the right control stick.
- **Manual**: This is full manual control without assistance of the autopilot.

Frequency Allocations - 900 MHz, 2.4 GHz, and 5.8 GHz.

Takeoff and Landing – Manual and automatic takeoff and landing functions exist on the Aero-M. In automatic takeoff, the PIC must set the aircraft to autonomous mode and it then senses direction of movement. The PIC stands into the wind holding the aircraft above his or her head. The PIC then runs and throws the Aero-M at an upwards angle. The aircraft senses the throw, powers the motor, and climbs to the altitude specified by the “takeoff” waypoint preprogrammed in the Mission Planner application uploaded to the aircraft prior to flight. In manual mode, the Aero-M is launched into the air from the same running position used in automatic takeoff, however, the PIC must immediately adjust the GCS to control the aircraft once it is airborne.

In automatic landing, the PIC must input a pattern of waypoints into a mission, using the Mission Planner software application, prior to takeoff. The waypoints are set at different locations and altitudes so that the aircraft gradually descends in a controlled and gradual manner to land safely. In manual landing mode, the PIC directs the Aero-M to a circle pattern (similar to a traffic pattern used in manned aircraft flight), followed by a final approach pattern flown into the wind at decreasing altitude.

Navigation System – The Aero-M is capable of navigation solely by the visual line-of-sight of the PIC and in manual mode operation. However, the aircraft may also be operated through pre-programmed flight plans, which are uploaded to the aircraft prior to take-off. An auto takeoff may be performed, after which the aircraft then begins its preprogrammed flight plan. Alternatively, the PIC may conduct a manual takeoff and then initiate the preprogrammed flight plan. At any time during the preprogrammed flight, the PIC can override the autopilot, abort the mission, and take immediate control of the aircraft. The aircraft supports complex and simple geo-fencing features that allow the PIC to create vertical and horizontal virtual walls to prevent the aircraft from operating outside that preprogrammed area.

Redundant Systems — The Aero-M combines the input from a multitude of sensors. Even though the data from all sensors is required for optimal system performance, dependent on the sensor, a single sensor malfunction is likely to result in degraded performance rather than a fatal response.

Emergency Procedures and System Failures

> *Motor Failure* **-** This will cause a fatal response in flight performance if the motor fails. However, the flight control surfaces will remain responsive and the aircraft can glide to the ground under manual control.
>
> *Airframe Failure* **–** Depending on the nature and severity, an airframe failure may result in decreased flight performance or a fatal response[16].
>
> *Navigation System Failure* **–** In a navigation system failure, or loss of communications channels required for autonomous operations, a failsafe visual and aural warning will display on the GCS and the Aero-M will initiate Return to Launch mode. Manual control may also be initiated on the GCS.
>
> *Power Failure* **–** A complete battery failure which results in power loss to the aircraft will result in a fatal response.
>
> *Low Battery Condition* **–** The PIC is alerted of a low battery condition through both a visual and aural warning, and the Aero-M initiates Return to Launch mode where it

[16] In a fatal response, the autopilot will maintain the aircraft operating above stall speed and it will descend along its flight path. Assuming the aircraft is within the VLOS of the PIC, the PIC would then take manual control and land the aircraft.

enters a circle pattern. In a critical battery condition, the PIC is again alerted through an aural and visual warning.

GCS Fail or Shutdown – A failure or shutdown of the GCS automatically initiates Return-to-Launch mode. In "Auto" mode, the aircraft will continue on its mission.

Line-of-Sight Loss **–** All flight operations will be conducted with the Aero-M within visual line-of-sight of the PIC. If the PIC's view becomes obstructed and line-of-sight is lost, the PIC may immediately place the aircraft into the Return to Launch or Loiter modes of operations.

Security – The Aero-M and communications links are encrypted by the manufacturer's proprietary software.

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APPENDIX E

SMALL UNMANNED AERIAL SYSTEM DESCRIPTION

3D Robotics X8+

Systems Overview

The 3D Robotics X8+ system can carry payloads up to 1.7 lbs. The system contains two full Inertial Measurement Unit (IMU) sensor suites, one acting as the primary flight sensor and the other used to compare data inflight and failover functionality, if it becomes necessary. The system also contains a barometer sensor. This eliminates the difficult portion of flying. The pilot-in-command ("PIC") has the ability to control the speed, roll, yaw and pitch of the aircraft.

The X8+ was designed to be flown within the direct Visual Line-of-Sight ("VLOS") of the operator at all times. All flight operations take place as a result of direct input by the PIC. Flight adjustments are made based on a two control stick system that is located on the Ground Control Station ("GCS"). Instrumentation indicating heading, altitude, horizontal speed, GPS position, battery level, data link, and GPS accuracy are additional aids made available to the PIC through the flight data screen located on the GCS. The aircraft was designed to operate in three different flight modes. In the basic "Manual" operations mode, the PIC controls all axes of the X8+ without any assistance from the system's autopilot function.

An autonomous operations, or "Auto," mode is available through available pre-programmed flight plans, which must be uploaded to the aircraft prior to take-off using the 3D Robotics Mission Planner software application. The PIC may set the X8+ to either an automatic takeoff or manual takeoff setting. At any time during the programmed flight, the PIC can provide inputs to abort and/or override the programmed flight to take immediate control of the aircraft. For pre-programmed flight, the PIC may utilize additional navigation settings, including landing spots and flight area (including visual no-fly zones, maximum altitude, and minimum altitude), so that the aircraft operates only within operator-specified flight parameters. In other words, Olsson will set up virtual fencing around the operational area, preventing the X8+ and the PIC from operating outside the planned flight area, including altitude. This reduces the needed operating area by omitting the need to factor in additional room for PIC operating error. In addition to the pre-programmable parameters, the X8+ is also set to default limits of 300 meters in distance and 100 meters in altitude.

In a "Return-to-Launch" mode, the X8+ returns to the position where it acquired GPS lock and completes an automatic landing. Similarly, in the "Loiter" mode, the X8+ enters a hover at its current altitude, which is again directed by the PIC on the GCS. In "Land" operations mode, the X8+ initiates an automatic landing at its current location.

The X8+ utilizes GPS for many modes of operation, making the system easy to navigate. In the case of lost or degraded GPS signal, the aircraft automatically switches to Manual operations mode so that the PIC may navigate the aircraft to a safe landing point. At all times through the GCS, the PIC is able to monitor the location of the X8+ through the flight data screen.

Many advanced safety features were also designed into the aircraft, including intelligent fault handling that allows the aircraft to detect a system fault while airborne, and to automatically initiate the Return-to-Launch operations mode. For example, the X8+ detects a loss of GPS, warns the PIC of the status and automatically enters Manual operations mode. Other faults that can be detected include loss of communication, and low battery levels. The PIC also comes with default geo-fence settings that limit the aircraft's operating altitude and operating distance.

Physical Characteristics of the X8+

Dimensions
- Width: 35 cm
- Length: 51 cm
- Height: 20 cm

Weight and payload
- Aircraft weight w/battery: 5.6 lbs
- Payload capacity: 1.7 lbs
- Max take-off weight: 7.3 lbs

Flight characteristics
- Maximum Turbulence Rating: light
- Radio Range: .6 miles[17]
- Flight Time: 15 minutes
- Airspeed: 14.5 mph default (6.5 m/s)
- Max altitude ASL: approximately 8,000 feet (MSL)[18]

Landing style/type – vertical lift / manual or automatic landing available

Propulsion System

- Engines - The X8+ is powered by SunnySky V2216-12 KV800 II motors that are connected to 8 APC propellers.
- Batteries - The X8+ utilizes a removable, rechargeable, lithium-polymer battery. The charge level status from the battery on the aircraft is continually monitored and real time levels are displayed on the control system used by the

[17] This figure reflects estimated values at ideal operating conditions. Environmental conditions may affect flight time, range, area coverage, and ground sampling distance.
[18] Olsson will not operate the aircraft above 400 AGL.

PIC. Predefined voltage levels indicate a low battery warning, which provides the PIC with a warning alarm that is both visual and audible. In such an instance, the aircraft will automatically initiate a landing at its current location. At any time during the battery warnings, full control of the aircraft is maintained. The battery is charged using a standard wall charger that is provided with the aircraft.

Maintenance - The X8+ is nearly maintenance free. Maintenance consists of inspections and verification of communications performed by a qualified person prior to each flight.[19]

Preflight checklist includes but is not limited to:

- Visual inspection of the aircraft, including the airframe, the front and rear arms, the propellers, and GPS mast;
- All payload system connections and components;
- Check charge of all batteries (aircraft and control system).

Reliability – The X8+ is designed for maximum reliability and to maintain performance over its life. The only components that experience routine wear are the propeller, batteries, motor, and servos. Battery conditions are monitored by the system with deviations reported to the PIC.

Contact with other objects during flight may cause other components, particularly the propeller, wings and servos to become damaged. Damaged components are likely to be detected during the full visual inspection of the airframe performed before each flight.

The X8+ detects numerous conditions which may make flying unsafe, such as reduced GPS accuracy, low battery charge, and lost-link with the GCS. Automatic pre-flight calibration checks prevent the aircraft from taking off if such conditions are present. During flight, a degradation or loss of communications between the X8+ and the GCS will initiate a failsafe action of Return-to-Launch and complete an automatic landing. This is displayed visually on the GCS.

Command and Control Systems - The GCS allows the PIC simultaneous control over the aircraft and any payloads. The right and left control sticks are located on the GCS and permit quick navigation. The flight data display screen provides all essential flight data to the PIC. The transmission of telemetry data to the GCS is selectable to the PIC at a rate up to 20 hz.

Displayed on GCS:

- Barometric Altitude
- Ground Speed

[19] Olsson specific maintenance procedures can be found in the Olsson GOM.

- Flight Time
- Ground Station Signal
- Position (Latitude and Longitude)
- Mode of Operation
- GPS Satellite (number of satellites)
- GPS Status
- GCS Battery Status
- X8+ Battery Status
- Meters from Launch Point
- UAS Failsafe Action (e.g., low battery, etc.)

Onboard Flight Instruments - The X8+ is equipped with an Inertial Navigation System (3-axis gyroscope, 3-axis magnetometer, 3 axis accelerometers, GPS receiver, barometric pressure sensor and GPS module).

Onboard Computer Systems - The X8+ is equipped with on-board computer systems to monitor (sensors, battery, etc.), control (speeds, altitude, position, etc.), and communicate (control, telemetry, etc.) with the PIC.

On-board Guidance and Navigation Equipment - The X8+ can operate autonomously for take-off, inflight operations, and landing. In automatic takeoff, the PIC must first arm the X8+ and its propellers in standard mode. The PIC then switches the X8+ to automatic mode and raises the throttle. For autonomous inflight operations 3D Robotics utilizes the Mission Planner software application. Mission Planner is a computer-based application for the PIC or operator to build a flight plan that is loaded to the X8+ prior to takeoff. In automatic landing, the PIC must input a landing waypoint into a mission prior to takeoff. The aircraft will land automatically at the landing waypoint, but the PIC must lower the throttle fully down so that the propellers disarm after the aircraft completes the landing. The PIC retains the ability to immediately take control of the X8+ with manual flight mode.

The X8+ has three different operations modes:

- **Auto**: This is used for autonomous missions preprogrammed using the 3D Robotics Mission Planner software application.
- **Loiter**: By selecting this mode, the PIC directs the aircraft to enter a hover.
- **Standard**: This is full manual control without assistance of the autopilot.

The X8+ has two additional landing modes:

- **Land**: By selecting this switch, the PIC directs the X8+ to end its flight and land at the current position. The throttle joystick must be lowered fully down so that the X8+ automatically disarms the propellers upon touchdown. During the land sequence, the PIC may reposition the X8+ using the right joystick.

- **Return-to-Launch**: With this switch selected, the X8+ returns to the launch point and initiates an automatic landing. The throttle joystick must be lowered fully down so that the X8+ automatically disarms its propellers upon touchdown. During the automatic landing, the PIC may reposition the X8+ using the right joystick. Note that the Return-to-Launch landing point is the location where the X8+ was armed prior to takeoff.

Frequency Allocations – 900 MHz, 2.4 GHz, and 5.8 GHz.

Takeoff and Landing – Manual and automatic takeoff and landing functions exist on the X8+. Automatic takeoff requires the use of the Mission Planner software application. To initiate the automatic takeoff, the PIC must arm the aircraft and its propellers and then switch the aircraft into automatic mode and raise the throttle. For manual takeoff, the X8+ must be armed at which point the motors will spin. The X8+ will also initiate an automatic landing when operating in an autonomous mode using the Mission Planner application. In the Return-to-Launch mode, the X8+ will return to its point of launch and automatically land. Similarly, in the Land mode, the X8+ will land at its current location.

Navigation System – The X8+ requires GPS lock prior to operation. The X8+ is capable of navigation solely by the visual line-of-sight of the PIC and in manual mode operation. However, the aircraft may also be operated through pre-programmed flight plans, which are uploaded to the aircraft prior to take-off. An auto takeoff may be performed, after which the aircraft then begins its preprogrammed flight plan. Alternatively, the PIC may conduct a manual takeoff and then initiate the preprogrammed flight plan. At any time during the preprogrammed flight, the PIC can override the autopilot, abort the mission, and take immediate control of the aircraft. The X8+ is set to default geo-fence settings that prevent the aircraft from exceeding an altitude of 100m (328 ft), and a distance of 300m (984 ft) from the GCS. If those limitations are exceeded, the aircraft automatically initiates the Return-to-Launch mode and lands.

Redundant Systems – The X8+ combines the input from a multitude of sensors. Even though the data from all sensors is required for optimal system performance, dependent on the sensor, a single sensor malfunction is likely to result in degraded performance rather than a fatal response.

Emergency Procedures and System Failures

Airframe Failure **–** Depending on the nature and severity, an airframe failure may result in decreased flight performance or a fatal response[20].

[20] In a fatal response, the autopilot will maintain the aircraft operating above stall speed and it will descend along its flight path. Assuming the aircraft is within the VLOS of the PIC, the PIC would then take manual control and lands the aircraft.

Navigation System Failure **–** The X8+ requires GPS for operations. GPS must lock prior to takeoff. If the X8+ loses GPS lock in flight, an aural and visual warning is provided to the PIC. The aircraft automatically switches into manual control (altitude hold mode) on the GCS. The PIC may also change this failsafe from manual control to an automatic landing.

Power Failure **–** A complete battery failure which results in power loss to the aircraft will result in a fatal response.

Low Battery Condition **–** The PIC is alerted of a low battery condition through both a visual and aural warning, and the X8+ initiates an immediate landing mode at its current location.

GCS Fail or Shutdown – A failure or shutdown of the GCS automatically initiates Return to Launch mode. In "Auto" mode, the aircraft will continue on its mission.

GCS Signal Loss – If the X8+ loses contact with the GCS, the aircraft returns to the launch point and lands automatically. The PIC is alerted to this situation with a blinking yellow status LED on the GCS.

Line-of-Sight Loss **–** All flight operations will be conducted with the X8+ within visual line-of-sight of the PIC. The X8+ is set to a default of a geo-fence of 300m (984 ft). If the X8+ travels beyond the 300m geo-fence, it automatically returns to its launch point and lands. The default setting may be disabled by the PIC.

Altitude Failsafe – The X8+ has a 100m (328 ft) altitude geo-fence enabled by default. If the geo-fence is exceeded, the X8+ automatically switches to Return-to-Launch.

Security – The X8+ and communications links are encrypted by the manufacturer's proprietary software.

APPENDIX F

FEDERAL REGISTRY SUMMARY

Pursuant to 14 C.F.R. Part 11, Olsson offers the following summary for publication in the Federal Register, should publication be necessary:

> Olsson Associates seeks an exemption from the following rules:
>
> 14 C.F.R. Part 21, Subpart H; 14 C.F.R. § 91.7; 14 C.F.R. § 91.9(b)(2); 14 C.F.R. § 91.113; 14 C.F.R. § 61.113(a)-(b); 14 C.F.R. § 61.133(a); 14 C.F.R. § 91.119(c); 14 C.F.R. § 91.151; 14 C.F.R. § 91.203; 14 C.F.R. § 91.405(a)-(b); 14 C.F.R. § 91.407(a)(1); 14 C.F.R. § 91.409(a)(1)-(2); and, 14 C.F.R. § 91.417(a).

Approval of these exemptions will permit Olsson to conduct commercial unmanned aircraft systems ("UAS") operations in a number of industries and applications. The exemptions will enhance safety by reducing risk to the general public and property owners from the risk and hazards associated with performing equivalent work through conventional manned aircraft.