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

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

May 12, 2015

Exemption No. 11567
Regulatory Docket No. FAA–2015–0388

Mr. Beau Dealy
Managing Partner
Apis Remote Sensing Systems, LLC
1702 Agnes Drive
Hays, KS 67601

Dear Mr. Dealy:

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 16, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Apis Remote Sensing Systems, LLC (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct precision agriculture, market research, surveying, mapping and inspection.

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.

Airworthiness Certification

The UAS proposed by the petitioner is an AgEagle.

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[1]. 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, Apis Remote Sensing Systems, LLC 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.

[1] Aerial data collection includes any remote sensing and measuring by an instrument(s) aboard the UA. Examples include imagery (photography, video, infrared, etc.), electronic measurement (precision surveying, RF analysis, etc.), chemical measurement (particulate measurement, etc.), or any other gathering of data by instruments aboard the UA.

Conditions and Limitations

In this grant of exemption, Apis Remote Sensing Systems, LLC 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 AgEagle 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 five 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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U.S. Department of Transportation /
Federal Aviation Administration
Docket Management System
1200 New Jersey Ave., SE
Washington, DC 20590

For: Exemption Request Under Section 333 of the FAA Reform Act and Part 11 of the Federal Aviation Regulations Concerning Operation of an Unmanned Aerial System Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012.

Submitted: February 16, 2015

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February 16, 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") and 14 C.F.R. Part 11, Apis Remote Sensing Systems, LLC (Apis), seeks an exemption from Federal Aviation Regulations ("FARs") listed in Part 1. "Overview of Exemption" listed below and further detailed in Appendix A.

The requested exemption would permit market research and commercial operations for the 2015 release of the AgEagle Robotic Aircraft System ("AgEagle") manufactured by AgEagle, LLC; Neodesha, Kansas, USA; for which Apis is a technology advisor, authorized training partner, and reseller.

1. Overview of Exemption

The regulations from which the exemption is requested are as follows:

14 C.F.R. Part 21; Subpart H
14 C.F.R. 91.203(a) & (b);
14 C.F.R. 45.23(b);
14 C.F.R. 61.113(a) & (b);
14 C.F.R. 61.133(a);
14 C.F.R. 91.7(a);
14 C.F.R. 91.9(b)(2);
14 C.F.R. 91.119(c);
14 C.F.R. 91.151(a);
14 C.F.R. 91.405(a);
14 C.F.R. 91.407(a)(1);
14 C.F.R. 91.409(a)(2);

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14 C.F.R. 91.417(a)

While a collective case for exemption is made within this letter, Appendix A takes care to discuss each rule listed prior in relevant context to the request; showing why exemption from the FARs of concern are appropriate, provide an equivalent level of safety, and are in the public interest.

2. Applicable Legal Standard under Section 333

Apis submits that grant of this exemption application for use of the AgEagle in precision agriculture, market research, surveying, mapping and inspection operations will advance the Congressional mandate in Section 333 of the Reform Act to accelerate the introduction of small Unmanned Aerial Systems ("sUAS") into the National Airspace system ("NAS") if it can be accomplished safely. This law directs the Secretary of Transportation to consider whether certain sUASs 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 sUAS 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 size, weight, speed, and operational capability of the sUAS.
- Operation of the sUAS in close proximity to airports and populated areas.
- Operation of the sUAS within visual line of sight of the operator.

Reform Act 333(b)(1) states that 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)[1].

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

[1] http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt381/pdf/CRPT-112hrpt381.pdf

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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; 14 CFR 91.203(a)(1).

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 sUASs for aerial surveying, mapping and inspection applications. Accordingly, the applicant respectfully requests that the FAA grant the requested exemption without delay.

3. Summary Background of the AgEagle Robotic Aircraft System

The AgEagle is a battery-powered electric fixed wing aircraft with a wingspan of approximately 56 inches and a take off weight of approximately 7.5 pounds including payload. The AgEagle is programmed and operated primarily using cellular data network services, with the Pilot In Command (“PIC”) overseeing operations using a laptop, tablet computer or smartphone connected to the Internet (usually over the same cellular data network). The AgEagle can also be piloted over a 900 MHz radio using a laptop, tablet, or smartphone. Failsafe controls for emergency landings are also available via a 900 MHz industry-standard transmitter / receiver.

4. Scope of Mission Operations

The primary role of the AgEagle is aerial-based land survey in sparsely-populated rural areas including the acquisition of aerial photography for photogrammetric and preliminary “scouting” purposes; primarily in the precision agriculture market space. The AgEagle is equipped to carry either still-shot or video cameras, as well as still-shot cameras that have been modified to detect near-infrared spectra in wavelengths attuned to plant health. Ultimately, the AgEagle system enables land stakeholders to make informed decisions in the context of acreage. In the case of industries such as agriculture, the goal is enhanced land management and resource conservation that saves the land operator input costs while maximizing yield.

As described in detail following, the scope of this exemption would permit the AgEagle to operate commercially in controlled conditions on private ground with the permission of the landowner and/or operator at low altitudes in a limited flight duration over an

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airspace that is inherently limited in range. Furthermore, the relatively small size, low weight, and lack of hazardous payload (fuel) when compared to conventional manned aircraft make the AgEagle a lower-risk alternative to conventional manned aircraft designed to perform similar missions.

5. Evidence of Airworthiness

Critical to our exemption application is evidence of the airworthiness of the AgEagle robotic aircraft solution. Since inception of its proprietary airframe design, AgEagle, LLC believes that it has shown compliance through a history of flight operations totaling approximately 19,080 operational hours[2]. Furthermore, the AgEagle solution is a product that is delivered to the customer fully rigged and fight tested. The AgEagle is sold as a complete product solution. Should the AgEagle not be airworthy, then a lack of sales would justify this conclusion and consumers would not continue to purchase the AgEagle.

The confidence of foreign regulatory bodies with respect to regular commercial use of the AgEagle has been already been proven; specifically in Australia. Falcon UAV, the AgEagle retailer for Australia (http://www.falconuav.com.au), has applied for and received a UAV Operator's Certificate from the Australian Civil Aviation Safety Authority ("CASA"). Falcon UAV is currently operating the AgEagle commercially under this certificate. Falcon UAV has graciously made this certificate available to Apis who can in turn confidentially provide this document to the FAA for review upon request.

6. Safety Features

The criteria set forth in current regulation specify the substantive showings of the safety and fitness of a device for operation to ensure that the FAA has sufficient basis to evaluate the aircraft's safety. The AgEagle has a significant set of automated features provided by DroneDeploy, a San Francisco, California-based UAV solutions company that provides a hardware / software solution that ensures safe takeoff, flight and landing in all but extreme conditions. Further details of operation can be found in Appendix C.

[2] As of Dec 2014, AgEagle staff and customers have performed over 6,360 flights, logging 19,080 hours of flight time with the first generation AgEagle regarding both development and release versions. The current generation product, has achieved over 480 flights and 1,440 hours of flight time globally by AgEagle and its customers. This is a significant amount of flight time collected to understand and refine the AgEagle sUAS as a product. AgEagle, LLC has gone on public record in the form of their own exemption request (FAA-2014-1104-0001) dated December 29, 2014 stating these flight hours as justification of airworthiness.

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Facilitated by the DroneDeploy solution, automated safety functions and safety-enhancing features of the AgEagle include:

- Automated preflight system performance checks and calibrations
- A preflight checklist for the sUAS operator
- A one-button “hit the deck” collision avoidance command which causes the aircraft to drop from its cruising altitude and loiter at 50 feet AGL.
- Automated condition and fault detection, warnings, and predefined responses to a number of flight and system conditions including:
    - High winds with system and user defined safety thresholds
    - Low battery with system and user defined safety thresholds
    - High temperature and other hardware safety threshold monitors
    - An automated return protocol for a lost communication link
- Predefined responses to flight parameters exceeding the aforementioned safety thresholds include behavior such as:
    - Attempting to reestablish radio communication
    - Returning to the home position to loiter
    - Returning to the home position to land
    - Landing at the current position
- In the case of a lost GPS fix, a non-automated flight mode is enabled which allows the operator to provide manual navigation inputs to assist in landing the vehicle.

7. Mandatory Operating Conditions

The requested exemption would permit the commercial operation of the AgEagle under the following restrictions:

- Operations will be performed in Class G Airspace.
- Operations will be conducted 5 nautical miles outside of medium to large airports [3].
- Operations will be conducted outside of U.S. Military Bases, U.S. National Parks[4] and posted Temporary Flight Restrictions (“TFRs”)[5].
- Operations will be performed at an altitude of no more than 400 foot above ground level (“AGL”) at a target speed of 40 knots.
- Operations will be performed on private property with documented permission of the landowner and / or land operator.

[3] As illustrated on the World VFR map on http://skyvector.com
[4] As illustrated on https://www.mapbox.com/drone/no-fly/#
[5] As Illustrated on the FAA TFR Map http://tfr.faa.gov/tfr_map_ims/html/index.html

- The aircraft will be operated in the field with both a Pilot In Command ("PIC") and a Visual Observer ("VO").
- The PIC will file a Notice to Airmen ("NOTAM") prior to each flight.
- The aircraft will remain within the visual line-of-sight of the PIC for the duration of the mission.
- For the duration of the mission, the VO will maintain direct voice contact with the PIC.
- Operations will occur during daytime hours under visual meteorological conditions.
- The aircraft will be operated in sparsely populated areas away from large assemblies of people and heavily trafficked roads.
- Any additional State and / or Local permits will be obtained prior to operation.

8. Operator Requirements

Given the comprehensive set of safety features built-in to the AgEagle, Apis proposes the following operator requirements in good faith with the safety of the National Airspace being paramount:

- The operator must have successfully completed and passed the FAA private pilot written examination or an FAA recognized equivalent.
- The operator must have completed a training program authorized by AgEagle, LLC for operation and maintenance of the AgEagle robotic aircraft system.

Apis notes that the FAA has found that the aforementioned safety factors have been sufficient to allow operation of sUASs by operators in the context of operations pursuant to public COAs[6]. The FAA has the statutory authority to grant exemptions to the requirements for and privileges associated with the grant of airmen's certificates per 49 USC 44701 (f).

- In addition, the operator will submit to a security background check equivalent to that currently required to obtain a private pilot's license. The FAA has made it clear in preceding exemptions[7] approved for operations in the same context that this type of security screening is critical to safety of the National Airspace; but as no official security screening procedures currently exist in the context of sUAS

[6] See Federal Aviation Administration, Notice N8900.227, Unmanned Aircraft Systems (UAS) Operational Approval, July 30, 2013.
[7] See exemption approvals 11110, and 11136

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operation, Apis is willing to work with a representative from the FAA and / or the Department of Homeland Security directly to ensure this qualification is met.

9. Appendices, Attachments, and Confidentiality of Proprietary Documents

Pursuant to this exemption from the FARs set forth above, Appendix A outlines the specifics of this request in detail so as to illustrate the applicant's understanding of their impact with regards to the safety of the National Airspace. As a steward of such, Apis has provided contextual detail pertaining to the operation of Apis Remote Sensing Systems as a company in Appendix B; as well as the technical specifications of our preferred sUAS platform, the AgEagle in Appendix C.

Additional documents pertaining to the specific maintenance and operation of the AgEagle are proprietary to Apis and AgEagle LLC. As such, Apis requests that such documents be held as confidential by the FAA as such time as said documents are provided to the FAA for review. Apis can and will provide these documents on request, but asks for a direct communication with an FAA liaison to provide the materials as such.

10. Summary & Conclusion

To summarize, we the applicant seek an exemption; outlined in specific detail in Appendix A for the allowance of market research and commercial operations of a small unmanned vehicle in surveying, mapping and inspection operations. Approval of the exemption allowing market research and commercial operations of the AgEagle for surveying, mapping and inspection operations will enhance safety by reducing risk. Conventional aerial survey and inspection operations using manned aircraft involve significantly larger aerial vehicles compared to the AgEagle, carry a significant quantity of combustible fuels, and require an on-board multi-person crew in piloting, observation, and survey roles. These operations require air transit to and from the location of the activity, and said operations have the propensity to include congested environments in close proximity to physical obstacles and / or presence of the general public. By contrast, the AgEagle weighs 7.5 lbs including payloads, uses a battery for power, does not require use of the National Airspace in transit to and from the area of activity, removes the need for airborne pilot and crew, and poses less risk to people and infrastructure on the ground.

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In the context of air safety and national security, the AgEagle possesses the following attributes:

- A small to modest overall size; consisting of a 56 inch wingspan and a weight of 7.5 lbs.
- A limited range governed by an approximate 40 minute operational time with fly-away failsafes.
- Load carrying capacity limited to a single sensor approximate to the size of a consumer point-and-shoot camera.
- A cruising speed of approximately 35 knots governed by software failsafes.
- Multiple failsafe measures inherent to the design of the system implemented to ensure safe flight, recovery and incident mitigation.
- No payload of explosives, combustibles, or other dangerous materials, such as fuel.

Given the aforementioned attributes in comparison to existing aircraft currently in operation in the national airspace, the AgEagle poses little if any threat to national security by the grant of the requested exemptions.

The operation of the AgEagle for market research, surveying, mapping and inspection operations in accordance with the strict conditions outlined above, will provide an equivalent level of safety supporting the grant of the exemptions requested herein, including exempting AgEagle from the airworthiness requirements in Part 21 of 14 CFR.

The satisfaction of the criteria set forth in Section 333 of the Reform Act (i.e. size, weight, speed, operating capabilities, operation within Visual Line-Of-Sight (“VLOS”) and lack of proximity to airports, populated or areas national security) and demonstrated equivalent level of safety as it relates to the requirement for FAA pilot certification, provide adequate if not significant justification for the grant of the requested exemptions allowing Apis commercial operation of the AgEagle in agricultural market research, surveying, mapping and inspection operations.

In conclusion, the safe operation of the AgEagle Robotic Aircraft System is of utmost concern, and safety remains paramount. Apis intends to operate within the spirit of all applicable FAA regulations and will adhere to any further refinements. The operation of sUAS for precision agriculture in remote rural areas can and will be beneficial to the farmers, ranchers and landowners of this nation; as Apis operators and observers intend to perpetuate the “safety first” mindset upheld by the FAA, while mitigating all risk to personnel and property both in the air and on the ground.

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Apis understands that the FAA is working diligently to safely integrate small Unmanned Aerial Systems into the National Airspace; and as such, requirements for safe operations could be subject to change. That said, Apis is prepared to amend or append this request in order to satisfy the requirements of safe operation as the requirements continue to evolve. Please do not hesitate to contact us concerning any additional requirements or clarification.

With sincere regards,

Beau Dealy
Managing Partner
Apis Remote Sensing Systems, LLC

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Appendix A

Overview of Regulations from which Exemption is Requested; Including Explanation in the Context of Appropriateness, Safety, and Benefit to the Public Interest.

The regulations from which the exemption is requested are as follows:

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

As the FAA continues the work of developing airworthiness standards for unmanned aerial systems, Apis seeks an exemption from the requirements for a certificate of airworthiness as set forth in 14 C.F.R. 91.203(a)(1); and in turn 14 C.F.R. Part 21. Apis asks for consideration of these exemptions in the context of the size, weight, speed, operational capability and the use of said system outside of the operational range of airports and away from populated areas. The AgEagle Robotic Aircraft System weighs approximately 7.5 lbs fully loaded with a wingspan of 56 inches. The AgEagle carries no pilot or passenger, carries no explosive materials or flammable liquid fuels, and operates at a relatively low altitude and slow speed exclusively within confines of private property. Given the small size and weight of the aircraft and the limited operating area associated with its utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H to achieve or exceed current safety levels. Furthermore, these criteria demonstrate that the AgEagle operating under the conditions proposed herein, will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) which has been issued an airworthiness certificate.

14 C.F.R. 45.23(b), 91.9(c) & 91.203(b): Marking of the Aircraft

Regulation 45.23(b) provides that the registration number of the aircraft must be on display prefixed by the Roman capital letter “N”. The regulation also states that lettering identifying the aircraft as in the “limited,” “restricted,” “light-sport,” “experimental,” or “provisional” category must be displayed near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high. In conjunction, regulation 91.9(c) provides that no person may operate a U.S.registered civil aircraft unless that aircraft is identified in accordance with part 45.

Given that the AgEagle has no cabin, cockpit, or pilot station, attempting to mark such areas would be futile. Furthermore, it is unclear at the time of writing this request as to whether or not the AgEagle would actually fit into one of the aforementioned categories as official marking systems for sUAS have not yet been established for operations

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inside the NAS. That said, Apis is prepared to register and display said registration number for any AgEagle flying under exemption if the decision regarding this exemption requires it. Should display of a registration number be required on the aircraft, Apis will make every effort to display the lettering in a high visibility format on the aircraft in lieu of specific guidelines governing registration numbers in the context of sUAS.
As pursuant to regulation 91.9(c), Apis believes that our cooperation with marking regulations that can reasonably be complied with in the context of the exemption should fulfill this requirement.
As pursuant to regulation 91.203(b), the relative size size and therefore lack of any cabin or cockpit to hold personnel or passengers is non-existent. As such, it would be impossible to display any airworthiness certificate for concerned passengers and crew even if the certificate was indeed required. Apis recognizes that the FAA has determined in prior exemptions that relief from 91.203(b) is not necessary; allowing relevant materials to be kept accessible to the operator in compliance with the regulations. However, Apis respectfully requests that that the record pertinent to this exemption state as much in the order of due process so as to ensure a meaningful level of compliance. As such, Apis will require for operation of the AgEagle that all relevant materials for operation be kept in a location accessible to the operator in a manner befitting current and future regulations.

14 C.F.R. 61.113(a) & (b) & 14 C.F.R. 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 noncommercial operations. Unlike a conventional aircraft that carries a pilot, passengers, and cargo, the AgEagle in this case is 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 be pilot in command of an aircraft for compensation or hire. AgEagle respectfully proposes that operator requirements should take into account the characteristics of the particular sUAS. The AgEagle has a high degree of pre-programmed control and various built-in technical capabilities through the DroneDeploy solution that strictly limit the potential for operation outside of the operating conditions set forth in the exemption application.

The AgEagle operates by way of an all-digital software platform powered by DroneDeploy with advanced features previously available only to larger and more complex unmanned aircraft. Automated features and advanced failsafe controls enable safe, reliable operation, as well as advanced networking capabilities and system extensibility. As such, nearly all operations in the context of what is traditionally handled

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and/or monitored by a pilot, either private or commercial, are handled by the autopilot under the auspice of the DroneDeploy system. Such features include:

- Intelligent fault handling- The system automatically detects potential issues with configurable automated response behavior such as a “return home” and landing routines.
- Automatic preflight checks- The system self-calibrates all of its sensors and performs diagnostics prior to takeoff to check for errors and no-fly situations.
- No-fly zones: The system has the ability to set up no-fly zones visually and using existing flight charts.
- Self-monitoring- Battery levels, GPS fix, radio connection(s), inflight wind speeds, and numerous other system and environmental conditions are continuously monitored, logged, and automatically handled by the system. In the event of a fault, the aircraft will perform the appropriate predefined fatal or non-fatal condition response.
- Battery communication: Flight time and battery minutes are available at all times to the operator. The aircraft will return to the mission point of origin and land automatically if the operational limits are reached.

As a matter of principle as well as a matter of good business, flight safety is of utmost priority. The AgEagle achieves this via the DroneDeploy system; presented to the operator in a means that limits the operators’ ability to operate outside of acceptable safety parameters; regardless of operating environment or project. The AgEagle offers superior safety over manned aircraft by removing the operator from presence on-board the aircraft and those potentially dangerous situations subsequently associated therein.

Given the aforementioned operational and safety features, Apis proposes that operators of the AgEagle should not be required to hold a commercial or private pilot certification. In lieu, operators will:

- Successfully complete and pass the FAA private pilot written examination or an FAA recognized equivalent.
- Complete a training program authorized by AgEagle, LLC for operation and maintenance of the AgEagle robotic aircraft system.
- Submit to a security background check equivalent to that currently required to obtain a private pilot’s license.

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Apis notes that the FAA has found that equivalent safety factors have permitted operation of sUAS by operators with similar qualifications in the case of operations pursuant to public COAs where the mandatory operating conditions specified above are present. See Federal Aviation Administration, Notice N8900.227, Unmanned Aircraft Systems (UAS) Operational Approval, at p. 20-21 (July 30, 2013). The FAA has the statutory authority, granted at 49 U.S.C.44701(f) to waive the pilot requirements for commercial operations.

Given these conditions and restrictions, an equivalent level of safety can and will be provided by those in operation of the AgEagle without a private pilot's certificate or a commercial pilot's certificate, under the conditions set forth herein.

The risks associated with the operation of the AgEagle (given its size, speed, operational capabilities, and lack of combustible fuel) are so diminished from the level of risk associated with private pilot operations or commercial operations contemplated by Part 61 with conventional aircraft (fixed wing or rotorcraft), that allowing operations of the sUAS as set forth above meets or exceeds the present level of safety provided under 14 C.F.R. 61.113(a) & (b) and does not rise to the level of requiring a commercial pilot to operate the aircraft under 61.133(a).

14 C.F.R. 91.7(a): Civil Aircraft Airworthiness.

This regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. Should the exemption be granted to allow commercial operation of the AgEagle without an airworthiness certificate, no standard will exist for airworthiness of the AgEagle. Given the precedence for exemption issuances of sUAS lacking a proper airworthiness certificate[8], Apis respectfully requests that the AgEagle be considered in a similar context as an equivalent (if not higher level) of safety will be achieved by a combination of the fault monitoring of the DroneDeploy system, as well as compliance with all flight protocols contained within the AgEagle operational instructions before, during, and after each flight.

14 C.F.R. 91.9(b)(2): Civil Aircraft Flight Manual in the Aircraft.

The regulation provides that no person may operate a U.S.registered civil aircraft,

> "For which an Airplane or Rotorcraft Flight Manual is not required by 21.5 of this chapter, unless there is available in the aircraft a current approved Airplane or

[8] See Exemption Approvals 11066, 11136, 11166 *et. al.*

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> Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof."

Given the size and configuration of the AgEagle, it has no ability or place to carry such a flight manual on the aircraft, not only because there is no pilot on board, but because there is no room or capacity to carry such an item on the aircraft.

The equivalent level of safety will be achieved by keeping the operational instructions at the ground control point where the operator in control of the AgEagle will have immediate access to it. Apis recognizes that the FAA has determined that relief from this sections is not necessary; allowing relevant materials to be kept accessible to the operator in compliance with the regulations. As in the context of 14 CFR 91.203(b), Apis prefers to have this matter documented in the order of due process so as to ensure a meaningful level of compliance. As mentioned prior, Apis will require for operation of the AgEagle that all relevant materials for operation be kept in a location accessible to the operator in compliance with current and future regulations.

14 C.F.R. 91.119(c): 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 established in this request for exemption, Apis will never operate the AgEagle higher than 400 feet AGL. It will not be operated in congested or populated areas. Flights conducted with the AgEagle will only take place on property with authorization of the the landowner and / or operator. Because sUAS aerial survey, mapping and inspection work can be, and is most often the case, accomplished at relatively low altitudes including altitudes less than 500 feet AGL, an exemption from Section 91.119(c) is needed.

Despite flying at lower altitudes than more conventional manned aircraft, an equivalent level of safety will be achieved given the size, weight, speed, and material with which the AgEagle is built. The AgEagle is not an aircraft built for transit; rather it is a survey tool that is transported via other means to its intended area of operation. Because of the inherent "fenced in" nature of its missions, that is, over land where affected individuals

will be aware of the flights, Apis feels that a lower altitude operation actually provides a higher level of safety. Compared to aerial survey operations conducted with aircraft or rotorcraft weighing far more than 7.5 lbs and carrying flammable fuel, any risk associated with these operations will be far less than those currently allowed with a conventional aircraft operating at or below 500 feet AGL. Moreover, the low altitude operations of the AgEagle will maintain a separation between such sUAS operations and the 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 AgEagle batteries provide approximately 40 minutes of powered flight. Apis would only conduct flight during the day; and without an exemption from 14 CFR 91.151, daytime flights would be limited to approximately 10 minutes in length. Given the limitations on its proposed operations and the location of those proposed operations, a longer time frame for flight in daylight VFR conditions is reasonable.

Operating the AgEagle without 30 minutes of reserve power does not beget the type of risks that Section 91.151(a) was meant to prevent given the size and speed at which the UAS operates, as well as given the fact that Apis intends to maintain a VLOS with the AgEagle at all times. The fact that it carries no pilot, passenger, or cargo also enhances its safety. Additionally, limiting AgEagle flights to 10 minutes would greatly reduce the utility of the aircraft. In the unlikely event that the AgEagle should run out of power, it would simply land on ground on which Apis had already been granted flight over by the landowner and / or operator. Given its weight and construction material, the risks are less than contemplated by the current regulation.

Apis believes that an equivalent level of safety can be achieved by maintaining 10 minutes of reserve power, which, allowing 30 minutes of flight time, would be more than adequate to return the AgEagle to its planned landing zone from anywhere in its VLOS operating area. Similar exemptions have been granted to others in similar situations, including Exemptions 2689, 5745, 10650, and 11110.

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14 C.F.R. 91.405(a), 14 C.F.R. 91.407(a)(1), 14 C.F.R. 91.409(a)(2) & 14 C.F.R. 91.417(a): Maintenance and Inspections Relating Thereto

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.

Maintenance of the AgEagle is performed by the operator in accordance with the instruction materials provided with the AgEagle per the guidance given during training from AgEagle LLC and / or one of its authorized training affiliates. When instruction and training is followed by the aircraft operator, an equivalent level of safety can be achieved in lieu of the aforementioned maintenance and inspection criteria set forth in the C.F.R. because the inherent properties of the AgEagle itself including:

- The relatively small size and mechanical simplicity of the AgEagle
- Its lack of cargo, crew, or passengers
- Any AgEagle mission will not extend past a predetermined area for which the operator has permission to conduct flight operations.
- The operator is trained to inspect all maintenance points on the aircraft prior to flight.

As a trained operator is an individual with a greater level of familiarity and understanding with the AgEagle platform, it follows that this person is also best suited to maintain the airworthiness of the aircraft in a context of a level of safety equivalent to that presently mandated.

All criteria pertinent to flight operations are logged by the DroneDeploy system and are available for immediate review by the operator. The DroneDeploy system also conducts a diagnostic inspection of hardware and software systems prior to launch, with any inspection failure being sufficient to suspend flight operations until the problem is resolved.

The AgEagle airframe is unique among its peers in that the manufacturer reinforces an otherwise standard foam airframe with sturdy and lightweight composite materials thus significantly reducing overall wear-and-tear to the airframe. If such an event occurs during operation that the airframe is rendered unsuitable for flight, the aircraft with take appropriate action to compensate to keep the aircraft airborne or terminate the mission in the context of either a Fatal or Non-Fatal Conditioned response (see Appendix C “Reliability”, “Fault Tolerance” and “Emergency Procedures and System Failures”).

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Appendix B

Company Profile

Apis Remote Sensing Systems, LLC (“Apis”) is a United States company located in Hays, Kansas. Apis was founded on a mission to provide second-to-none small Unmanned Aerial Systems (“sUAS”) sales, support, and service enriched by scientific insight to its customers in and around Western Kansas. The founding partners have over twenty-five years combined experience in Geographic Information Systems (GIS) and remote sensing; and our staff has a strong background in providing technology solutions to industries that insist on above-the-bar customer service, such as local government and public safety. Our knowledge of the acquisition methods, sensors, and deliverables associated with GIS, paired with a drive to provide insightful customer service puts Apis in a unique industry position to facilitate the adoption of sUAS within agriculture and the rural business market as a whole. Apis continues to work with the agribusiness industry, cooperatives, local universities and the rural public at large to promote a positive “people first” view of unmanned systems.

Apis is the exclusive Western Kansas dealer for the AgEagle Robotic Aircraft System; engineered and manufactured by AgEagle, LLC; a United States Company located in Neodesha, Kansas. Apis is an authorized training center for AgEagle and licenses documentation and training materials to AgEagle for their customers internationally. According to the manufacturer, AgEagle systems have a demonstrated track record with respect to safety, logging over 19,080 operational hours while surveying approximately 1,272,000 acres to date without incident to property or person.

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Appendix C

Technical Specifications of the AgEagle Robotic Aircraft System[9]

The AgEagle can carry payloads up to 2.5 lbs and flies at a maximum wind threshold of 43 mph for sustained winds and wind gusts up to 55 mph. To this point, the AgEagle employs a system that automatically compensates for wind rather than relying on the operator to determine the impact of the wind with respect to the mission dynamic at the altitude the system is flying. The end result is a system capable of gathering high quality aerial survey data at higher wind thresholds; a trait that is imperative for many aerial inspection operations.

The AgEagle has an operational range of up to 20 Statute miles (17.38 Nautical Miles); however, software failsafes actively restrict the functional range to safe and appropriate distances in-line with Visual Line-Of-Sight ("VLOS") operation.

All flight operations are GPS controlled, making the system stable, steady, and easy to navigate. At any point that the operator is not explicitly in command of the system, the AgEagle automatically holds its position via GPS navigation (i.e. GPS hold for reliable location loiter). Image acquisition is also GPS controlled allowing for a sophisticated level of camera control that is also straightforward to operate. The flight control system employs GPS positioning and navigation as well as a variety of sensors including range-finding, barometric pressure, temperature, and wind speed to ensure a higher level of reliability with respect to other sUAS in its class.

Powered by the DroneDeploy autopilot enhancement solution, the AgEagle can be operated in both semi- and fully autonomous flight modes. In semi-autonomous mode, the operator controls flight operations in real-time via a map interface. For fully autonomous flights, pre-planned flight paths are programmed via the same map interface before the mission. All waypoints, landing zone points and flight area dimensions are all entered before the mission and stored completely in non-volatile aircraft memory, ensuring the AgEagle operates only within specified pre-programmed parameters.

The AgEagle includes many advanced safety features that make it a practical choice in the context of rural operation. Built-in intelligent fault handling allows the AgEagle to

[9] Technical Specifications of the AgEagle have been provided to Apis by the manufacturer upon their request.

detect a system fault while in the air, and to automatically fly back to its takeoff location and land. Faults that can be detected include:

- Loss of radio communication
- Exceeded preset wind thresholds
- Low battery levels
- Operator-defined “no fly zones” as well as maximum flight ranges and altitudes

In addition, the AgEagle must pass a series of automated flight checks initiated by the DroneDeploy system prior to launch to ensure the system is flight-ready.

The AgEagle can be operated entirely by a touchscreen or point-and-click map-based interface. Beyond safety, the responsibility of the operator is to program the aircraft with the proper navigation parameters, and allow the the autopilot system to control the operational minutiae. Data used for mission planning can be saved and flight plans can be re-used where appropriate.

The body of documentation provided for instruction and operation of the AgEagle can be made available upon request[10].

1. Physical Characteristics of the AgEagle

- Dimensions:
  - 56 inch wingspan
  - 26 inch length
  - 6.5 inch height
- Weight (without payload, including batteries): 7 pounds
- Weight with sensor payload (takeoff weight): 7.5 pounds
- Fuel: Not Applicable
- Propulsion System
  - Engine: One electric brushless DC motor.
  - Power: Self-contained, high-duration Lithium Polymer (“LiPo”) batteries monitored by the on-board autopilot via real-time data feeds to ensure maximum flight duration and subsystem safety processes.
  - Charging: Battery charger included with the system monitors and balances current loads. Can be performed via standard wall outlet (AC), or using DC power.
- Landing: “Belly landing” utilizing a polycarbonate protective “skid” plate.

[10] See Application Section 9: “Appendices, Attachments, and Confidentiality of Proprietary Documents”

2. Performance Characteristics of the AgEagle

- Maximum Altitude: 400 ft AGL
- Maximum Endurance: 40 minutes
- Maximum Range: Visual Line Of Sight (“VLOS”)
- Weather Minimums: Not Applicable
- Winds Maximum: 40 mph (sustained)
- Minimum ceiling: VLOS
- Minimum visibility: VLOS
- Icing conditions: None (No-fly)
- Precipitation: None (No-fly)

3. Maintenance

The AgEagle performs automatic preflight checks utilizing the DroneDeploy system. The failure of any preflight check will prevent takeoff. As an added measure of safety per instruction materials and training provided by AgEagle or one of its adjuncts, a qualified operator is to perform a visual inspection of the AgEagle prior to each flight.
The preflight checklist includes (but is certainly not limited to):

- Visual inspection of the airframe, servos, and control surfaces
- Visual inspection of motor mount and propeller integrity
- Check charge of all batteries (aerial vehicle, command station, radio repeater station)

Besides the tasks associated directly with the aforementioned preflight checks, the AgEagle is nearly maintenance free.

4. Reliability

The system is designed for maximum reliability to maintain consistent performance over the product lifespan. Components experiencing routine wear include motors, batteries, and servos. Battery and motor conditions are monitored by the DroneDeploy system with deviations reported instantaneously to the operator.

Contact with other objects sometimes during take-off, but usually during landing may cause servos, pushrods, or controlling surfaces to become damaged. Damaged components are likely to be detected during the full visual inspection of the airframe performed before each flight. Likewise, structural damage affecting flight characteristics will be detected not only visually, but by onboard sensors via the DroneDeploy system as well.

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The AgEagle detects numerous conditions which may make flying unsafe, including (but not limited to) reduced GPS accuracy, magnetic anomalies, low battery charge, battery cell imbalances, and temperature fluctuations. Automatic preflight checks prevent the AgEagle from taking off if such conditions are present; or, if the condition is detected during flight, the system will trigger a Fatal Conditioned Response ("FCR") with respect to aforementioned fault detection system.

5. Fault Tolerance

The key feature of the AgEagle fault tolerance is its mechanical simplicity. The AgEagle airframe is of a flying wing configuration with one electric motor and two elevon controlling surfaces. Failure of the motor or any component failure detectable by the system will be reported to the operator and will cause the AgEagle to perform an FCR or Non-Fatal Conditioned Response ("NFCR"), depending on the type of failure.

6. Emergency Procedures and System Failures

The AgEagle has extensive failure detection and handling capabilities. All failures are deeded to be either FCR or NFCR.

- Sensor Failure: Failure of onboard flight instruments/sensors will degrade performance and will result in either a FCR or a NFCR, depending on their severity. If the AgEagle becomes unstable due to sensor failure, the autopilot system will trigger an appropriate landing response to prevent a fly-away condition.
- Motor Failure: Given the inherent fixed-wing airframe design, the AgEagle can be safely landed in the event of motor failure. Such an event would be handled as an FCR or NFCR depending on severity and the autopilot system will trigger an appropriate landing response.
- Power Failure: A complete battery failure causing power loss to the sUAS will result in significantly degraded flight performance. However, given the minimal power consumption necessary to maintain radio link, autopilot, and control surface operation, a motor failure is more likely to occur before a complete power failure.
- Airframe Failure: If airframe is damaged in ways that impacts flight characteristics, the AgEagle will behave similar to as if an onboard flight instrument failed.
- Navigation System Failure: In a navigation system failure, degraded GPS will result in an FCR or NFCR depending on the severity of the failure(s).

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- Low Battery Condition: Operator will be alerted of a low battery condition and the aircraft will initiate landing procedures as soon as able.
- VLOS Loss: All flight operations will be conducted with the AgEagle within visual sight of the Pilot in Command (“PIC”). If the PIC’s view becomes obstructed and VLOS is lost, the PIC may instruct the AgEagle to loiter in its current position until VLOS is reestablished, or to return to the predetermined landing site, or to land at the current position.
- Security: The system and communication links are encrypted by proprietary software provided by the DroneDeploy system.

7. Command and Control Systems

The AgEagle Ground Control Station (“GCS”) powered by DroneDeploy allows the operator simultaneous control over aircraft and sensor payload. Interface control allows for quick navigation and data entry while the display screen provides all essential flight data to the operator. Telemetry data is transmitted to the command station at least once per second.

Displayed on GCS:

- Position
- Navigation Route
- Aircraft Identifier
- Position
- Altitude
- Heading
- North Seeking Arrow
- Range to Target
- Calculated target position
- Date / time
- Sensor heading and orientation relative to aircraft

Onboard Flight Instruments

- The AgEagle is equipped with an Inertial Navigation System including:
    - 3-axis gyroscope
    - 3-axis magnetometer
    - GPS receiver
    - Static pressure sensor
    - Range-finding sensor for precision AGL altitude measurement

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- The AgEagle is equipped onboard computer systems to monitor (sensors, battery, etc.), control (speeds, altitude, position, etc.), and communicate (control, telemetry, etc.).
- The AgEagle can operate autonomously; it does not require any input from groundbased equipment, or from the operator to remain airborne.
- Frequency Allocations: 900 MHz, 2.4 GHz, 5.8 GHz, 1,700 – 2,100 Mhz, custom
- A flight termination link to prevent a “fly away” or other potentially dangerous situations is available to the operator at the GCS.
- The AgEagle is launched autonomously via catapult. A Landing Zone (“LZ”) is designated by the operator prior to takeoff and identified in the GCS software. Landing is handled autonomously at the cue of the operator after the completion of the survey mission. Between instruction sets from the operator, the AgEagle is programmed to autonomously loiter over the LZ until further operator instruction is provided.
- Maps specific to navigation and mission planning are provided via the Drone Deploy system, which are overlaid with GPS positional data from the AgEagle.
- Navigation waypoints can be created before and during flight operation. Over the course of normal operation, waypoints are combined to create a scan pattern-type flight pattern conducive to collecting nominal aerial survey data.
- The AgEagle combines the input from a multitude of sensors to create redundancies in the system. Even though the data from all sensors is required for optimal system performance, a single sensor malfunction is likely to result in degraded performance and possibly an FCR or NFCR, rather than leading to a catastrophic failure.