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

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

August 24, 2015

Exemption No. 12561
Regulatory Docket No. FAA−2015−2382

Mr. Gary S. Berg
50 Gephart Road
Yakima, WA 98901

Dear Mr. Berg:

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 May 28, 2015, you petitioned the Federal Aviation Administration (FAA) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct aerial photography and videography.

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 a DJI Phantom 3 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[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, Mr. Gary S. Berg 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, Mr. Gary S. Berg is hereafter referred to as the operator.

[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.

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 DJI Phantom 3 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 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 August 31, 2017, unless sooner superseded or rescinded.

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

Enclosures

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Date: May 28, 2015

U. S. Department of Transportation, Docket Operations
West Building Ground Floor, Room W12-140
1200 New Jersey Ave. SE
Washington, DC 20590

RE: Petition of Gary S. Berg for Exemption Pursuant to Section 333 of the FAA Reform Act
Attn: To whom it may concern

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the Reform Act) and 14 C.F.R. Part 11, Gary S. Berg ("Petitioner"), developer and operator of Small Unmanned Aircraft Systems ("sUASs") equipped to conduct aerial photography and videography, hereby applies for an exemption from the listed Federal Aviation Regulations ("FARs") to allow commercial operation of its sUASs, so long as such operations are conducted within and under the conditions outlined herein or as may be established by the FAA as required by Section 333.1.

As described more fully below, the requested exemption would permit the operation of small, unmanned and relatively inexpensive sUAS under controlled conditions in airspace that is 1) limited 2) predetermined and 3) controlled. The proposed exemption, if granted, would allow Gary S. Berg to conduct commercial operations of small Unmanned Aircraft Systems ("UAS") or Unmanned Air Vehicles ("UAV's") while meeting or exceeding all of the operational and safety requirements Congress has set forth in Section 333.

Petitioner holds an FAA airman's certificate (Private Pilot, Single Engine Land) as well as a Washington state driver's license, (See Appendix A) and has been been designing, building, and flying radio controlled aircraft for over 40 years. Petitioner has experience with nearly every type of radio-controlled aircraft from trainers to high performance aerobatic models, single engine, multi engine, sailplanes, helicopters, and multi-rotors. The Petitioner had a high performance airplane design published in Model Airplane News magazine in 1989. (See Appendix B).

Unmanned Aircraft Systems are oftentimes seen as superior to manned airplanes and helicopters due to the small size of the aircraft, cheaper equipment and personnel cost, and reduced noise and minimal environmental impact, all of which promotes public safety.

The UAS, powered by batteries, is smaller, lighter and more maneuverable than larger aircraft running on combustible fuel. It operates at lower altitudes with no people on board, thereby reducing risk and enhancing safety when compared to a manned aircraft. The likelihood of an accident resulting in death, serious bodily injury, or significant property damage is greatly reduced. With a small payload and maximum flight time of only 30 minutes, there is little or no risk to national security.

Low level oblique photos and video from several angles are far more effective than ground based imagery for displaying the characteristics of large, complex properties with several buildings and large trees. As a Private Pilot, the Petitioner is familiar with the cost and capabilities of lightweight, manned General Aviation aircraft. A UAS safely operates in a much smaller space and at a fraction of the cost of a manned aircraft. The benefits of reduced cost and improved quality of presentation from the UAS will be a valuable benefit to many potential clients for a variety of uses.

Petitioner plans to exploit the capabilities of Unmanned Aerial Systems to offer a multitude of services, including but not limited to:

- Aerial photography
- Event Photography/Videography
- Agricultural imaging
- Real Estate Photography
- Aerial mapping/surveying
- Construction site inspections and monitoring
- Search and Rescue
- News gathering
- UAS design/construction/testing
- Flight training

Statutory Authority Section 333, titled “Special Rules for Certain Unmanned Aircraft Systems”, provides a mechanism for seeking expedited FAA authorization of safe civil UAS operations in the NAS. Section 333(a) states that the FAA “shall determine if certain unmanned aircraft systems may operate safely in the national airspace system before completion of the (comprehensive) plan and rulemaking required by section 332(b)(1) of this Act or the guidance required by section 334 of this Act.” In Section 332(b)(1), Congress made it clear that Section 333 provides a mechanism for “expedited operation authorization” if several factors are met. Petitioner meets all requirements to permit FAA approval of commercial UAS operations. The Petitioner requests relief from the following, as well as any other regulations the FAA deems appropriate:

Regulations from which the exemption is requested:
14 C.F.R. Part 21

14 C.F.R. 45.23 (b)
14 C.F.R. 61.113(a) and (b)
14 C.F.R. 91.7 (a)
14 C.F.R. 91.9 (b) (2)
14 C.F.R. 91.109
14 C.F.R. 91.119
14 C.F.R. 91.121Page 3
14 C.F.R. 91.151(a)
14 C.F.R. 91.203 (a) & (b)
14 C.F.R. 91.205 (b)
14 C.F.R. 91.215
14 C.F.R. (91.401 - 91.417)

In addition, the FAA has levied several restrictions in granting previous 333 exemptions. Although there is no FAR to be exempted from which would allow the following, the Petitioner seeks explicit written permission for the following:

- Eliminate 3-Days Notice to the nearest FAA district office for flight in Class G Airspace.

  The requirement to notify the nearest FAA district office 3 days in advance of any commercial flight places an unnecessary burden on the operator of a UAS when flying in Class G airspace. In many cases, it may prevent a timely UAS flight entirely when it could be most beneficial, such as for news gathering or search and rescue. For agricultural imaging, flights will take place over large fields of crops, far from any airports or populated areas. When developing a new unmanned aircraft, several test flights are often made daily, with changes noted and results logged. A 3-day notice requirement would greatly slow innovation and development. Furthermore, if 3 days notice is given for a flight and then weather conditions prevent the flight, another 3 day notice period must pass before the flight can take place.

  This requirement is not levied upon the pilot of a recreational flight. A hobby pilot is only asked to notify the control tower or airport manager before flying within 5 miles of an airport. When compared to a hobby flight that can take place at any time, a professional commercial UAS operator will have the experience, superior equipment, and well-established procedures to allow for safe flight when and where necessary in Class G airspace. For flights within Class B, C, D or E airspace the Petitioner will seek to establish a memorandum of agreement with the local Air Traffic Control authority which will specify acceptable operating standards within that airspace. Until such a memorandum is in place, 3 days notice to the local FAA district office is acceptable. Flight within Class A airspace is not applicable to this petition. The Petitioner hereby requests relief from requiring 3 days notice of a flight to the

local FAA district office when that flight is to take place in Class G airspace, and within other airspace types as outlined above.

- Allow Night UAS Operations

  The prohibition of commercial UAS flight at night is unnecessarily restrictive and may prevent UAS flight when it might be most beneficial, such as for news gathering or search and rescue. Events to be photographed or filmed often happen after dark. There is no such night prohibition for the operator of a recreational flight. When compared to a hobby flight that can take place at any time, a professional commercial UAS operator will have the experience, superior equipment, and well-established procedures to allow for safe flight at any time of day or night, weather permitting.

  To enhance safety, the Petitioner will use a well-lit aircraft that is clearly visible in all directions. Such an aircraft is more prominently visible in flight than even during daylight hours (See Appendix C). Furthermore, night flights will be limited to uncontrolled Class G airspace, within line-of-sight of the operator, no further away than 500 feet horizontally and at a maximum altitude of 250 feet AGL, and at an airspeed below 30 knots. When a night flight is planned, a prior visit to the site during daylight hours will take place, with the pilot becoming familiar with the surroundings and any obstacles such as trees, power lines, etc. The Petitioner hereby requests permission to fly UAS at night, within the parameters outlined above.

Aircraft Types

To begin commercial operations, the Petitioner will make use of a 3D Robotics X8, or a DJI Phantom 3 Pro aircraft. Both of these aircraft types have been approved for use with several existing Section 333 exemptions. These aircraft will be operated and maintained according to the manufacturer's instructions.

In addition, the Petitioner will use this exemption to develop new aircraft which will be used commercially by himself or other pilots. All aircraft used will have a maximum gross takeoff weight of less than 55 pounds. All aircraft will employ both visible and audible warnings to notify the pilot when the main battery voltage has dropped to a pre-determined level. All aircraft will be registered with the FAA as a Small Unmanned Aircraft System (Special or Experimental Airworthiness Certificate) before being sold or used for commercial flights. Thus, an amendment to this exemption request for each new aircraft type developed is unnecessary.

All aircraft developed and used commercially will rely on airborne flight controllers with autopilot and Global Positioning System capabilities, such as the DJI Naza or 3D Robotics

Pixhawk. These controllers have the ability to automatically limit the height and distance they can be flown from the launch point. In the event of a radio communication loss between the pilot's control transmitter and the UAV, the controller will automatically trigger a "fail-safe" mode in which the aircraft will return to the launch point and land safely without any further pilot input. In the unlikely event of a loss of GPS signal at the same time, the controller will hold the UAV level and slowly descend to a safe landing at its present location.

Any aircraft purchased, developed, or modified under this exemption request will accumulate a minimum of 10 hours flight time before being employed for commercial missions. Each flight will be logged, along with a record of changes, results, and performance. See Appendix D for an example of a flight and maintenance log for an aircraft in development. In addition, a complete Pilot's Operating Handbook will be developed for each aircraft model, giving any pilot the information needed to operate and maintain the aircraft safely.

Every aircraft, whether purchased or developed by the Petitioner, will be inspected before each flight in accordance with the manufacturer's guidelines. A written checklist will be used, as shown in Appendix E.

Ground Station and Video

The Petitioner makes use of a "First Person View" (FPV) system that consists of a camera and video transmitter on board the aircraft, and a small portable display screen mounted on a tripod on the ground as shown in Appendix F. This provides a real-time view from the aircraft, allowing for composition of photos and video. In addition, text and graphic data is overlaid on the screen image providing the pilot with altitude, distance, heading, airspeed, and battery voltage information. Since a free-standing display screen is used instead of goggles that may limit the pilot's surrounding view, line-of-sight with the UAV is maintained by both the pilot and observer. The video transmitter on board the aircraft transmits in the 5.8GHz range with a power of 25 milliwatts and meets FCC requirements for license-free use in the United States. The camera and video transmitter are powered by their own small battery, completely separate from the UAV power system. Should this video downlink fail during flight, the pilot will immediately return the UAV to the launch point and land via line-of-sight piloting.

FCC Information

The radio control transmitters used for controlling the UAV comply with part 15 of the FCC rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The radio transmitters used for controlling the UAV employ wireless technology which has been tested and found to be compliant with the applicable regulations governing a radio transmitter in the 2.400GHz to 2.4835GHz frequency range.

Antenna Separation Distance

When operating the transmitter, the PIC will maintain a separation distance of at least

5 cm between his body (excluding fingers, hands, wrists, ankles and feet) and the antenna to meet RF exposure safety requirements as determined by FCC regulations.

Pilot in Command and Observer Qualifications and Duties

The Pilot In Command (PIC) will maintain at least a Sport Pilot Certificate and a current driver's license or 3rd Class Medical certificate. The PIC must have logged at least 2 hours flying time and 3 takeoffs and landings within the last 30 days with the type of UAS being utilized. The PIC will have at least 100 hours total time and at least 30 hours flying Radio Controlled Model Aircraft of which at least 10 hours must be flying UAV's. Training will be conducted within the controlled environment of a local Radio Control Club flying field. The Petitioner has the ability to provide "dual controls" utilizing two identical radio-control transmitters with a wired link between them. One transmitter is designated the master transmitter and the other transmitter is designated as a slave. The PIC instructor, utilizing the master transmitter, will at all times be able assume immediate control of the UAV.

The PIC is responsible for the safe and efficient operation of the aircraft. Specific duties include all preflight preparation, crew or observer briefings, in flight operation, post flight requirements, and all procedures including but not limited to:

- Preflight inspections of aircraft and ground equipment
- Site selection and planning
- Safe in-flight operations
- Risk mitigation to persons and property

The Observer must have the visual acuity to observe the UAV and be able to communicate clearly with the PIC at all times during a flight. The Observers duties are:

- Warning the PIC of any impending obstacles in the flight path of the sUAS.
- Warning the PIC of any other air traffic entering the vicinity.
- Warning the PIC of any deviations in the planned flight path of the sUAS.
- Warning the PIC should any unauthorized personnel appear in the area of the planned flight.
- The Observer will have the authority to order the PIC to terminate the flight should he feel the flight cannot be conducted safely.

General Operating Standards

- The Petitioner will only operate a sUAS within line of sight of the pilot and observer and will operate at sites that are a sufficient distance from populated areas. Such operations will insure that the sUAS will not create a hazard to users of the national airspace system or the public.

- Weather minimums will be 3 miles visibility and a 1000 foot ceiling, with winds below 15 knots.
- Prior to takeoff, a complete preflight inspection of the aircraft will be completed using a checklist specific to that UAS. See Appendix E for an example checklist.
- Before an operation of a UAV within 5NM of an airport with a control tower, the control tower will be called to notify ATC of the UAS operations. If the airport is not tower controlled, airport management will be notified. The PIC will give the position, altitude and the times the UAS will be operated. The UAV will be operated within a distance of no more than 1500 feet horizontally and 400 feet AGL during daylight hours, or within 500 feet horizontally and 250 feet AGL at night.
- PIC will give the right of way to avoid flying in the proximity of full-scale aircraft. At no time will the UAV be operated within the final approach course and the takeoff course of any runway.
- Maximum flight time for each operational flight will be 30 minutes.
- Flights will be terminated at 25% battery power reserve should that occur prior to the 30 minute limit.
- The UAS will be programmed so that it cannot be operated at an altitude of more than 400 feet AGL.
- Minimum crew for each operation will consist of the UAS Pilot and Visual Observer.
- All UAS operated by the Petitioner weighs less than 55 pounds, including the payload (i.e. camera, lens, and gimbals). No flight will be made with a gross weight exceeding 55 pounds.
- The UAV will operate at speeds of no more than 60 knots, can hover, and can simultaneously move vertically and horizontally.
- Given the small size of the UAV and the restricted sterile environment within which they will operate, our UAS operations adhere to the Reform Act's safety requirements.
- All operations must occur in FAA Class G airspace unless prior notification has occurred or a Memorandum Of Agreement is in place, at no more than 400 ft AGL, at an airspeed of no more than 60 knots and no further than 1500 feet from the PIC.
- All operations must utilize a Visual Observer (VO). The VO and PIC must be able to communicate by voice at all times during a flight operation.
- Operations over private property will be conducted only with the permission of the property owner.
- All required permits will be obtained from state and local government prior to operation;
- Flights will not be conducted over densely populated areas.
- Flights will not be conducted directly over any open-air assembly of people.
- Flights will not be conducted over heavily trafficked roads.
- A flight will be immediately terminated when any of the following occurs:
    - Battery voltage reaches 25% of fully-charged voltage;
    - Visible or audible low-voltage alarm is seen or heard;
    - GPS signal is lost;
    - Live video signal (FPV) is lost;

- Any structural or mechanical failure;
- Abrupt weather changes, such as sudden rain or gusty winds;
- Unexpected persons, vehicles, or aircraft enter the area;
- Any other condition in which the pilot or observer feels the flight cannot be continued safely.

Additionally, Petitioner requests permission to use a UAS to benefit first responders nearby who might require assistance, including firefighters, police, search and rescue organizations, news and media outlets, etc. while remaining subject to all limitations and procedures cited in this application.

EXEMPTION REQUESTS AND EQUIVALENT LEVEL OF SAFETY

Gary S. Berg requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the sUAV System:
14 CFR Part 21, Airworthiness Certificates
This part establishes the procedures for the issuance of an airworthiness certificate. While the FAA continues to work to develop airworthiness standards for Unmanned Aerial Systems, we request an experimental certificate be issued for the aircraft designed in accordance with this application, under either or both of the following provisions:
21.191 Experimental certificates. Experimental certificates are issued for the following purposes:
(a) Research and development. Testing new aircraft design concepts, new aircraft equipment, new aircraft installations, new aircraft operating techniques, or new uses for aircraft.
(b) Showing compliance with regulations. Conducting flight tests and other operations to show compliance with the airworthiness regulations including flights to show compliance for issuance of type and supplemental type certificates, flights to substantiate major design changes, and flights to show compliance with the function and reliability requirements of the regulations. Since the experimental certificate can be used for commercial purposes such as market surveys, sales demonstrations, and customer crew training, we would expect that an experimental certificate would permit our commercial purpose as well. The aircraft will not carry persons or property, will not carry fuel, and will only fly under strict operational requirements. Combined with the UA's light weight, being constructed primarily of carbon fiber, wood and plastic, we propose that the UA will be at least as safe, if not safer, than a conventionally certificated aircraft performing the same mission. If an experimental airworthiness certificate is not appropriate for this application, then we request an exemption of 14 CFR Part 21, Subpart H, and the requirement for an airworthiness certificate in general, citing the equivalent level of safety outlined in the previous paragraph.
14 CFR 45.23 Display of marks; general and 45.29 Size of marks.
These regulations provide that each aircraft must display "N" and the aircraft's registration number in letters at least 3 inches high. Additionally, the aircraft must display the word

"EXPERIMENTAL" in letters at least 2 inches high near the entrance to the cabin, cockpit, or pilot station. The sUAV does not have an entrance in which the word "EXPERIMENTAL" can be placed, and may not have a registration number assigned to it by the FAA. We propose to achieve an equivalent level of safety by including the word "EXPERIMENTAL" in the placard on the top of the aircraft, as shown above, where the PIC (Pilot In Control), VO (Visual Observer) and others in the vicinity of the aircraft while it is preparing for launch will be able to see the designation. Additionally, we feel that the permanent placard discussed in the previous paragraph will provide the aircraft's registration information at the ground station. Finally, we will display at the ground station a high contrast flag or banner that contains the words "Unmanned Aircraft Ground Station" in letters 3 inches high or greater. Since the aircraft will operate within 3/4 NM of the ground station, the banner should be visible to anyone that observes the aircraft and chooses to investigate its point of origin.

14 CFR 61.113 Private pilot privileges and limitations: Pilot in Command and 61.133 Commercial pilot privileges and limitations.

The regulation provides that no person that holds a Private Pilot certificate may act as pilot in Command of an aircraft for compensation or hire. Subparagraph (b) allows a private pilot to act as pilot in command of an aircraft in connection with any business or employment if: (1) The flight is only incidental to that business or employment; and (2) The aircraft does not carry passengers or property for compensation or hire. Our proposed operations require that the PIC must hold at least a Private Pilot Certificate issued by the FAA and since the aircraft cannot carry passengers, we feel we meet the intent of 61.113 Subparagraph (b) even though the intent of this application is to conduct a business.

14 CFR 91.7 Prohibits the Operation of an aircraft without an airworthiness certificate. As no such certificate will be applicable in the form contemplated by the FARs, this Regulation is inapplicable.

14 CFR 91.9 Civil aircraft flight manual, marking, and placard requirements.

This regulation provides that no person may operate an aircraft unless a current, approved flight manual is in the aircraft. We assume that the intent of this requirement is to ensure that flight manual information is available to the aircrew while operating the aircraft. We request an exemption to this requirement since the aircraft is not only too small to carry documentation, the documentation would not be available to the crew during flight operations. To obtain an equivalent level of safety and meet the intent of 91.9, we propose that a current, approved sUAS Flight Manual must be available to the crew at the ground station anytime the aircraft is in, or preparing for, flight.

14 CFR 91.109 Flight Instruction; Simulated instrument flight and certain flight tests

The regulation states that "No person may operate a civil aircraft that is being used for flight instruction unless that aircraft has fully functioning dual controls." Training will be conducted at a local Radio Control Club flying field. Petitioner has the ability to provide "dual controls" utilizing two identical control transmitters with a wired link between the transmitters. One transmitter is designated the master transmitter and the other transmitter is designated as a slave. The PIC instructor, utilizing the master transmitter, will be at all times be able assume control of the sUAV.

91.119 Minimum safe altitudes:

General. The regulation states that over sparsely populated areas the aircraft cannot be operated closer than 500 feet to any person, vessel, vehicle, or structure. Since the typical mission of the sUAS would be photography or survey of persons, vessels, vehicles or structures it would be necessary to operate closer than 500 feet to the items listed. Operations will only be flown over property or persons where permission has been obtained and careful pre-planned flight path has been performed. The aircraft will be operated at a low altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface. Therefore we maintain that due to the small size of the UAS, the hazard to persons, vehicles and structures is minimal compared to manned aircraft, which should be considered in granting the exemption.

CFR 91.121 Altimeter settings.

The regulation requires that aircraft shall maintain cruising altitudes by reference to an altimeter setting available within 100 NM of the aircraft. The sUAS will always fly below 400 feet AGL and within line-of-sight of the PIC, and will not need to maintain cruising altitudes in order to prevent conflict with other aircraft. An Above Ground Level altimeter measurement above the takeoff point is transmitted via radio from the sUAS on-board computer to the display screen held by the PIC, providing a constantly updated AGL readout.

14 CFR 91.151 Fuel requirements for flight in VFR conditions.

The regulation provides that no person may begin a flight in an airplane under day-VFR conditions unless there is enough fuel to fly to the first point of intended landing and to fly after that for at least 30 minutes. We feel the intention of this paragraph is to provide an energy reserve as a safety buffer for delays to landing. The sUAV is battery operated and the maximum duration of flight from a single battery charge is 30 minutes with a 20% reserve. Since the aircraft will never fly more than 1500 feet from the point of intended landing, a full battery charge at launch will ensure that we meet the reserve energy requirement of this paragraph. Furthermore, the battery voltage is transmitted by the UAS and displayed to the PIC on the ground station. A warning is displayed on the ground station when the battery voltage drops to a predetermined level, giving the PIC ample time to land safely with power in reserve. There are also visible and audible low-voltage warnings aboard the aircraft. We request an exemption to the word "fuel" and ask for an equivalent interpretation with the word "energy".

14 CFR 91.203(a) & (b) Civil aircraft: Certifications required.

The regulation provides that an airworthiness certificate, with the registration number assigned to the aircraft and a registration certificate must be aboard the aircraft. Additionally, subparagraph (b) provides that the airworthiness certificate be "displayed at the cabin or cockpit entrance so that it is legible to passengers or crew." The sUAS is too small to carry documentation, does not have an entrance, and is not capable of carrying passengers or crew. To obtain an equivalent level of safety and meet the intent of 91.203, we propose that documents deemed appropriate for this aircraft by the FAA will be with the crew at the ground control station and available for inspection upon request. In order to identify the aircraft, we propose that the information found on airworthiness and registration certificates be permanently affixed to the aircraft via placard containing the above information plus the word "EXPERIMENTAL" to satisfy the requirement of 14 CFR 45.23.

14 CFR Subpart E (91.401- 91.417)- Maintenance, Preventive Maintenance, Alterations
The regulation provides that the operator is primarily responsible for maintaining the aircraft in an airworthy condition, including compliance with part 39 and 43. Paragraphs 91.407 and 91.409 require that the aircraft be "approved for return to service by a person authorized under 43.7" after maintenance and inspection. It is our intention that the PIC perform maintenance and inspection of the aircraft and "be authorized to approve the aircraft for return to service." The PIC will ensure that the aircraft is in an airworthy condition prior to every flight and in addition conduct detailed inspections after every two hours of flight. Maintenance performed by the PIC is limited to repairing small cracks, replacing a propeller, checking electrical connections and updating software and firmware for the on-board computer, replacing structural components, and replacing electronic or electrical components. All other maintenance will be performed by the manufacturer or their designated repair facility. The PIC will document work performed in accordance with 91.417. The Petitioner feels that due to the size, construction, and simplicity of the aircraft, the PIC can ensure an equivalent level of safety.

Safety and Benefits of the UAS

Gary S. Berg will be using the UAS in a variety of applications that generally require expensive full-size manned aircraft to complete. Small, light, unmanned aerial vehicles offer myriad benefits over the use of full-sized manned aircraft for electric power line inspection, oil/gas pipeline inspection, advanced agriculture, film and still photography, just to name a few. Replacing significantly larger manned aircraft carrying crew and flammable fuel with small UAS carrying no passengers or crew creates a much greater margin of safety for the pilots and crew, as well as for people and property on the ground. By granting Gary S. Berg‘s requested exemptions, the FAA will help drive development of safe and successful commercial UAS operations and will advance the public knowledge base for such operations. Gary S. Berg is committed to promoting the UAS research efforts of policymakers including the FAA, NASA, DOD and DARPA by sharing data from its commercial UAS operations and serving as a resource for future UAS research operations. Thus, the FAA has good cause to grant this Petition.

Conclusion

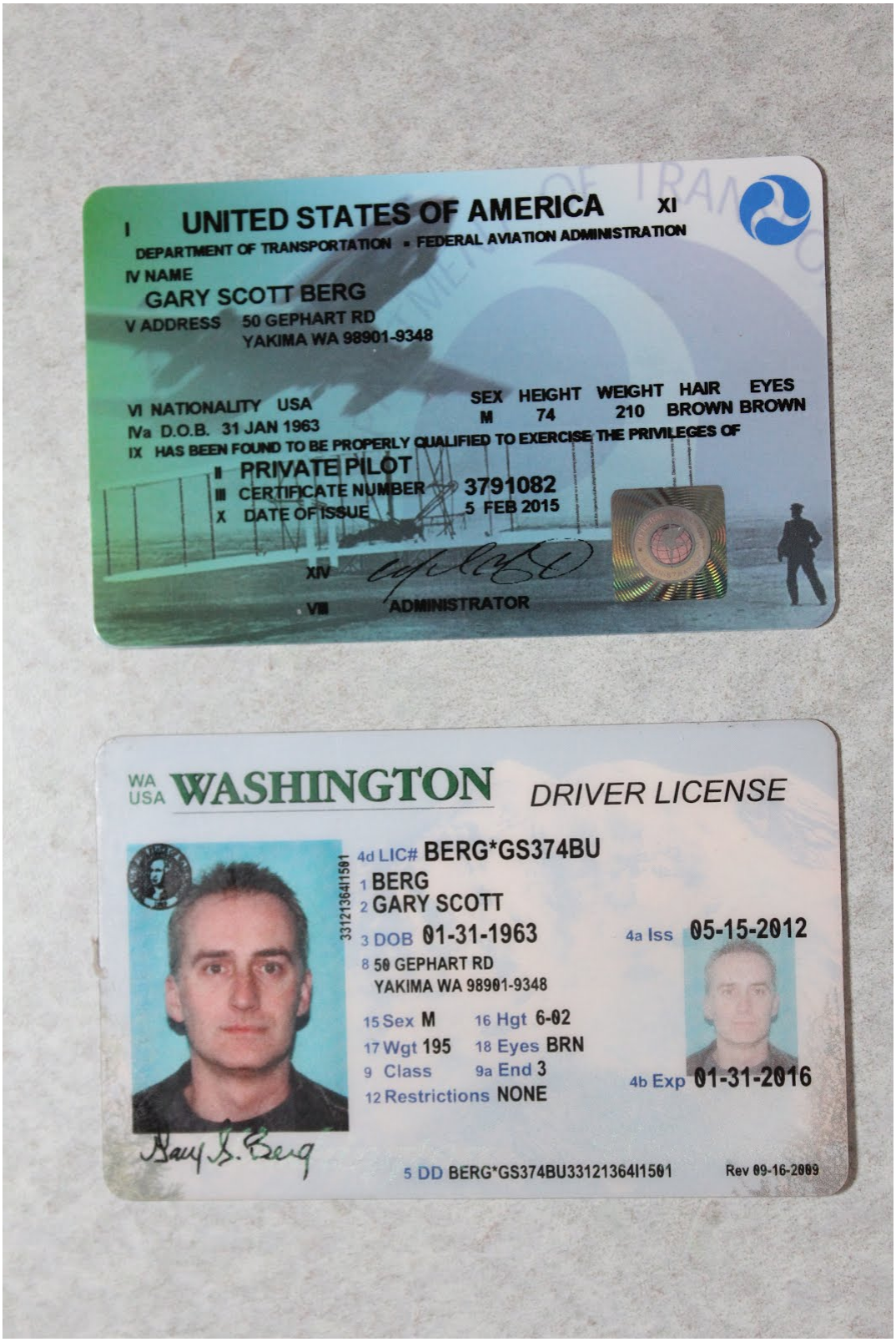
As pointed out in this application, all the UAS’s which the applicant would use, under authorization by the US DOT-FAA, are small, light-weight devices operated within the line of sight of the Pilot-in-Command (PIC), less than 400 feet above the ground and outside 5 miles from any airport, heliport, seaplane base, spaceport, or other location with aviation activities, unless the air traffic control authorities (ATC) have been notified and have authorized each flight within a radius of this distance. All our sUAS’s have proven capability for controlled flight. They include devices offered for general sale on the market around the world and have often been used as Model Aircraft in the USA. The Petitioner is certain that the studies conducted until now by the FAA, about Section 332, Public Law 112-95, 2014, have already provided you with the assurances on the airworthiness of UAVs such as these. The Petitioner has over 40 years of experience designing, building, and operating radio-controlled aircraft,

and has never had an accident resulting in injury or property damage. For the foregoing reasons, the exemptions requested herein should be granted and Gay S. Berg should be permitted to conduct small UAS operations in accordance with its manuals and all other operating parameters deemed necessary and appropriate by the FAA. The submission of this application and its contents is the best demonstration that indeed it is possible to pursue the authorization process so that some UAVs may be used for safe and legitimate commercial activities.

Signed,

Gary S. Berg

Appendix A - Airman Qualifications



Appendix B - Model Airplane News magazine
Volume 117, Number 1, January 1989

PREDATOR

Construction

by GARY BERG and CINDY WARREN

AN UNUSUAL "TAIL-LESS" SPORT DESIGN DEVELOPED ENTIRELY ON THE COMPUTER!

WHEN YOU PUT a high-tech engineering computer and a high-flying R/C hobbyist together, what do you get?—the Predator! As an employee of Dowty Decoto, an aerospace manufacturing firm, my constant companion during weekdays is a Unigraphics II computer-aided design and manufacturing system, produced by a division of McDonnell Douglas. Its daily task is to generate engineering drawings and related information, which we use to build equipment for the aerospace industry. When I introduced the system to the world of model aviation, the Predator resulted.

Unique in appearance, the model was designed to be a good-looking, agile performer and it's easy to build and fly. Although not a beginner's plane, the model can be flown by anyone who can handle a good low-wing Sunday flier; so if you'd like to tear up the skies with a real performer, the Predator will be a fun change of pace.

The design methods may be state-of-the-art, but the construction and materials are user-friendly and familiar. The use of lite-ply and spruce makes the airframe very strong, so additional strengthening isn't necessary and will only add weight. Careful selection of building and finishing materials will result in a light, attractive aircraft.

CONSTRUCTION: As I mentioned, construction is fairly straightforward. Building will go much faster if you start by cutting out all the parts, so making your own "kit."

• Wing: Begin by pinning down the bottom front and rear spruce spars. The rear spar must be shimmed up off the board for proper positioning with the ribs. Glue all the ribs into place, then add the top spars, the ½-inch-square balsa leading edge and the 1⅛x⅛-inch trailing edge. When the glue is dry, install the sheeting over the leading and trailing edges and center section, and add the cap strips. Allow the wing to dry thoroughly before removing it from the building board, then turn it over and trim the building alignment tabs from the ribs.

The elevons are built by laminating a molded gapless hinge between a strip of balsa trailing-edge stock and a strip of lite-ply. (CA should be used throughout this assembly.) Make several pinholes through the balsa so that the glue can penetrate. The elevons are attached to the wing by laminating the other flange of the hinge between the wing's existing trailing-edge stock and the strip of ⅞x¼-inch rectangular balsa. (Again, use CA.)

With the elevons attached, the wing panels are joined by laying them upside-down and inserting the plywood dihedral braces and wing-mounting plate. When the glue is dry, add the balsa sheeting and cap strips to the bottom of the wing. Add the elevon torque

(Continued on next page)

Designer Berg seems pleased with his CAD Predator. Designed during lunch hours, we're sure!

SAVE TIME WITH CAD

THREE-DIMENSIONAL Computer-Aided Design (CAD) has become standard for the production of thousands of types of parts, assemblies and structures. Everything from sneakers to the Space Shuttle has components that were designed with the help of computers. Before the actual hardware is ever made, a full-scale "model" can be built on a computer screen. This model can be easily examined, assembled or modified, to verify the integrity of the design without costly and time-consuming production or re-work.

Just what every R/C designer needs—a full-blown CAD system. Next, we'll go from disc to cutter to produce wooden parts just like the big guys do with NC equipment!

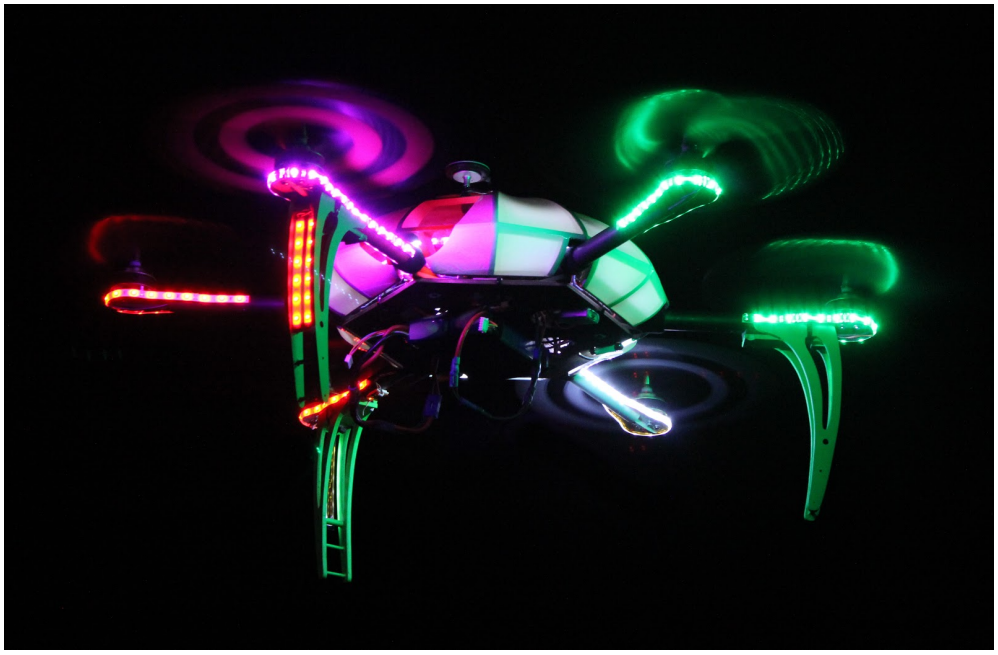
The design of a model airplane may not be so critical, but CAD provides the same benefits. For example, an airfoil shape can be entered into the machine and, once defined, this shape can be scaled up or down, relocated or edited in a matter of seconds. When finalized, an entire wing structure can be generated from this single airfoil.

This kind of accuracy isn't obtainable by using conventional drafting techniques; also a great time saver. Design can be printed on plotter to any scale, including man-carrying!

A copy of this shape is placed at the wing root. Another copy, scaled down slightly, is placed at the tip. The outer surface of a tapered wing panel has now been defined. This surface can be sliced at regular intervals, creating exact patterns for wing ribs. Standard stock sizes are then laid in place for spars and leading and trailing edges, giving each rib the necessary notches. A complete wing design in minutes; no pencils, no balsa scraps, no headaches!

While the Predator was the product of a million-dollar industrial computer system, there are reasonably priced drafting packages available for your PC, too. Before long, you'll be throwing away your T-square and buying food for your new "pet mouse!" ■

Appendix C - Night flying UAV



Appendix D - UAV Flight and Maintenance Log

		Total flight time:	12:52:05			Aircraft: Hexcopter 2.0
Flight	**Date**	**Location**	**Flight Time**	**Landings**	**Battery**	**Recharge ma.**	**Notes**
1	2/13/2015	Home	0:07:00	5	2x 4S 3000mah		First flight! Tested Manual, Atti, GPS fight modes. Twitchy, gain may be too high.
2	2/13/2015	Home	0:04:00	6	2x 4S 3000mah		Manual mode, trying to get pitch/roll gain adjusted. Drops toward motor 5. (Aft right)
3	2/13/2015	Home	0:04:00	3	2x 4S 3000mah		Can't get pitch/roll gain dialed in. Won't lift off level in Atti/GPS mode. Need to recalibrate Naza and ESC's.
4	2/13/2015	Home	0:05:00	3	2x 4S 3000mah		Recalibrated Naza controller. Locked pitch/roll gain at 255%. Set attitude gain to 150% with X2 control. Better stability in Manual mode, but still seeing wind-induced oscillations that get out of hand. (Wind approx. 10mph) Dailed up attitude gain to 170% during flight. Reduced pitch/roll to 245% for next flight.
5	2/15/2015	Home	0:07:00	6	2x 4S 3000mah		Reprogramed/recalibrated all ESC's. Tried pitch/roll gain at 150%. Better, but still not right. Suspicious of No. 5 motor or ESC, although it seems to run fine when plugged into the rx by itself.
6	2/16/2015	Home	0:06:00	4	2x 3S 4000mah		Landing gear changed to short, stiff temporary legs. Tried 3S batteries to see if it would make a difference. Pitch/roll gain set at 150% with X2 control. Problem not solved. Motors cutting out and running rough.
	2/16/2015						After research and conversations with a couple of experts, the concensus is that the Turnigy Plush ESC's aren't playing nice with the 22-pole Multistar motors. The Plush ESC's have a 200hz refresh rate, and the throttle output is averaged over several cycles. (400hz or faster is needed). The result is throttle response that is sometimes much too slow for a multirotor, causing oscillations and motor shutdown. Ordered a new set of 40 amp SimonK ESC's from Heads Up RC, made specifically for multi's.
	2/20/2015						Disassembled frame. Removed Turnigy Plush 25 amp ESC's. Replaced with EMax Simon 40 amp ESC's. Reassembled, realigned, and torqued frame. Set initial pitch/roll gain to 150% with X2 control. Initial yaw gain at 180%. Installed temporary landing gear. Inspected and reinstalled props. Ready for flight test.
7	2/20/2015	Home	0:05:00	5	2x 4S 3000mah		Success!! Wind at 15-20 mph, so tried manual hover in the garage. Some turbulence from ground effect, but hover and control response are much improved. Settled on 200% pitch/roll gain. Yaw gain seemed good. ESC's cool after flight.
8	2/21/2015	Home	0:05:30	3	2x 4S 3000mah		Test flight outside. Slight oscillations in GPS mode. Dialed pitch/roll gain down to 165%.
9	2/21/2015	Home	0:06:00	3	2x 4S 3000mah		Test flight outside. Gusty winds 10-12 mph causing turbulence, but GPS held position well. Slight CCW spiral in GPS hover, need to adjust antenna.
	2/21/2015	Home					Adjusted GPS antenna. Reinstalled proper landing gear. Too windy for more flying.
10	2/22/2015	Home	0:06:00	2	2x 4S 3000mah		Recalibrated compass. Wind 5-10 mph. Settled on pitch/roll gain at 200%. Spiral problem in GPS hover solved.
11	2/22/2015	Home	0:06:20	2	2x 4S 3000mah		Wind 10 mph. GPS position hold working well. Flying good, but not perfect. Going to try adjusting yaw gain next.
	2/22/2015						Added separate 12-volt power panel and 3S battery for video & lighting (to be installed later)
12	2/22/2015	Home	0:06:10	3	2x 4S 3000mah		Programmed low motor timing in all ESC's. Set Yaw gain to 170% with X2 control. GPS mode working well, with good control response. Some oscillations in hover, smoother in forward flight.
	2/22/2015						No. 2 ESC went up in smoke right after power up. No. 5 ESC acting flaky... Sometimes works fine, sometimes motor jitters but won't start. They're going back to Heads Up RC. Ordered a new set of HobbyWing XRotor 40A's.
	2/28/2015						Installed LED lighting. Removed ESC's.
	3/7/2015						Installed new HobbyWing XRotor 40 Amp ESC's. Calibrated throttles on each. Set pitch/roll gain to 200% with X2 control. Yaw gain at 180%. Inspected and reinstalled props. Ready to test.
13	3/7/2015	Home	0:07:00	3	2x 4S 3000mah		Success at last! The new ESC's work well with the Multistar motors. Very smooth flight with good stability. Settled on 240% for pitch/roll gain. Self-level and GPS worked well. Some instability in the Z-axis, set vertical gain to 115% with X2 control for the next flight.
14	3/7/2015	Home	0:07:25	1	2x 4S 3000mah		Flying very well now. Entire flight was in GPS mode. Set vertical gain at 100%. Set Attitude gain to X2 control for next flight, just to experiment with control sensitivity.
15	3/7/2015	Home	0:06:30	2	2x 4S 3000mah		Settled on 133% for Attitude gain. GPS held very well in a 10mph breeze. Hands-off hover was stable enough to get some photos.

Appendix E - UAV Preflight and Postflight Checklist

Before flying session

- Torque arms
- Torque motors
- Torque props
- Check motor freeplay, bearings free.
- Check wiring
- Check battery connectors
- Check landing gear
- Check dome mounting
- Visual inspection

Preflight

- Install battery
- Install camera & connect USB cable.
- Connect voltage alarm, check cells balanced, 4.0 volts min.
- All TX switches forward
- Turn on transmitter
- Connect main power
- Yellow LED flashing?
- Turn on ground station
- Turn on speaker
- Turn on VTX
- **Turn on camera**
- **Video link working?**
- **Test camera tilt and shutter**
- **Wait for flashing yellow LED to stop.**
- **Confirm GPS (green LED)**
- **Lights on**
- **Secure dome**
- **Clear area**
- **Start motors**
- **Takeoff**

After landing

- **Motors off**
- **Disconnect main power**
- **Camera off**
- **VTX off**
- **Lights off**
- **Disconnect voltage alarm**
- **Transmitter off**
- **Ground station off**
- **Speaker off**

Hexcopter 2.0 Checklist

Aux 2 Settings

Canon
NOR/REV
96% - 145%

Mobius/Gimbal
NOR/**REV**
115% - 15%

Appendix F - FPV Ground Station