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

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

June 30, 2015

Exemption No. 11965
Regulatory Docket No. FAA–2015–0222

Mr. Douglas Sigler
CEO and Owner
Aerialspecs, Inc.
48675 Jefferson Drive
Macomb, MI 48044

Dear Mr. Sigler:

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 posted to the public docket on January 30, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Aerialspecs, Inc. (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct remote visual line-of-sight videography, data collection, sensing, and visual 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. However, the FAA received two comments in support of the petition made to the docket.

Airworthiness Certification

The UAS proposed by the petitioner are the Lockheed Martin Indago, DJI Phantom 3, DJI Inspire 1, DJI S900, DJI S1000, and SenseFly eBee Ag.

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, Aerialspecs, Inc. 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

[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.

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, Aerialspecs, Inc. 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 Lockheed Martin Indago, DJI Phantom 3, DJI Inspire 1, DJI S900, DJI S1000, and SenseFly eBee Ag 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 July 31, 2017, unless sooner superseded or rescinded.

Sincerely,

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

Enclosures

Project Officer: _____

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Petition for Exemption / Rulemaking to the FAA

Commercial visual line-of-sight sUAS Operations

Prepared by Robert R. Murrell

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SUMMARY

Pursuant to 14 CFR Part 11, the following summary is provided by Aerialspecs, Inc. for publication in the Federal Register:

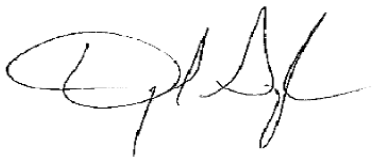
Aerialspecs, Inc. is seeking exemption from the following regulations to operate small Unmanned Aerial Systems for the purposes of remote visual line-of-sight videography, data collection, sensing, and visual inspection:

- 14 CFR PART 61: Certification: Pilots, Flight Instructors, and Ground Instructors
- 14 CFR §61.113 (a) & (b): Private pilot privileges and limitations: Pilot in Command
- 14 CFR Part 21, Subpart H: Airworthiness Certificates 14 CFR §91.203 (a) (1)
- 14 CFR §45.23 (b). Marking of the Aircraft
- 14 CFR §91.7(a): Civil Aircraft Airworthiness
- 14 CFR §91.9 (b) (2): Civil Aircraft Flight Manual in the Aircraft
- 14 CFR §91.103 (b)(2): Preflight Action
- 14 CFR §91.105: Flight Crewmembers at Stations
- 14 CFR §91.109: Flight Instruction
- 14 CFR §91.119: Minimum safe altitudes
- 14 CFR §91.121: Altimeter Settings
- 14 CFR §91.151: Fuel requirements for flight in VFR conditions
- 14 CFR §91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration
- 14 CFR §91.405 (a); 407 (a) (1); 409 (a) (2); 417(a) & (b): Maintenance Inspections

It is the position of Aerialspecs, Inc. that a new license class be created for the commercial visual line-of-sight of sUAS. Many industries needlessly place the lives of employees in harm's way every day to keep the general public safe and deliver products to their customers. Requiring reasonable everyday workers in hazardous jobs to obtain a Pilot's license is too costly and time consuming. The rigor and cost associated to achieving a private pilots certificate is typically $10,000 USD and 50 - 60 hours of an individual's time. This far exceeds the training necessary to achieve a CDL with a Hazmat endorsement required to transport dangerous cargo over land.

Aerialspecs, Inc. believes it has created training, certifications, operational standards, and equipment specifications that represent reasonable guidelines for operation of sUAS comparable to risk sUAS poses and similar to CDL, forklift, or other hazardous equipment employees are entrusted to operate every day. Aerialspecs, Inc. is willing to partner with the FAA to create a new license class leveraging this exemption as its springboard. Until then we believe or training and certification standards, the type of equipment, operating standards, fly-off procedures, and clear areas of operation defined herein exceed the standards set forth in FAA Advisory Circular AC 91-57 for hobby operations and provide an equivalent level of safety supporting the grant of the exceptions requested herein. This satisfies the criteria provided in Section 333 of the Reform Act of 2012 providing adequate justification for these exceptions allowing for commercial operations of sUAS within visual line-of-sight by Aerialspecs, Inc.

Aerialspecs, Inc. is committed to the safety of the everyday worker and believes that through our services and this exemption we can provide safe, quality operations of sUAS to reduce the risk to employees, improve our customers OSHA ratings, and protect the public.



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EXEMPTION

SCOPE

The scope of this exemption includes Aerialspecs, Inc. employees, affiliates, partners, vendors, or any other person or entity operating in a flight capacity on behalf of Aerialspecs, Inc. for the purpose of commercial visual line-of-sight sUAS operations leveraging both manual command and control, and auto piloted flight.

SPECIFIC EXEMPTIONS

14 CFR PART 61: CERTIFICATION: PILOTS, FLIGHT INSTRUCTORS, AND GROUND INSTRUCTORS

The regulations set forth in 14 CFR Part 61 require a pilot certificate and medical certificate for anyone operating as a required pilot of a civil aircraft.

Aerialspecs, Inc. is seeking exemption from 14 CFR Part 61 on the grounds that the FAA does not require a pilot certificate for recreational use of aerial vehicles with the same configurations hereunder today as defined by FAA Advisory Circular AC 91-57, Model Aircraft Operating Standards[1]. Also, the operation of sUAS is far simpler than large scale aircraft, especially with modern flight control and stabilization systems, requiring less training and experience to be safe and effective. Finally, there is no evidence to support the rigor of a pilot certificate, or lack thereof, makes the operations of sUAS more or less safe.

Aerialspecs, Inc. exceeds the voluntary standards defined in FAA Advisory Circular AC 91-57 as well as maintains the equivalent level of safety intended by 14 CFR Part 61 by strictly following the Flight Operations Certification and General Operational Guidelines herein. Equipment Operators will have a minimum number of total flight hours overall, minimum number of total flight hours per sUAS type, minimum number of flight hours per year, knowledge of airspace and restrictions, aviation background checks, medical certification, and basic first aid training.

14 CFR §61.113 (A) & (B): PRIVATE PILOT PRIVILEGES AND LIMITATIONS: PILOT IN COMMAND

These regulations limit private pilots to non-commercial operations only. Although Aerialspecs, Inc. is seeking exemption from certificates, ratings, and authorizations, it may still leverage licensed pilots to operate a sUAS. To not violate the regulations set forth in 14 CFR §61.113 (a) & (b), an exemption is required.

Aerialspecs, Inc. is seeking exemption from 14 CFR §61.113 (a) & (b) on the grounds that the level of risk associated with the operation of a sUAS compared to commercial operations of a piloted aircraft when Part 61 was conceived is so negligible that having a private pilot as the Pilot In Command exceeds the present level of safety achieved by 14 CFR §61.113 (a) & (b).

Aerialspecs, Inc. will maintain an equivalent level of safety by operating a sUAS hereunder in specific operational areas away from the general public that will not carry passengers or crew, not exceed an operational weight of 24.9476 kg (55 lbs.) including payload, and not exceed ground speeds of 25 m/s (56 mph).

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

This regulation requires that aircraft have a current certificate of airworthiness. It also requires that the airworthiness certificate be displayed in the cabin or cockpit entrance so that it is legible to passengers and crew.

Aerialspecs, Inc. is seeking exemption from 14 CFR Part 21, Subpart H: Airworthiness Certificates 14 CFR §91.203 (a) (1) on the grounds that a sUAS operated hereunder does not carry passengers or crew, will not weigh more than 24.9476 kg (55 lbs.) including payload, and will not exceed ground speeds of speeds of 25 m/s (56 mph). A sUAS hereunder will fly under strict guidelines in narrow operational areas. This combined with the safety measures herein provide a greater degree of safety to the public than conventional operations conducted with airworthiness certificates issued under 14 CFR Part 21, Subpart H. *See Public Safety and General Operational Guidelines for more information*.

The Federal Aviation Act (49 USC §44701 (f)) and Section 333 of the Reform Act both authorize the FAA to exempt aircraft from the requirement for an airworthiness certificate, upon consideration of the size, weight, speed, operational capability, and proximity to airports and populated areas of the particular sUAS.

14 CFR §45.23 (b): Marking of the Aircraft

This regulation requires:

> *"When marks include only the Roman capital letter 'N' and the registration number is displayed on limited, restricted or light-sport category aircraft or experimental or provisionally certificated aircraft, the Equipment Operator must also display on that aircraft near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words 'limited,' 'restricted,'' 'light-sport,' 'experimental,' or 'provisional,' as applicable."*

Aerialspecs, Inc. is seeking exemption from 14 CFR § 45.23 (b) on the grounds that sUAS operated hereunder do not have a cabin, cockpit or pilot station. Their size makes it impossible to fit the word "Experimental" in letting no smaller than 2 inches high. To maintain compliance with §45.29 (f), Aerialspecs, Inc. will require the word "Experimental" on sUAS fuselages so that the operator, spotter, or supporting personnel working with the vehicle will see the identification.

Precedence has been set by the following exemptions issued by the FAA[2]: Exemptions Nos. 10700, 10167, and 10167A.

14 CFR §91.7(a): Civil aircraft airworthiness

This regulation requires that no person may operate a civil aircraft unless it is in airworthy condition.

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.7(a) on the grounds that there will be no airworthiness certificate issued for the aircraft. Should this exemption be granted, no FAA regulatory standard will exist for determining airworthiness for such vehicles.

Given the size of the aircraft, the requirements contained in the equipment maintenance manuals, and use of safety check lists prior to each flight, an equivalent level of safety will be provided.

14 CFR §91.9 (b) (2): Civil Aircraft Flight Manual in the Aircraft

This regulation requires that an approved Flight Manual, manual materials, markings, and place cards, or any combination thereof be placed in the aircraft and available to the pilot.

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.9 (b) (2) on the grounds that the sUAS operated hereunder have no cockpit and are not large enough to carry a Pilot or the Flight Manual.

The equivalent level of safety will be maintained by keeping the flight manual at the ground control point where the Equipment Operator controlling the sUAS or the Observer will have immediate access to it.

Precedence has been set by the following exemptions issued by the FAA[3]: Exemption Nos. 8607, 8737, 8738, 9299, 9299A, 9565, 9565B, 10167, 10167A, 10602, and 10700.

14 CFR §91.103(B)(2): PREFLIGHT ACTION

This regulation requires the pilot in command to take certain action before a flight, specifically:

> *"(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:*
>
> *(1) For civil aircraft for which an approved Airplane or Rotorcraft Flight Manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and*
>
> *(2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature."*

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.103 on the grounds that there is no FAA approved Rotorcraft Flight Manual for the UAV. The Equipment Operator will follow a preflight checklist provided by the UAV manufacturer as well as validating UAV performance, battery requirement for the specific flight, landing and takeoff distances, area of operations, and weather conditions appropriate for VFR. *See General Operational Guidelines for more information.*

14 CFR §91.105: FLIGHT CREWMEMBERS AT STATIONS

This regulation requires that crewmember be at flight stations, presumably in the aircraft, wearing safety belts or harnesses during takeoff, landing, and while en route.

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.105 on the grounds that sUAS operated hereunder have no cockpit and are not large enough to carry a Pilot. Aerialspecs, Inc. will provide the equivalent level of safety by requiring an Equipment Operator and Spotter for each sUAS in operation and require a securing strap between the C2 remote and the Equipment Operator.

14 CFR §91.109: FLIGHT INSTRUCTION

This regulation requires any civil aircraft (except a manned free balloon) to have dual flight controls when used for flight instruction.

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.109 on the grounds that sUAS are remotely controlled within line-of-sight and by design do not have dual controls. Flight control is accomplished through a microcontroller accepting human and/or software input that communicates flight commands via radio to the UAV. Aerialspecs, Inc. will provide the equivalent level of safety by the fact that neither Equipment Operator nor instructor will be onboard the UAV. It will also follow the General Operational Guidelines defined herein where the sUAS will be operated is specific, predefined areas, and the flight instruction behaving in the role of Chief Equipment Operator, will be present during instruction and have access to the controller.

Precedence has been set by the following exemptions issued by the FAA[4]: Exemption Nos. 5778K & 9862A.

14 CFR §91.119: Minimum safe altitudes

This regulation specifies the minimum altitudes of operation under various conditions including restricting operations below 152.4 m (500 Ft. AGL) over non-congested areas.

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.119 under special circumstances on the grounds that many of the specific use cases defined herein have structures below 152.095 m (499 ft.) AGL and to gather relevant information on said structure the UAV must operate well below specified minimums.

Aerialspecs, Inc. will provide the equivalent level of safety by flying in specific areas of operation away from the general public. The equipment will not carry any hazardous or explosive cargo, travel no more than 25 m/s (56 mph), and not exceed 24.9476 kg (55 lbs.) in operational weight including payload. The Equipment Operator and Spotter will also be equipped with aviation radios to communicate with nearby traffic. The details of the flight will be publicly publish on the Aerialspecs, Inc. corporate web site indicating the location, two dimensional operational area, maximum altitude, start time, and expected duration.

14 CFR §91.121: Altimeter Settings

This regulation requires each person operating an aircraft to maintain cruising altitude by reference to an altimeter that is set:

> **"**(iii) In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure; **"**

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.121 on the grounds that some of the aircraft used rely strictly on GPS for altitude and those aircraft that have an altimeter will auto calibrate ground level to the atmospheric pressure at time of startup.

Aerialspecs, Inc. will provide an equivalent level of safety by including in the preflight checklist verification that GPS fix is sufficient to maintain altitude within a reasonable margin of error, that the GPS altitude is correct before flight, or in case of barometric altimeter based aircraft, that the altimeter reads 0 m (0 ft.) AGL before flight.

14 CFR §91.151: Fuel requirements for flight in VFR conditions

This regulation requires:

> *"(a) No person may begin 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.*
>
> *(b) No person may begin a flight in a rotorcraft 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, to fly after that for at least 20 minutes."*

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.151 on the grounds that sUAS operated hereunder generally have battery limits of approximately 20-60 minutes depending on atmospheric conditions,

make, model, and age of the battery. In some cases this would provide no reserve capability, in others, leaving not enough flight time to gather the information required for the visual inspection of the wind turbine.

Aerialspecs, Inc. will maintain an equivalent level of safety by flying in specific areas of operation away from the general public. The equipment will not carry any hazardous or explosive cargo, travel no more than 25 m/s (56 mph), and not exceed 24.9476 kg (55 lbs.) in operational weight including payload. Flight operations will cease when battery levels reach 15% of their startup capacity. This restriction will provide ample battery life for the UAV to return to its designated landing area.

Precedence has been set by the following exemptions issued by the FAA[5]: Exemptions Nos. 10673, 2689F, 5745, 10673, and 10808.

14 CFR §91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration

This regulation requires in part:

> *"(a) Except as provided in § 91.715, no person may operate a civil aircraft unless it has within it the following:*
>
> *(1) An appropriate and current airworthiness certificate…*
>
> *(b) No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew."*

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.203 (a) & (b) on the grounds that the sUAS at full operations weight will be less than 24.9476 kg (55 lbs.) including payload, has no cockpit, and has no room to carry a pilot onboard.

Aerialspecs, Inc. will maintain an equivalent level of safety by keeping these documents at the ground control point where the pilot flying the sUAS will have immediate access to them; to the extent they are applicable to the sUAS.

Precedence has been set by the following exemptions issued by the FAA[6]: Exemption Nos. 9565, 9665, 9789, 9789A, 9797, 9797A, 9816A, and 10700.

14 CFR §91.405 (a); 407 (a) (1); 409 (a) (2); 417(a) & (b): Maintenance Inspections

These regulations require that each owner or operator:

> *"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;"*

Aerialspecs, Inc. is seeking exemption from 14 CFR §91.405 (a), 407 (a) (1), 409 (a) (2), and 417(a) and (b) on the grounds that these regulations and the regulations set forth in Part 43 are intended for aircraft with airworthiness certificates and a sUAS hereunder will not be issued an airworthiness certificate.

Aerialspecs, Inc. will maintain an equivalent level of safety by operating a sUAS hereunder in specific operational areas away from the general public that will not carry passengers or crew, not exceed an operational weight of 24.9476 kg (55 lbs.) including payload, and not exceed ground speeds of 25 m/s (56 mph). Should a mechanical issue arise the sUAS can immediately land within the operational area.

Aerialspecs, Inc. will also perform routine and scheduled inspections of all sUAS and follow the maintenance recommendations of the equipment manufacturer. A log of all maintenance and repair will be kept for each sUAS to ensure the highest operational performance.

Per the Operational Procedures herein, all flights will perform a pre-flight and post-flight checklists which will include visual inspection of the equipment to identify anomalies before they become an issue. See Maintenance and Repair for more information on the maintenance and repair of sUAS by Aerialspecs, Inc.

PUBLIC SAFETY

Aerialspecs, Inc. will follow these specific safety measures to ensure the safety of our employees and the general public:

- A sUAS operated hereunder will remain confined to an operational area.
- No flight operations will occur inside restricted or special use, airspace.
- No flight operations will occur inside Class B, C, or D airspace with the following conditions:
    - No flight operations will occur within a 5 nm (9260 m) radius of a Class A airport in Class B, C, or D airspace with a floor of SFC.
    - Flight operations will be restricted to a maximum altitude of 400 ft. (121.92 m) AGL outside the 5 nm (9260 m) radius of a Class A airport in Class B, C, or D airspace with a floor of SFC.

  Figure 1.1 depicts the area of operations in Class B, C, or D airspace with floor of SFC new a Class A airport.
- No UAV will operate or cross over a roadway designated as a highway by the Federal or State government the roadway is in with the exception of the specific use case of Municipal Police, Fire, and Search and Rescue or specific situations during Bridge Inspection. See Municipal Police, Fire, and Search and Rescue and Building, Bridge, Structure, or Span Inspection below for more information.
- All operations will be performed by a trained two-man crew: Equipment Operator and Spotter. The Equipment Operator will be responsible for piloting the UAV while the Spotter will focus on ground and air hazard identification.
- No UAV operated hereunder will exceed an operational Weight 24.9476 kg (55 lbs.) including payload.
- No UAV operated hereunder will exceed a ground speed of 25 m/s (56 mph).
- All UAV operated hereunder will be battery operated with no more than 60 minutes of minutes of flight time on a single charge.
- All UAV operated hereunder will have “Return to Home” capability to return to a predetermined point should the sUAS Equipment Operator lose C2 communications.
- No UAV operated hereunder will carry flammable, explosive or otherwise hazardous material.

For more information on Equipment Operator and Spotter see the Operational Roles below, for more information on equipment, see Equipment Specification below. Additional information on Aerialspecs, Inc. operating standards is available in Operating Standards and Appendix A. General Flight Process below.

Safety of our Employees

Employees with operational roles will be issued and minimally required to wear during operations the following personal protection equipment:

- ANSI Z89.1-2009 Type I Class C Helmet with chin strap.
- Safety Glasses.
- Safety Gloves.
- Hard sole steel toe safety boots that cover the ankle.
- ANSI Class 2 Safety Vest.

Addition safety equipment may be required depending on the specific use case or environment. The Equipment Operator is accountable for safety equipment beyond the minimum specified above.

During operations the Equipment Operator or Spotter will have immediately available the following safety equipment:

- ABC fire extinguisher.
- 5 person first aid kit.

Safety of our Customers

- All nonessential customer personnel we be prohibited from entering the defined operational area.
- All essential customer personnel we be required to use the same safety equipment as the Equipment Operator and Spotter while inside the operational area.
- All essential customer personnel we be briefed by Aerialspecs, Inc. on the associated health and safety hazards of being in close proximity of a sUAS.

Operational Roles

Aerialspecs, Inc. will utilize the following operational roles to provide safe operations of sUAS. All operational roles will be required to maintain Flight Operations Certification status as defined below. Employees in Equipment Operator or Spotter roles will be used interchangeably.

Chief Equipment Operator

The Chief Equipment Operator is in charge of and accountable for all flight operations hereunder and is accountable for the Equipment Operators and Spotters.

The Chief Equipment Operator will have knowledge of and authorize all sUAS flight operations hereunder and will monitor weather, VFR conditions, Restricted, TFR, or SUA airspace, and AIRMET/SIGMET zones. The Chief Equipment Operator will manage the operational relationship between Aerialspecs, Inc. and the FAA, FDSO, NTSB, State of Michigan, and local municipalities, obtaining permits and permission for operations where required.

The Chief Equipment Operator will have full authority to cancel or abort any flight, any time, for any reason. The Chief Equipment Operator will also conduct the daily Mission Briefing for all employees with operational roles.

Equipment Operator

The Equipment Operator is accountable for the safe operation of the sUAS and is effectively the Pilot-In-Command. The Equipment Operator will have full authority to cancel or abort any flight, any time, for any reason.

Spotter

The Spotter is responsible for the safe operation of the sUAS. The job of the Spotter is to assist the Equipment Operator in "see and avoid," monitoring the operational area for hazards, and/or incursions by unauthorized personnel or the general public on land, sea, or in the air. The Spotter will have full authority to cancel or abort any flight, any time, for any reason. A Spotter will maintain the same level of proficiency as an Equipment Operator.

Flight Operations Certification

Failure to comply with the terms of this Petition for Exemption, the process and procedures established by Aerialspecs, Inc., as well as local, State, and Federal laws may result in the revocation of certification for flight and termination from Aerialspecs, Inc.

Flight Certification

To be eligible for an operational role an employee must be 21 years of age or older, pass a TSA equivalent background check, pass a Third Class medical examination, maintain basic first aid certifications, have a valid driver's license in the State of Michigan, and have not been convicted of a DUI or DWI or have refused an alcohol or drug test in the 60 working days prior to flight operations certification training.

All operational roles will receive an 8 hour training course one the basics of safe operations of sUAS used by Aerialspecs, Inc. This course will include the following:

- Health and safety hazards to employees and the general public.
    - Required Personal Protection Equipment.
    - Cutting hazards.
    - Fall hazards.
    - High speed collision hazards.
    - Electric shock hazards.
    - Fire hazards.
    - Safe handling and disposal of batteries.
- Additional hazards to other land, sea, and air traffic.
    - Potential issues encountering traffic.
    - "See and avoid" tactics.
- Identifying hazards on the job site.
    - Obstacle Identification.
    - Overhead utility lines.
    - Ropes, cables, and guy wires.
    - Areas designated for the public.
    - Avian hazards.
- Potential issues during operations, including:

    - Equipment Failure.
    - Operational Area incursion.
    - RF Interference.
    - Fly-offs or un-commanded flight.
    - Unexpected changes in weather.
    - Fires.
- Aerialspecs, Inc. operating standards.
- General flight procedures.
    - Roles and responsibilities.
    - SUA checks.
    - TFR checks.
    - Airspace checks.
    - Weather verification.
    - Effective pre and post-mission briefings.
    - Pre and post-flight checklists.
- Emergency flight procedures.
    - Fly-off or un-commanded flight.
    - Operational Area incursions.
    - Crashes.
    - Aborting a flight.
    - Communicating with pilots over Aviation Radio.
- Reporting incidents to the FAA.

Upon completion of the training all operational roles will be given a test on the materials. Failure to pass the test with an 80% score or better will require the employee to retake the course. All operational roles will be required to take this course annually or sooner should major operational changes be required. Should major operations changes be required inside the annual period, operational roles may only be required to take a bridge course with appropriate testing designed around the changes.

Each operational role must obtain 8 hours of combined flight and equipment training for each type of equipment before being certified to operate the equipment.

Aerialspecs, Inc. will keep a record of training, certification, logged operational hours, and equipment certified, for each person in an operational role.

Equipment Operator and Spotter Flight Time Requirements

The equipment operator and spotter must 8 hours of flight time logged checked off by a Chief Equipment Operator to obtain a Flight Operation Certification. Once certified an Equipment Operator or Spotter will have an 8 hour flight time probation where they cannot be partnered with another Equipment Operator or Spotter who is on probation. Those 8 hours of flight will be logged and checked off by the experienced Equipment Operator or Spotter not on probation.

To maintain Flight Operations Certification an Equipment Operator or Spotter must log at least 10 hours of operational time, either on-the-job or practice, annually, excluding the flight time logged during the initial Flight Operations Certification checks.

Chief Equipment Operator Flight Time Requirements

In addition to the Equipment Operator and Spotter Flight Time Requirements above, A Chief Equipment Operator must have at least 20 hours of operational time in the field and no incidents where he or she was deem "at fault" in the last 12 calendar months.

TSA Equivalent Background Check

Aerialspecs, Inc. employees, affiliates, partners, vendors, or any other person or entity operating in a flight capacity on behalf of Aerialspecs, Inc. must pass an annual Aviation Background Check pursuant to FAA Regulations 14 CFR Parts 121, 125 and 135. Aerialspecs, Inc. will contract Universal™ [13], to provide Aviation Background Checks.

Medical Examination

All roles will be required to maintain annually a Third Class Medical certification from a local Aviation Medical Examiner.

Basic First Aid Certification

All roles will be required to maintain annual Basic CPR, Basic First Aid, and Basic AED certifications from the American Red Cross.

Operating Standards

The following are a set of operational standards Aerialspecs, Inc. will use upon approval of the exemption. These standards are intended to replicate the level of safety intended during the drafting of many of the regulations Aerialspecs, Inc. is seeking exemption for. These standards are not all inclusive and will likely change as Aerialspecs, Inc. matures this capability.

- No flight operations will occur inside restricted or special use, airspace.
- No flight operations will occur inside Class B, C, or D airspace with the following conditions:
    - No flight operations will occur within a 5 nm (9260 m) radius of a Class A airport in Class B, C, or D airspace with a floor of SFC.
    - Flight operations will be restricted to a maximum altitude of 400 ft. (121.92 m) AGL outside the 5 nm (9260 m) radius of a Class A airport in Class B, C, or D airspace with a floor of SFC.

  Figure 1.1 depicts the area of operations in Class B, C, or D airspace with floor of SFC new a Class A airport.
- No UAV will operate outside visual line-of-sight of the Equipment Operator or Spotter.
- No UAV will operate outside the range of the C2 transceiver of the Equipment Operator.
- No UAV will operate or cross over a roadway designated as a Highway by the Federal or State government the roadway is in with the exception of the specific use case of Municipal Police, Fire, and Search and Rescue or specific situations during Bridge Inspection. See Municipal Police, Fire, and Search and Rescue and Building, Bridge, Structure, or Span Inspection below for more information.
- All planned operations will have an on-site survey done by an Equipment Operator or Spotter prior to operations.
- No flight operations will occur without the knowledge and permission of a Chief Equipment Operator.

- There will be a daily Mission Briefing conducted by a Chief Equipment Officer evaluating weather, AIRMET/SIGMET, SUA, TFR, and other factors to determine flights and flight windows for the day.
- A Chief Equipment Operator will monitor all restricted or Special Use Airspace, TFR, and AIRMET/SIGMET restrictions taking the appropriate actions with the Equipment Operator.
- All planned flight operations will be made publically available on the Aerialspecs, Inc. corporate web site with the exception of Municipal Police operations of extreme circumstance. The information published will include:
    - The date, time, and duration of the operations.
    - The geographical position of the operational area.
    - The type of equipment being used.
- There will be an Equipment Operator and Spotter for each UAV during flight operations.
- A Chief Equipment Operator, Equipment Operator, or Spotter may cancel or abort a flight at any time for any reason. The Equipment Operator and Spotter have the responsibility to abort the flight should the situation arise.
- All flight operations require a Chief Equipment Operator or Equipment Operator, and Spotter present per sUAS in operation.
- The Equipment Operator and Spotter will have in their possession the ability to communicate with aircraft in the area via Aviation Radio.
- A Mission briefing will be conducted to identify local hazards and plan of action to meet the objectives of the flight.
- A designated takeoff and landing point will be identified and clearly marked as a hazard with cones, flags, or some other obvious means. This point will also be set as the “return to home” point of the UAV.
- A pre-flight check will be conducted per the equipment manufacturer and any standards set forth by Aerialspecs, Inc.
- The Equipment Operator and Spotter will remain in constant communication during operations via voice or radio. In the event that communications between the Equipment Operator and Spotter are lost, flight operations shall cease with a controlled landing of the UAV until communications can be established.
- Should unauthorized personnel or a member of the general public enter the operational area, either on land, sea, or in the air during sUAS operations, flight operations shall cease with a safe, controlled landing of the UAV until the hazard has cleared.
    - All other air traffic in or near the operational area will have the right of way and appropriate action will be taken by the Equipment Operator to avoid the traffic.
- sUAS operations hereunder will comply with FAA §91.155 Basic VFR weather minimums[7] for daytime operations for Class G airspace and follow typical “see and avoid” standards during operations.
- No sUAS will be flown in weather conditions that exceed FAA §91.155 Basic VFR weather minimums[7] for daytime operations for Class G airspace or the operational envelope set forth by the equipment manufacture.
- Flight operations will cease with a safe, controlled landing of the UAV at the designated landing point when battery onboard the UAV reaches 15% of its capacity.
- The Equipment Operator and Spotter will conduct a Mission Debriefing when flight operations have been completed to document and share any learnings during the flight.

- The Equipment Operator will log the flight when operations have been completed.

For detailed information on the process see Appendix A. General Flight Process below. Figure 1.1 depicts the area of operations in Class B, C, or D airspace with floor of SFC neear a Class A airport.

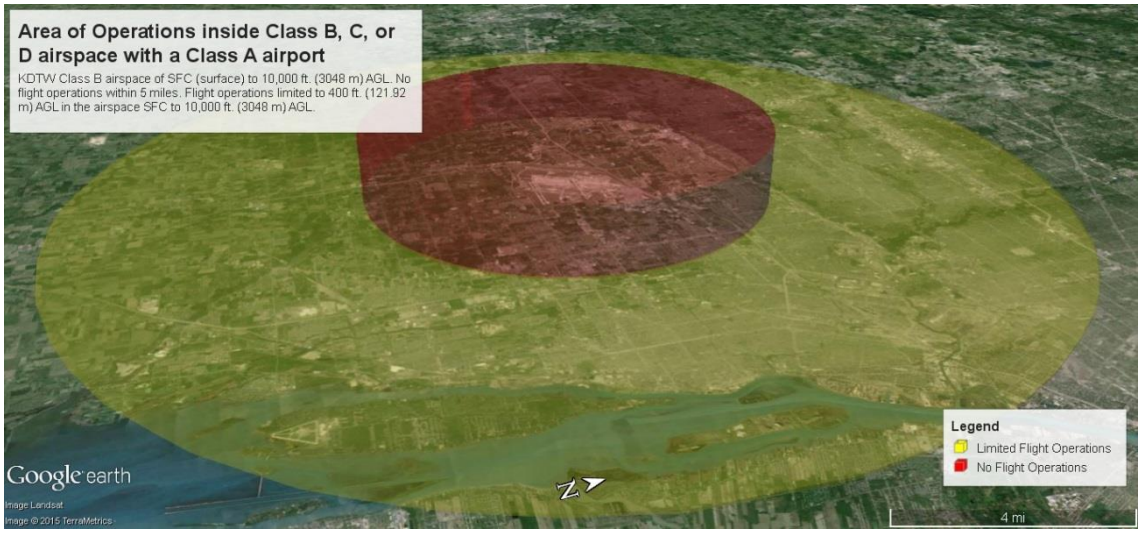


Fig. 1.1 *Example area of operations inside Class B, C, or D airspace with a Class A airport. No flight operations are permitted within 5 nautical miles. Flight operations within the 12 nautical mile Class B airspace SFC to 10,000 ft. (3048 m) AGL will be restricted to maximum altitude of 400 ft. (121.92 m) AGL.*

Fly-off Procedures

In the unlikely event of loss of control or communications with a UAV resulting in un-commanded flight outside the operational area where all other attempts to abort the flight have failed, the following procedures will be followed:

- The Equipment Operator will immediately contact the ATC responsible for the airspace the operations are in to notify them of the hazard. The Equipment Operator will provide ATC with the following information:
  - Last known position of the UAV.
  - The last known situation: altitude AGL, ground speed, and heading.
  - The operational weight of the UAV.
  - The estimated flight time remaining.
  - Any defining characteristics of the UAV to help in locating and identifying the vehicle in flight.
- The Equipment Operator will contact the Chief Equipment Operator to log the incident.
- The Equipment Operator will provide periodic updates the ATC responsible for the airspace providing information, if telemetry is available, until UAV is recovered or the estimated flight time remaining has expired.
- The Equipment Operator will contact the ATC responsible for the airspace once the UAV is recovered or the estimated flight time remaining has expired to inform them the hazard no longer exists.
- The Equipment Operator will contact the Chief Equipment Operator once the UAV is recovered, or the estimated flight time remaining has expired, to close the incident.

- The FSDO will be notified of the incident.
- A safety incident will be logged with Aerialspecs, Inc. with a follow-up investigation in an attempt to learn from the incident.

For detailed information on the process see Appendix B, Fly-Off Process below. Similar to the General Operating Standards above, these procedures are not all inclusive and will likely change as Aerialspecs, Inc. matures this capability.

Flight Standards District Offices Notification

Aerialspecs, Inc. will report weekly to the FSDO the planned flights for the coming business week in electronic document format. This document will include the following information:

- Date, time, and duration of the mission.
- Location of the operations.
- Operational area.
- Nature or objective of the mission.
- Planned equipment to be used.
- How to contact the Equipment Operator and Spotter for the mission.

Aerialspecs, Inc. will also create a special webpage on its corporate website specifically for the FSDO containing the information above and allowing for additional comments or request. Ad-hoc or emergency services will be reported to the FSDO within one business week. Any fly-off, aerial operational area incursion, or crash will be reported to the FSDO in accordance to current guidelines.

The company is currently focusing on business operations in the State of Michigan. The Michigan FSDO locations are:

East Michigan
8800 Beck Road-Eastside, Belleville, Michigan, 48111
Phone: (734) 487-7222
Fax: (734) 487-7221

Grand Rapids
3196 Kraft Avenue Southeast, Grand Rapids, Michigan, 49512
Phone: (616) 954-6657
Fax: (616) 940-3140

Aerialspecs, Inc. will establish a relationship with the FSDO East Michigan and Grand Rapids offices following the approval of this Petition for Exemption.

Equipment Specification

Aerialspecs, Inc. will limit operations of a UAV hereunder to light weight, battery operated configuration with following minimum specifications:

- Fixed wing or multi-rotor craft
- Maximum operational Weight 24.9476 kg (55 lbs.) including payload.
- Maximum ground speeds of 25 m/s (56 mph).
- Battery operated with no more than 60 minutes of minutes of flight time on a single charge.
- “Return to Home” capability.

- A flight controller leveraging any combination of the following: GPS, IMU, altimeter, computer vision, magnetic compass, or ultrasonic ranging and stabilization.
- Remotely operated in the public 2.4 GHz, 5.8 GHz, or 900 MHz FCC Part 15 bands as well as non-C2 information from the cellular bands in the GSM, CDMA, and LTE spectrums depending on carrier or service availability.
- External GPS tracker with cellular transmitter in the GSM, CDMA, and LTE spectrums, depending on carrier or service availability, to send periodic location updates.

MAINTENANCE AND REPAIR

Aerialspecs, Inc. will keep a maintenance log of all sUAS operated hereunder and make available this log to the FAA or NTSB upon written request. This log will include:

- The uniquely identifiable sUAS requiring maintenance or repair.
- The date and time of the maintenance or repair.
- The nature of the maintenance or repair.
- The motivation for the maintenance or repair.
    - Equipment Failure.
    - Crash.
    - Manufacturer recall or request.
    - Chief Equipment Operator, Equipment Operator, or Spotter service request.
    - Mandate by a regulating body at the Federal, state, or local level.
- The company, organization, and/or individual who performed the maintenance or repair.
- The actions taken to validate the maintenance or repair was complete and successful and the equipment is in operational order as defined by the equipment manufacturer.

Aerialspecs, Inc. will minimally follow the maintenance and repair recommendations set forth by the sUAS equipment manufacturer.

Specific Use Cases

Below are the specific use cases Aerialspecs, Inc. is intending to operate under. Each use case describes how the sUAS will be used as well as the operational area, and any additional safety measures unique to the use case. In the event that a specific use cases operational area conflicts with the constraints defined in the Operating Standards herein, those constraints defined in the Operating Standards will take precedence.

In the event the size of an operational area exceeds the range constraints defined in the Operational Standards herein the mission will be broken up into multiple sorties.

Wind Turbine Construction and Inspection

Using sensors, video and still image surveillance, a sUAS will be used to visually inspect the easements, tower, nacelle, blades, and hub in multiple EM spectrums for the purposes of routine inspection, damage verification, restoration planning, 3D site mapping, and flood and drainage monitoring of easements on privately owned farms.

Aerialspecs, Inc. will also experiment with probes that can take measurements on engineering points on wind turbine blades. These measurements will typically be impedance measurement to validate that blade lightning arrester systems are in good operating condition.

Prior to turbine construction a sUAS will be used to fly the complete blade sweeping area of a planned turbine. Leveraging an attached strobe light, aerial and ground video, point clouds, and computer simulation, Aerialspecs, Inc. can ensure the visibility of a wind turbine to the property owners before committing to an agreement with the operator.

Operational Area

For inspection of an existing turbine the UAV will operate within a 600 ft. (182.88 m) horizontal radius of the wind turbine center with a maximum altitude of 400 ft. (1221.92 m) AGL. If the wind turbine is over 400 ft. (121.92 m) AGL, then the maximum altitude will be no more than 50 ft. (15.24 m) above the tip of the airfoil fully extended above the nacelle. In the State of Michigan, that is typically no more than 550 ft. (167.64 m) AGL as the majority of wind turbines are no more than 499 ft. (152.1 m) AGL. The UAV will also operate over the easements designated as access to the wind turbine. In such a case the UAV will not fly more 50 ft. (15.24 m) on either side from the center line of the easement and no more than 100 ft. (30.48 m) AGL in height. Figure 2.1 depicts the operational area for a wind turbine inspection.

Fig. 2.1 Operational area for wind turbine inspection.

During turbine construction planning, the operational area will be limited to the property it is planned to reside on and no more than 400 ft. (121.92 m) AGL. Figure 2.2 depicts the operational area for a proposed wind turbine.

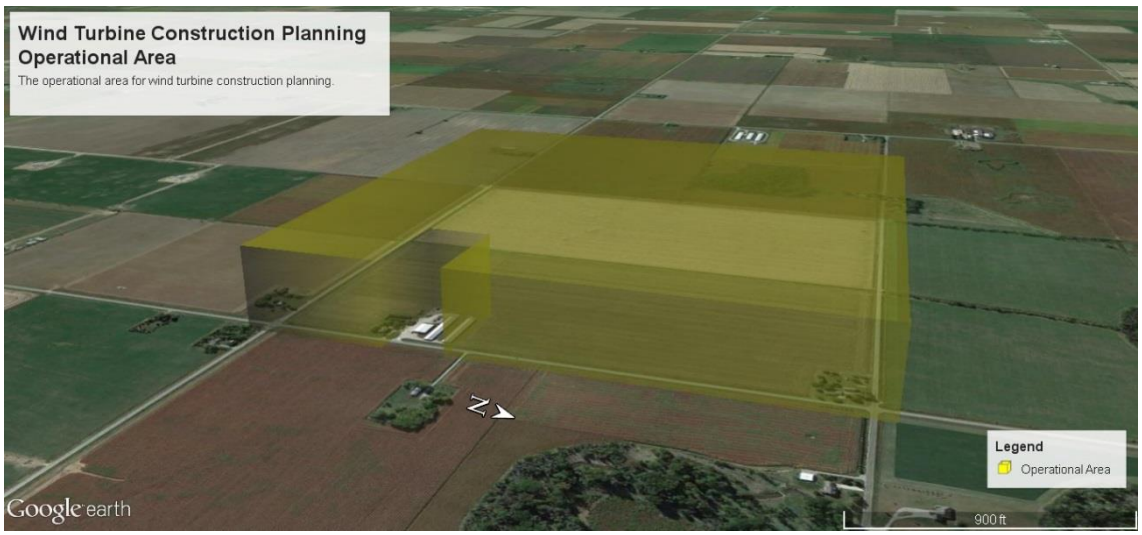


Fig. 2.2 Operational area for wind turbine construction planning.

In the case of validating the visibility of turbine prior to construction the UAV will operate within a 600 ft. (182.88 m) horizontal radius of the wind turbine center with a maximum altitude of 400 ft. (1221.92 m) AGL. If the wind turbine is over 400 ft. (121.92 m) AGL, then the maximum altitude will be no more than 50 ft. (15.24 m) above the tip of the airfoil fully extended above the nacelle. In the State of Michigan, that is typically no more than 550 ft. (167.64 m) AGL as the majority of wind turbines are no more than 499 ft. (152.1 m) AGL in height. Figure 2.3 depicts the operational area for validating the visibility of a wind turbine.

Fig. 2.3 Operational area for wind turbine visibility validation.

Additional Safety Measures

- The wind turbine must be shut down, in a locked configuration to prevent wing feathering, nacelle, or blade rotation, and tagged as "personnel on site" or other relevant protective tagging that would prevent the turbine or its operators from starting it up during sUAS operations.
- Under certain circumstances the nature of the fault may prevent the turbine from being completely passivated. In those situations operations may commence provided that:
    - The hub, blades, or nacelle are damaged in a manner that would likely prevent the blades rotation.
    - The tower has collapsed.
    - The nacelle is directed into the wind and the wings are feathered to minimize rotation.
    - The operator has physically secured the turbine on sight.
- No members of the general public will be permitted in the operational area during operations with appropriate signage on display.

Payload

- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.
- Environmental Monitoring Sensors including but not limited to radiological, biological, chemical, gas, noise, light, vibration, and range sensors.
- Impedance Measurement Probe
- Other sample probes requiring direct or indirect contact with structure or equipment.
- Strobe light.

Electric Generation, Transmission, Sub Transmission, and Distribution Facilities Inspection

Using sensors, video and still image surveillance a sUAS will be used to inspect transformers, insulators, switches, breakers, fuses, lines, enclosures, towers, poles and any other supporting equipment at substations and generating facilities.

In addition, sUAS will be used to inspect high voltage transformers, insulators, switches, breakers, fuses, lines, enclosures, towers, poles and any other supporting equipment. A sUAS will also be used to generate 3D maps and validate construction of new equipment.

Using sensors, video and still image surveillance a sUAS will be used to document and provide live video feeds to utilities to validate issues, assess damage to transformers, insulators, switches, breakers, fuses, lines, enclosures, towers, poles and any other supporting equipment, and generate 3D maps to plan repairs after large storms or other incident severely impacting the distribution grid.

Operational Area

The operational area for substations and generation facilities is no more than 100 ft. (30.48 m) horizontally from the building or structures property line and a maximum altitude of 400 ft. (121.92 m) AGL. If the substation or generating facility has equipment over 400 ft. (121.92 m) AGL then the operational area will be a maximum altitude of 50 ft. (15.24 m) above the tallest part of the substation or generation facility and 100 ft. (30.48 m) horizontally from the building or structure down to 400 ft. (121.92 m) AGL. Below 400 ft. (121.92 m) AGL, the horizontal operational area will then extend to 100 ft. (30.48 m) from the building or structures property line. Figure 3.1 depicts the operational area for a substation or generation facility.

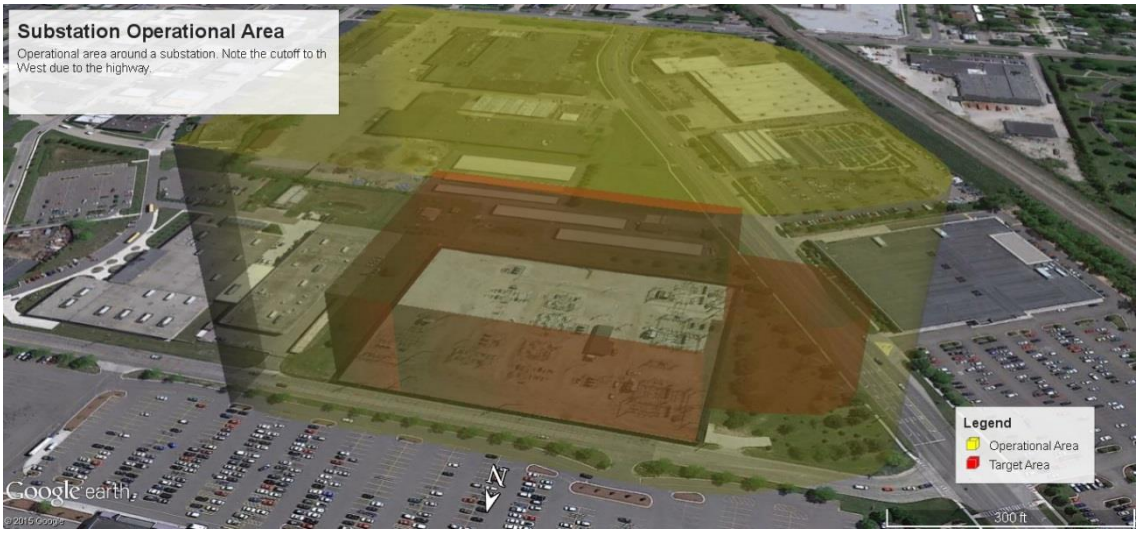


Fig. 3.1 *Operational area for transmission and sub transmission Towers.*

The operational area for transmission, sub transmission, and tie lines will be 100 ft. (30.48 m) from the utility easement and a maximum altitude of 400 ft. (1221.92 m) AGL.

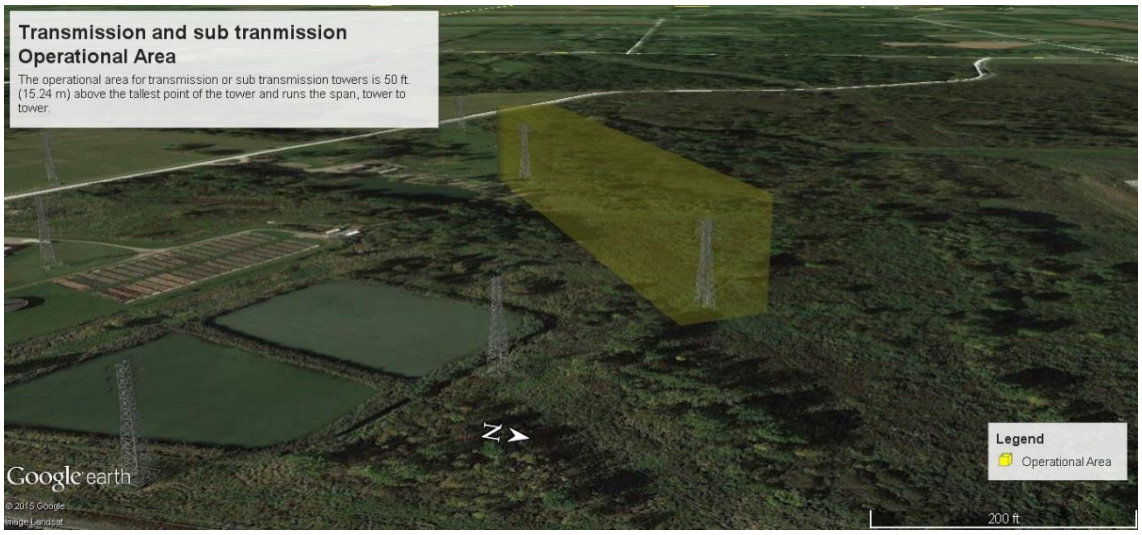


Fig. 3.2 *Operational area for transmission and sub transmission Towers.*

For distribution assets, the operational area will be localized to job sites or incident areas with due diligence of focusing on the utility easement defined with a maximum altitude of 400 ft. (121.92 m) AGL. Figure 3.3 depicts the operational area of operations on the distribution grid.

Fig. 3.3 Operational area for the distribution grid. In most cases on residential property.

Additional Safety Measures

- sUAS will be tested at a utility training facilities to validate safe operations near energized equipment.
- A representative will be present during any utility operations inside the property of a substation or generation facility.
- Employees will be trained in the health and safety hazards of electrical equipment and power lines.

Payload

- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.
- Environmental Monitoring Sensors including but not limited to radiological, biological, chemical, gas, noise, light, vibration, and range sensors.

Building, Bridge, Structure or Span Inspection

Using video and still image surveillance, a sUAS will be used to visually inspect commercial, industrial, or residential buildings, church spires, bridges, structures, or spans and their supporting equipment for routine inspection, damage assessment, 3D site mapping, or construction or repair verification. This inspection may include, but not limited to, piping, ductwork, conduit, cabling, expansion joints, smoke stacks or chimneys, storage containers, boilers, pressure vessels, and other equipment for industrial purposes may be inspected as well. In the case of smoke stacks or chimneys, a UAV may be used to mount and retrieve inspection rigs for internal inspection.

A UAV equipped with a rudimentary de-nesting rod may be used on industrial equipment that requires the area to be free of debris such as pressure relief values, inspection ports, intake or exhaust ports, or transceiver equipment.

Operational Area

In the case of buildings or structure the operational area is no more than 100 ft. (30.48 m) horizontally from the building or structures property line and a maximum altitude of 400 ft. (121.92 m) AGL. If the building or structure is over 400 ft. (121.92 m) AGL then the operational area will be a maximum altitude of 50 ft. (15.24 m) above the tallest part of the building or structure and 100 ft. (30.48 m) horizontally from the building or structure down to 400 ft. (121.92 m) AGL. Below 400 ft. (121.92 m) AGL, the horizontal operational area will then extend to 100 ft. (30.48 m) from the building or structures property line. Figure 4.1 depicts the operational area around a large building above 400 ft. (121.92 m) AGL. Figure 4.2 depicts the operational area around a structure below 400 ft. (121.92 m) AGL.

Fig. 4.1 *Operational area around a building taller than 400 ft. (*121.92 m*) AGL. Note the area around the perimeter of the property only extends to 400 ft. (121.92 m) AGL. Also note the North side of the operational area does not extend over the highway.*

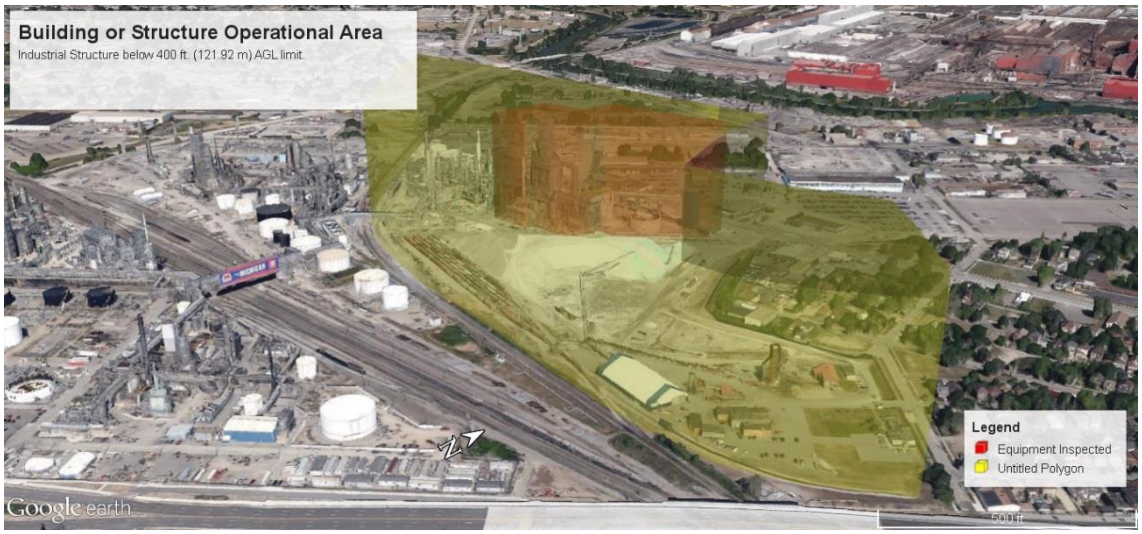


Fig. 4.2 *Operational area around a structure below 400 ft. (121.92 m) AGL limit.*

The operational area for bridges or spans is no more than 100 ft. (30.48 m) horizontally from the span or bridges property or outer most structure, where appropriate and a maximum altitude of 400 ft. (121.92 m) AGL. If the bridge or span is above 400 ft. (121.92 m) AGL then the maximum altitude is 50 ft. (15.24 m) above the tallest part of the bridge or span. The area underneath the bridge to the ground or water level will be considered the operational area as well. For bridges carrying vehicle traffic, no UAV will be flown over the roadway except around tower sections. Figure 4.3 depicts the operational area around a bridge or span.

The operational area around the tower section of a bridge or span when over roadways is no more than 50 ft. (15.24 m) horizontally from the tower section, a minimum altitude of 50 ft. (15.24 m) above the roadway, and a maximum altitude of 400 ft. (121.92 m) AGL. If the tower section of a bridge or span is above 400 ft. (121.92 m) AGL, including the 50 ft. (15.24 m) buffer, then the maximum altitude is 50 ft. (15.24 m) above the tallest part of the bridge or span.

Fig. 4.3 *Operational area around a bridge or span, minus the towers. Note no area over roadway.*

Additional Safety Measures

- No sUAS will operate in an explosive atmosphere environment.
- No bridge, span, or structure that crosses over a roadway designated as a Highway by the Federal or State government the roadway is in will be inspected unless the highway has been closed in the operational area.
- The EM spectrum of antennas, buildings, bridges, structures, or spans containing transmitting equipment will be evaluated for interference of the C2 systems of the sUAS and vice versa.
- Equipment with intake or exhaust ports, or transmitters will be shut down before de-nesting operations will occur.
- Equipment tied to smoke stacks or chimneys to be inspected will be shut down before internal inspections occur.
- Due to the nature of visibility in major metropolitan areas special handling of heliports will be taken. No sUAS operations in a major metropolitan area will occur within 1 statute mile (1.6 km) of a heliport without informing the owner of the heliports of the sUAS operations. This communication will include:
    - Date, time, and duration of the mission.
    - Location of the operations.
    - Operational area.
    - Planned equipment to be used.
    - How to contact the Equipment Operator and Spotter for the mission.
- Sidewalks, bike paths, and any other pedestrian pathways inside the operational area will have appropriate warning signs, rope, tape, or other signaling methods to cordon off the area.
- If a bridge or span can carry pedestrian traffic, the bridge or span must be closed to pedestrians.
- If a bridge or span is for vehicle traffic the UAV will not be flown over the roadway with the exception of the tower sections. It will be flown outside the guardrail, main cables, hangers, or underneath the roadway.
- Operations over roadways around bridge or span tower sections will not be conducted if wind gusts exceed 20 MPH (8.94 m/s).

Payload

- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.
- Environmental Monitoring Sensors including but not limited to radiological, biological, chemical, gas, noise, light, vibration, and range sensors.
- De-Nesting or debris removal probes for removing animal nests or other debris.
- Other sample probes requiring direct or indirect contact with structure or equipment.

Agriculture Inspection

Using video and still image surveillance, a sUAS will be used to gather visible, NIR, and IR photos of crops to establish crop health for farmers. Aerialspecs, Inc. may also experiment with using other sensors to evaluate air, water, and soil conditions of crops.

Operational Area

UAV operations will be limited to a no more than 100 ft. (30.48 m) horizontally from the property line with a maximum altitude of 400 ft. (121.92 m) AGL. Figure 5.1 depicts the operational area for agriculture inspection.

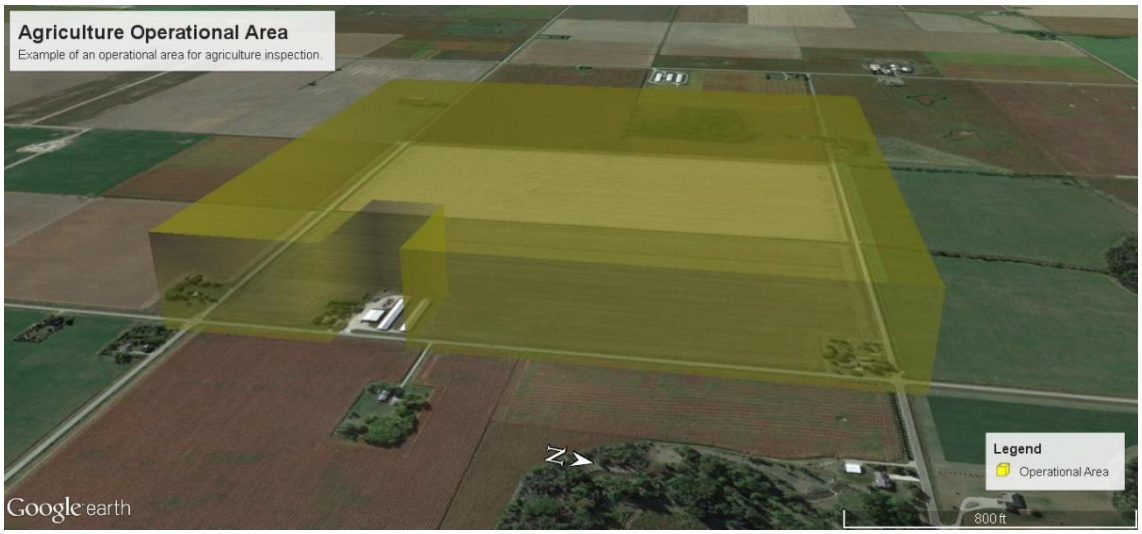


Fig. 5.1 *Operational area for agriculture inspection.*

Additional Safety Measures

- No farm equipment will be manned or operational in the operational area.

Payload

- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.

Industrial / Mining Environmental Inspection

Using video and still image surveillance, a sUAS will monitor stockpiles, ash piles, run-off, storage ponds, erosion, and document the environmental impact of those areas. 3D mapping will be leveraged to measure volume and traversal of the environment over time. Aerialspecs, Inc. will experiment with other sensors including radiological, biological, and chemical as well.

Operational Area

UAV operations will be limited to a no more than 100 ft. (30.48 m) horizontally from the property line with a maximum altitude of 400 ft. (121.92 m) AGL. Figure 6.1 and Figure 6.2 depict operational areas for environmental inspection. In the case of a quarry, pit, or hole, AGL will be measure from the base.

Fig. 6.1 *Operational area for environmental monitoring, in this case a stockpile.*

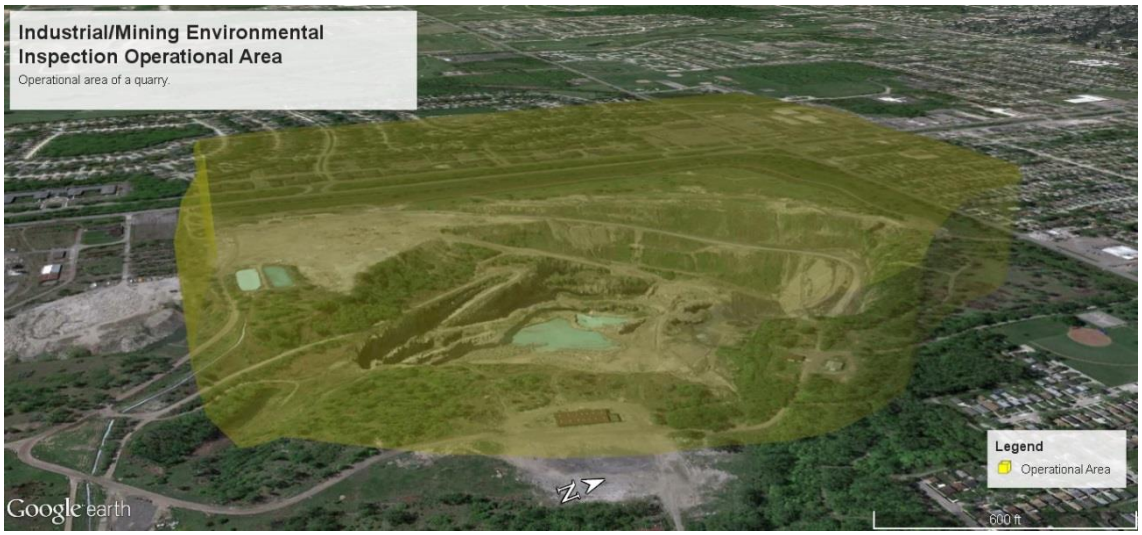


Fig. 6.2 *Operational area for environmental monitoring, in this case a quarry.*

Additional Safety Measures

- No sUAS will operate in an explosive atmosphere environment.

Payload

- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.
- Environmental Monitoring Sensors including but not limited to radiological, biological, chemical, gas, noise, light, vibration, and range sensors.
- De-Nesting or debris removal probes for removing animal nests or other debris.
- Other sample probes requiring direct or indirect contact with structure or equipment.

Municipal Police, Fire, and Search and Rescue

Using audio, video, and still image surveillance a sUAS will be used to provide live visual, audio, telemetry information to Police, Fire, Search and Rescue personnel during major incidents such as bomb threats, major vehicle accident involving hazardous materials, infrastructure or building collapse, flooding, mudslide, landslide, hostage situation, or any other incident that poses an immediate threat to the health, lives, or safety of the general public or emergency response personnel. When equipped, the sUAS may also be used to provide live audio via directional microphone or active laser listening device where allowed by law. Aerialspecs, Inc. will experiment with other sensors including radiological, biological, and chemical as well.

A sUAS will be used to generate point clouds for 3D mapping and monitoring of flood zones, rubble piles, or measuring spills.

Aerialspecs, Inc. will experiment with using a sUAS to tow a rescue rope or drop flotation devices to people during water or ice rescue.

Operational Area

The operational area will be defined by the Incident Commander handling the response. A typical operational area for a Police or Fire incident will be any suburban or metropolitan public, commercial, industrial, or residential property. In the case of buildings or structure the operational area is no more than 100 ft. (30.48 m) horizontally from the building or structures property line and a maximum altitude of 400 ft. (121.92 m) AGL. If the building or structure is over 400 ft. (121.92 m) AGL, including the 50 ft. (15.24 m) buffer, then the operational area will be a maximum altitude of 50 ft. (15.24 m) above the tallest part of the building or structure and 100 ft. (30.48 m) horizontally from the building or structure down to 400 ft. (121.92 m) AGL. Below 400 ft. (121.92 m) AGL, the horizontal operational area will then extend to 100 ft. (30.48 m) from the building or structures property line. For the safety of the Equipment Operator and Spotter the horizontal area may be extended to 1000 ft. (304.8 m) from the incident area. Figure 7.1 depicts the operational are for a Police or Fire incident. Figure 7.2 depicts the operational area for search and rescue.

Fig. 7.1 *Operational area for Police and Fire.*

Fig. 7.2 *Operational area for search and rescue.*

For broader operations such as damage assessment, impact analysis, or search and rescue the operational area will be defined by the Incident Commander handling the response with a maximum altitude of 400 ft. (121.92 m) AGL.

Over a highway, the operational area will be 1000 ft. (304.8 m) radius around the approximate center of the Incident area with a maximum altitude of 400 ft. (121.92 m) AGL. Per the Additional Safety Measures defined hereunder, a 300 foot (91.44 m) barrier or buffer must be established and the highway must be closed.

Fig. 7.3 *Operational area over highway. Due to the nature of hazardous or explosive cargo sometimes shipped over highways, an sUAS may have to enter anywhere from up to 1000 ft. (304.8 m) away for increased safety to the Equipment Operator and Spotter. Note the 300 ft. (91.44) barrier established in the Incident Area depicted in red.*

Additional Safety Measures

- No sUAS will operate in an explosive atmosphere environment.
- No operations will occur while any other police, fire, or search and rescue aerial vehicles are operating in response to the incident.

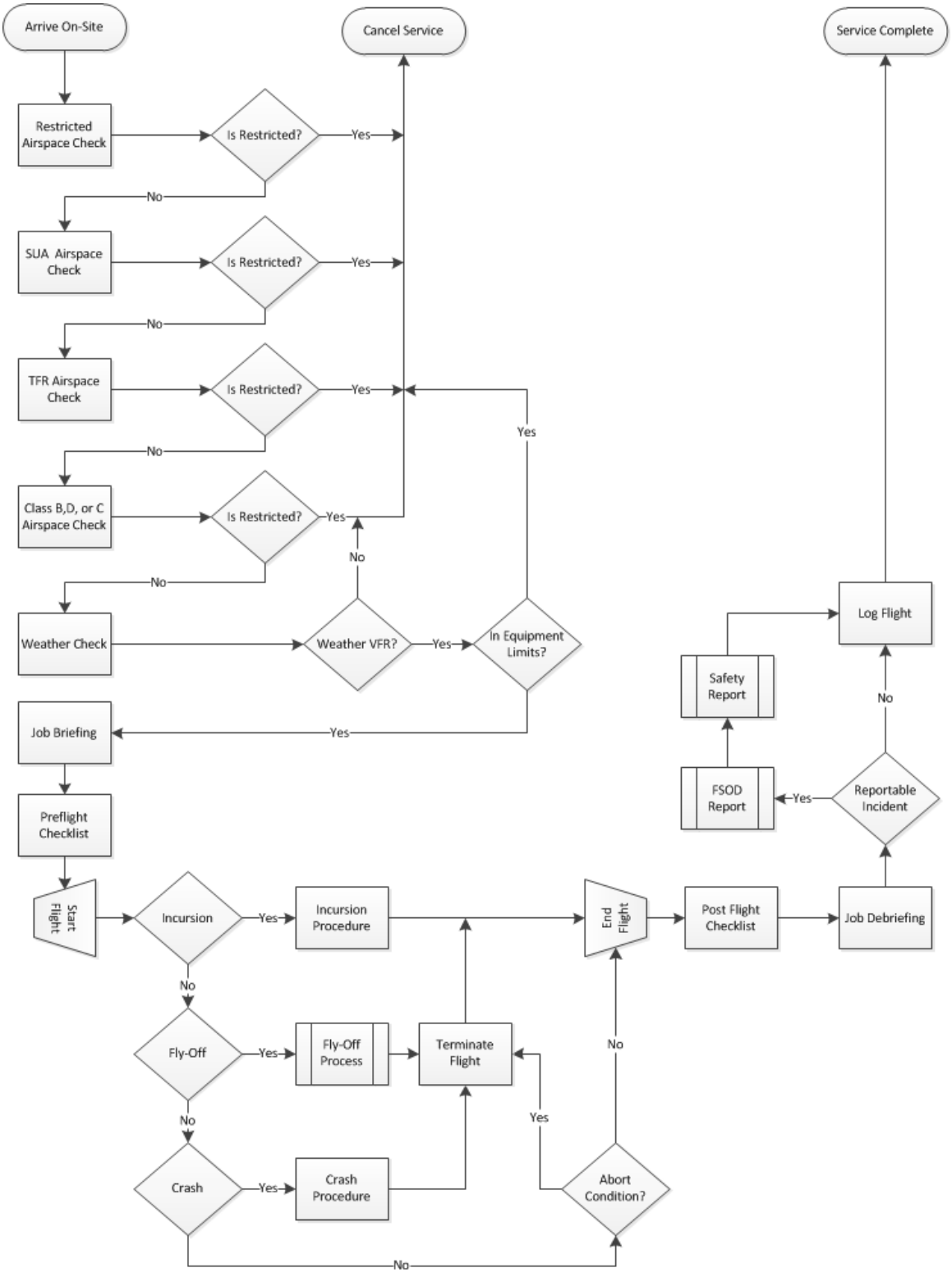
- The agency handling the response to the incident will designate the Incident Commander on scene as the liaison between the agency and the Equipment Operator and Spotter.
    - The Incident Commander will be responsible for obtaining the necessary warrants, permits, exemptions, authorizations, or licenses to operate sUAS for the situation.
    - The Incident Commander will have the same authority to abort or cancel a flight as the Equipment Operator and Spotter.
    - The Incident Commander must be in constant communication with the Equipment Operator and Spotter via voice or radio during Operations. In the event that communications between the Equipment Operator and Incident Commander are lost, flight operations shall cease with a controlled landing of the UAV until communications can be established.
- The Equipment Operator and Spotter will operate under the guidelines of the National Incident Management System as governed by the United States Department of Homeland Security.
- Personal protection equipment appropriate for the situation will be specified by the liaison and used by employees at all times during operations. Examples include respirators, flame retardant clothing, or ballistics vests.
- Due to the nature of visibility in major metropolitan areas special handling of heliports will be taken. No sUAS operations in a major metropolitan area will occur within 1 statute mile (1.6 km) of a heliport without informing the owner of the heliports of the sUAS operations. This communication will include:
    - Date, time, and duration of the mission.
    - Location of the operations.
    - Operational area.
    - Planned equipment to be used.
    - How to contact the Equipment Operator and Spotter for the mission.
- A UAV never be used to restrain, detain, subdue, or physically engage an individual. In the case of water or ice rescue, a UAV may be used to tow a lead line to, or drop a flotation device near an individual in a manner that minimizes the risk of contact with the individual.
- Every attempt will be made by the Equipment Operator to access the incident area with the UAV via easements or public property, avoiding flying over private property except in extreme cases.
- No sUAS operations will occur over any roadway designated a Highway by Federal or State Government the roadway is in unless the Highway has been closed at the point of the incident and a minimum 300 ft. (91.44 m) safety zone has been established around the incident.

PAYLOAD

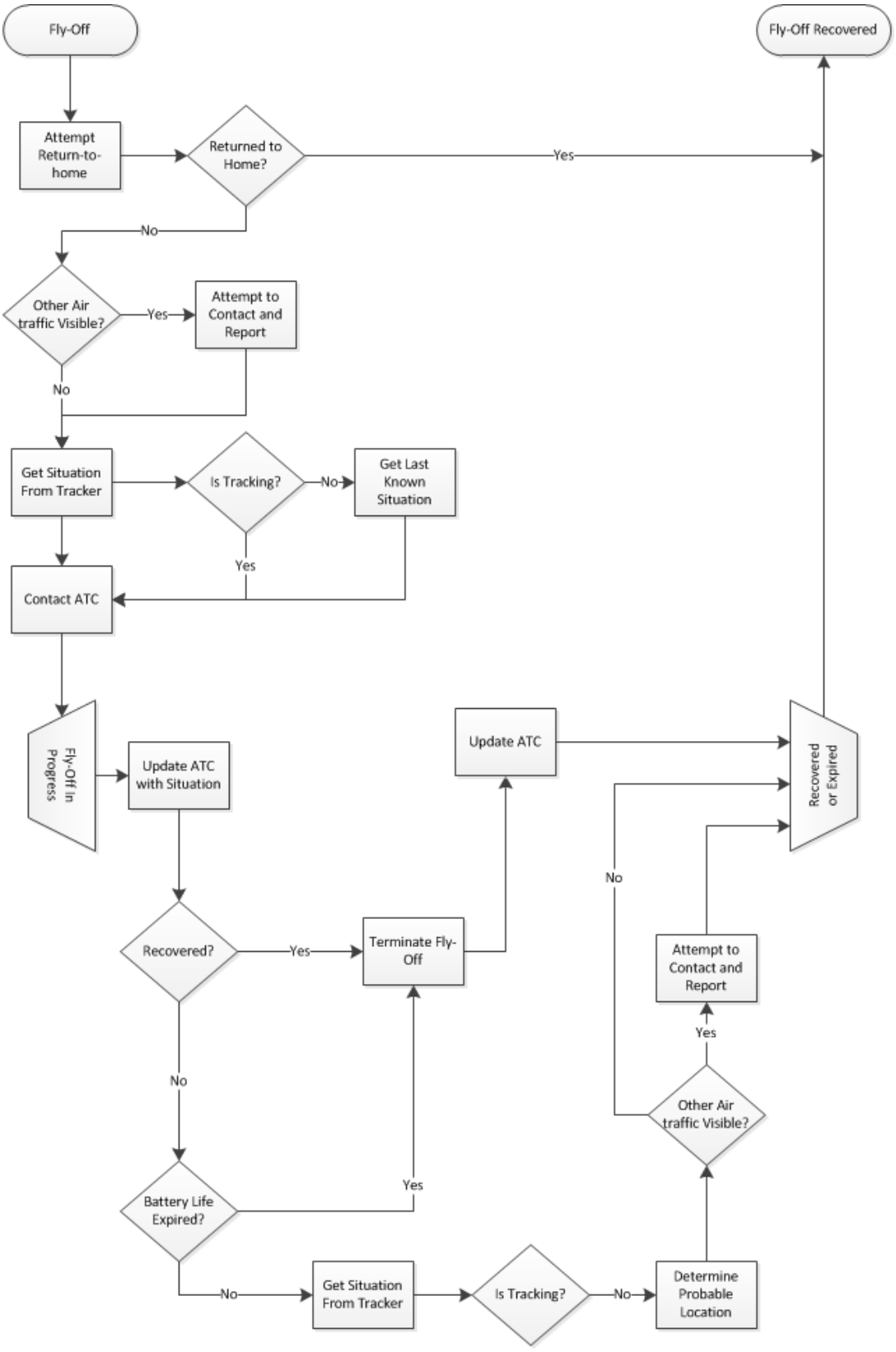
- Passive video and/or still imaging equipment in various electromagnetic spectrums including IR, NIR, visible light, terahertz, and UV.
- Environmental Monitoring Sensors including but not limited to radiological, biological, chemical, gas, noise, light, vibration, and range sensors.
- Active and/or passive listening devices (in accordance with local, State, and Federal laws).
- Rescue Lead lines or life preservers for search and rescue.
- Audio speaker, siren, or bull horn.

APPENDIX

A. GENERAL FLIGHT PROCESS



B. Fly-off Process



GLOSSARY OF TERMS

AGL

Above Ground Level: The altitude above ground level for any given location.

AIRMET

AIRman's METeorological Information: An AIRMET is a weather advisory issued by the NOAA that advises of weather that maybe hazardous, other than convective activity, to single engine, other light aircraft, and Visual Flight Rule (VFR) pilots.

ATC

A service provided by ground-based controllers who direct aircraft on the ground and through controlled airspace, and can provide advisory services to aircraft in non-controlled airspace.[9]

C2

Command and Control: Telemetry used to control the vehicle including manual commands from the controller.

EM

Electromagnetic Radiation: radiation consisting of electromagnetic waves, including radio waves, infrared, visible light, ultraviolet, x-rays, and gamma rays.[15]

FLY-OFF

The un-commanded flight of an UAV due to interference or malfunction that typically resulting in loss of the vehicle.

FSDO

Flight Standards District Office: pronounced FIZ-doe, is a regional office of the United States Federal Aviation Administration.[14]

GPS

Global Positioning System: A device used to determine geographic position I latitude, longitude and altitude above sea level.

IMU

Inertial Measurement Unit: Sometimes referred to as a solid state gyro, an IMU determines position and orientation or an object through a technique known as dead reckoning by detecting the gravitational force, or G, on a particular axis.

IR

Infrared: is invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers (frequency 430 THz) to 1 mm (300 GHz).[10]

NIR

Near Infrared: Infrared region of the electromagnetic spectrum (from about 800 nm to 2500 nm).[11]

NTSB

National Transportation and Safety Board: The independent Federal Agency Charged with determining the probable cause of transportation accidents and promoting transportation safety, and assisting victims of transportation accidents and their families.

SFC

Surface or Ground Level.

SIGMET

SIGnificant METeorological Information: A SIGMET is a weather advisory issued by the NOAA that contains meteorological information concerning the safety of all aircraft.

sUAS

Small Unmanned Aircraft System: A UAV and all its supporting systems for operations. Usually includes the remote controller and ground stations used for communication, imagery, and telemetry.

TFR

Temporary Flight Restriction: The pertinent sections of the FAR (14 CFR Sections 91.137, 91.138, 91.139, 91.141, 91.143, 91.145, 99.7) describe temporary flight restrictions. A TFR is a geographically-limited, short-term, airspace restriction, typically in the United States. Temporary flight restrictions often encompass major sporting events, natural disaster areas, air shows, space launches, and Presidential movements.[8]

UAV

Unmanned Aerial Vehicle: An unmanned, remotely operated, aerial vehicle in a fixed wing or multiple rotor copter configuration.

UV

Ultraviolet: Ultraviolet (UV) light is electromagnetic radiation with a wavelength from 400 nm to 10 nm, shorter than that of visible light but longer than X-rays.[12]

VFR

Visual Flight Rules: A set of regulations which allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

REFERENCES

1. FAA Advisory Circular AC 91-57, Model Aircraft Operating Standards
   http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/1acfc3f689769a56862569e70077c9cc/$FILE/ATTBJMAC/ac91-57.pdf
2. Exemptions relating to 14 CFR §45.23 (b): Marking of the Aircraft
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=15968&ExemptNo=10700
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=15071&ExemptNo=10167
3. Exemptions relating to 14 CFR §91.9 (b) (2):
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=12862&ExemptNo=8607
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=13111&ExemptNo=8737
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=13119&ExemptNo=8738
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9299
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9565
   http://aes.faa.gov/Form/Doc.asp?SelExemptID=15071&ExemptNo=10167
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10602
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10700
4. Exemptions relating to 14 CFR §91.109: Flight Instruction
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=5778K
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9862A
5. Exemptions relating to 14 CFR §91.151: Fuel requirements for flight in VFR conditions
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10673
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=2689F
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=5745
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10673
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10808
6. Exemptions relating to 14 CFR §91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9565
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9665
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9789
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9797
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=9816A
   http://aes.faa.gov/AES.NET/GetPDFDocument.aspx?ExemptNo=10700
7. FAA Code of Federal Regulations, Part 91 General Operating and Flight Rules, Subpart B - Flight Rules, Sec. 91.155 Basic VFR weather minimums:
   http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgFAR.nsf/0/074608a2fa18b48a86256eeb006704ef!OpenDocument
8. TFR Definition
   http://en.wikipedia.org/wiki/Federal_Aviation_Regulations#Temporary_flight_restrictions
9. ATC Definition
   http://en.wikipedia.org/wiki/Air_traffic_control
10. Infrared Definition
    http://en.wikipedia.org/wiki/Infrared
11. Near Infrared Definition
    http://en.wikipedia.org/wiki/Near-infrared_spectroscopy
12. Ultraviolet Definition
    http://en.wikipedia.org/wiki/Ultraviolet
13. Universal™ Aviation Background Check
    http://www.universalbackground.com/solutions/aviation.asp
14. FSDO Definition
    http://en.wikipedia.org/wiki/Flight_Standards_District_Office

15. EM Definition
    http://dictionary.reference.com/browse/electromagnetic+radiation