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

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

May 5, 2015

Exemption No. 11467
Regulatory Docket No. FAA–2015–0261

Mr. Jeffrey J. Antonelli
Attorney
Antonelli Law
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Chicago, IL 60602

Dear Mr. Antonelli:

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.

The Basis for Our Decision

By letter dated January 29, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Aerial Inspection Resources, Inc. (hereinafter petitioner or operator) for an exemption. The exemption would allow the petitioner to operate an unmanned aircraft system (UAS) to conduct examination and monitoring of power lines, pipelines and related utility structures.

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

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

Airworthiness Certification

The UAS proposed by the petitioner is a DJI Spreading Wings S1000.

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

The Basis for Our Decision

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

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

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

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Aerial Inspection Resources LLC is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and

91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

In this grant of exemption, Aerial Inspection Resources, 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 DJI Spreading Wings S1000 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 April, 30, 2017, unless sooner superseded or rescinded.

Sincerely,

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

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U.S. Department of Transportation
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January 29, 2015

Re: Request for Exemption under Section 333 of the FAA Modernization and Reform Act of 2012 and Part 11 of the Federal Aviation Regulations from 14 C.F.R 21(h); 14 C.F.R. 43.7; 14 C.F.R. 43.11; 14 C.F.R. 45.11; 14 C.F.R. 45.27; 14 C.F.R. 45.29; 14 C.F.R. 91.7(a); 14 C.F.R. 91.9(b)(2); 14 C.F.R. 91.9(c); 14 C.F.R. 91.103(b)(2); 14 C.F.R. 91.105; 14 C.F.R. 91.109; 14 C.F.R. 91.113(b); 14 C.F.R. 91.119(b) and (c); 14 C.F.R. 91.121; 14 C.F.R. 91.151; 14 C.F.R. 91.203(a) and (b); 14 C.F.R. 215; 14 C.F.R. 91.403; 14 C.F.R. 91.405; 14 C.F.R. 91.407; 14 C.F.R. 409; and 14 C.F.R. 91.417.

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the Reform Act) and 14 C.F.R. Part 11, Antonelli Law on behalf of Aerial Inspection Resources LLC ("AIR"), an operator of Small Unmanned Aircraft Systems ("sUAS") equipped to conduct aerial inspection of utility infrastructure, 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. The intended sUAS operations contemplated by this petition are in the public interest because they clearly satisfy the "Four D's" of exemplary uses of UAS: to replace work that is Dangerous, Difficult, Dull, or Dirty, and at the same time provide an equivalent or greater level of safety than alternative manned aircraft operations.

Approval of exemptions for AIR will allow commercial operations of the DJI S1000 to examine and monitor power lines, pipelines, and structures in Class G airspace nationwide. The requested exemption should be granted because operation of small UASs, weighing approximately 24.25 lbs. (11 kg.), inclusive of battery and payload, conducted in the strict conditions outlined below, will provide an equivalent level of safety, as Congress intended, while still allowing commercial operations. The lightweight aircraft covered by the exemption are far safer than conventional operations conducted with helicopters and fixed-wing aircraft weighing thousands of pounds and carrying highly flammable fuel, and operating in close proximity to the ground, power lines, transmission towers, pipelines, and people. The seven factors Congress directed the FAA to consider when approving Section 333 exemption petitions - size, weight, speed, operational capability, proximity to airports, proximity to populated areas, and operation within visual line of sight – each support the request. In particular, the aircraft are small, and will operate at slow

speeds, and close to the ground in order to more safely and efficiently conduct inspections that would otherwise involve a risk of death to the inspectors. The substantial increase of safety and decrease of risk to human life, coupled with the low risk use of sUASs to conduct these inspections, weighs heavily in favor of granting the exemption.

Pursuant to 14 C.F.R. 11.35, AIR requests confidential treatment for certain information provided with this request for exemption. Specifically, AIR is submitting its proprietary user manual and training syllabus under separate cover as Exhibits 19 and 20. It requests that the information contained in those exhibits not be made public because they are trade secrets whose disclosure would harm AIR. They are valuable commercial data this is not publically available and are protected from release under the Freedom of Information Act 5 U.S.C. 552(b)(4).

For your ease in reviewing this petition, please refer to the table of contents which begins on page 3. If we can provide any additional information to assist your understanding or review of this document, please do not hesitate to contact us at 312-201-8310 or via email at Jeffrey@Antonelli-Law.com.

Thank you,

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Exhibit 9: Futaba 8FG User Manual ..... Submitted Separately

Exhibit 10: Astraeus Aerial, Docket No. FAA-2014-0352, Grant of Exemption (Sept. 29, 2014) ..... .42

Exhibit 11: Brian Hernandez, *3 Killed in Crash When Helicopter Hits Power Lines Near Silt in Western Colorado*, ABC7 NEWS DENVER Jan. 27, 2014, http://www.thedenverchannel.com/news/local-news/3-killed-in-helicopter-crash-near-silt01272014 70

Exhibit 12: *Power-line-inspection Copter Crashes in Alabama; 2 Killed*, COLUMBUS DISPATCH, Aug. 20, 2014, http://www.dispatch.com/content/stories/national_world/2014/08/20/power-line-inspection-copter-crashes-2-killed.html 73

Exhibit 13: Sabra Stafford, *Turlock Man Killed in Power Line Accident*, TURLOCK JOURNAL (Texas), Aug. 8, 2013, http://www.turlockjournal.com/archives/21204/ 74

Exhibit 14: A. Pagnano, M. Hopf & R. Teti, *A Roadmap for Automated Power Line Inspection. Maintenancce and Repair*, 8th CIRP Conference on Intelligent Computation in Manufacturing Engineering, 12 Procedia CIRP 234-9 (2013)..... 75

Exhibit 15: U.S. Department of Transportation Pipeline nad Hazardous Materials Safety Administration "Pipeline Incident 20 Year Trends," http://www.phmsa.dog.gov/pipeline/library/datastatistics/pipelineincidenttrends 81

Exhibit 16: Montana City Gets OK to Drink Water After Oil Spill in River, DAILY MAIL.COM, Jan. 23, 2015, http://www.dailymail.co.uk/wires/ap/article-2921204/Montana-oil-spill-renews-worry-safety-old-pipelines.html 85

Exhibit 17: North Dakota: Pipeline Rupture Spills 3 Million Gallons of Saltwater, N.Y. TIMES, Jan. 22, 2015, http://nyti.ms.1JfsgEx 94

Exhibit 18: Memorandum from Mark W. Bury, Assistant Chief Counsel for Int'l Law, Legislation and Regulations, Fed. Aviation Admin., to John Duncan, Dir., Flight Standards Serv. (Aug. 8, 2014) 95

Exhibit 19: AIR UAS Operations Manual ..... Submitted to the FAA Confidentially

Exhibit 20: AIR UAS Training Program Syllabus ..... Submitted to the FAA Confidentially

Exhibits 19 and 20 have been submitted confidentially and are not available to the public.

I. Publishable Summary

Pursuant to 14 C.F.R. Part 11, the following summary is provided for publication in the Federal Register, should it be determined that publication is needed:

Applicant seeks an exemption from the following rules:

14 C.F.R 21(h); 14 C.F.R. 43.7; 14 C.F.R. 43.11; 14 C.F.R. 45.11; 14 C.F.R. 45.27; 14 C.F.R. 45.29; 14 C.F.R. 91.7(a); 14 C.F.R. 91.9(b)(2); 14 C.F.R. 91.9(c); 14 C.F.R. 91.103(b)(2); 14 C.F.R. 91.105; 14 C.F.R. 91.109; 14 C.F.R. 91.113(b); 14 C.F.R. 91.119(b) and (c); 14 C.F.R. 91.121; 14 C.F.R. 91.151; 14 C.F.R. 91.203(a) and (b); 14 C.F.R. 215; 14 C.F.R. 91.403; 14 C.F.R. 91.405; 14 C.F.R. 91.407; 14 C.F.R. 409; and 14 C.F.R. 91.417 to operate commercially a small unmanned aircraft system (sUAS) (25lbs or less).

Approval of exemptions for AIR will allow commercial operations of the DJI S1000 to examine and monitor power lines, pipelines, and are related utility structures in Class G airspace nationwide. The sUAS will collect high resolution still photographs, as well as infrared and ultraviolet spectral images, including a light weight Lidar system to collect "point cloud" data of these elements. AIR will use the Lidar system to create accurate surface elevation models and digital elevation models. The requested exemption should be granted because operation of small UASs, weighing approximately 24.25 lbs. (11 kg.), inclusive of battery and payload, conducted in the strict conditions outlined below, will provide an equivalent level of safety, as Congress intended, while still allowing commercial operations. The lightweight aircraft covered by the exemption are far safer than conventional operations conducted with helicopters and fixed-wing aircraft weighing thousands of pounds and carrying highly flammable fuel, and operating in close proximity to the ground, power lines, transmission towers, pipelines, and people. The seven factors Congress directed the FAA to consider when approving Section 333 exemption petitions - size, weight, speed, operational capability, proximity to airports, proximity to populated areas, and operation within visual line of sight – each support the request. In particular, the aircraft are small, and will operate at slow speeds, and close to the ground in order to more safely and efficiently conduct inspections that would otherwise involve a risk of death to the inspectors. The substantial increase of safety and decrease of risk to human life, coupled with the low risk use of sUASs to conduct these inspections, weighs heavily in favor of granting the exemption.

II. Petitioner's Contact Information

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III. Aerial Inspection Resources LLC's Operations

A. The sUAS

The requested exemption will permit AIR to operate the DJI S1000, with a maximum weight of approximately 24.25 lbs. (11 kg), inclusive of batteries and technical payload. This rotorcraft operates at a speed of no more than 20 knots and has the capability to hover and move in the vertical and horizontal planes simultaneously.

The sUAS will have the following specifications or equivalent:

Airframe: DJI S1000
Control System: A2, which includes the Main Controller (MC), Internal Measurement Unit (IMU) with a built-in internal sensor, barometric altimeter (which measures attitude and altitude), compass, GPS, and radio receiver (Rx).
Tx: Futaba 8FG
Rx: Internal in A2
Motors: DJI 4114-11
Propellers: DJI-Innovations Composite folding blades with 15" diameter and 5.2" fixed propeller pitch
Data Link: DJI 2.4 Ghz Data Link
Video Link: DJI 5.8 Ghz
OSD: iOSD Mark II, which allows live telemetry to be displayed to the visual observer, including the battery level and altitude
Gimbal: Zenmuse
Batteries: Lithium Polymer batteries with capacity of 8,000-42,000 mah

Please refer to Exhibits 1-9 for further information about the DJI S1000 and A2 control system and the Futaba 8FG transmitter.

B. Flight Conditions

The sUAS will be flown in Class G airspace under 400 feet above ground level ("AGL") and under controlled conditions over property that is restricted as laid out in Exhibit 19, Section 4.4. The sUAS will be used to monitor pipelines, power lines, and condition of transmission towers nationwide. AIR's work will be monitored by their utility clients. AIR will work with local FSDO when planning operations. AIR will only operate its sUAS in visual meteorological conditions (VMC): no less than 500 feet below and no less than 2,000 feet horizontally from a cloud or when visibility is at least 3 statute miles from the PIC. The flight crew will always make a safety assessment of the risk of every operation, and will only operate when it is determined that no undue hazards are present.

Please refer to the following sections of Exhibit 19 for more information about the flight conditions:

4.24: Weather Limits

10.4: Personnel Responsibilities for Deployments
11.2: Weather

C. Flight Operations

The purpose of every sUAS flight will be to safely, accurately, and efficiently aerially inspect assets such as pipelines, power lines, and transmission towers. The sUAS will collect high resolution still photographs, as well as infrared and ultraviolet spectral images, including a light weight Lidar system to collect "point cloud" data of these elements. AIR will use the Lidar system to create accurate surface elevation models and digital elevation models.

Every sUAS flight will use at minimum a two person flight crew: a pilot-in-command (PIC) and a visual observer (VO). The PIC will have, at minimum, a private pilot certificate. Both the PIC and VO will have sUAS-specific training from AIR prior to becoming employees as well as annually. For further information, please refer to Exhibit 19, Section 9: Training and Exhibit 20, submitted confidentially for proprietary reasons for further information.

The standard operational procedures are set out in Exhibit 19. Please refer to the following sections for information pertaining to operations:

4.3: DJI S1000 Setup Checklist
4.4: DJI S1000 Preflight Checklist
4.5: DJI S1000 Takeoff Checklist
4.7: DJI S1000 Landing Checklist
7.3: Personnel (including the operational duties of the PIC and the VO)
10.4: Personnel Responsibilities for Deployments
10.5: Personal Equipment
10.6: Log Books
11: Pre-Flight/Post-Flight Actions
12: Emergency Procedures

While the majority of flights will be manually piloted, some flights will be preprogrammed into the DJI S1000 by the PIC. This automated feature will be used when using the Lidar system in order to obtain the most accurate data for the target area. Throughout automated flights, the PIC will always hold the transmitter, monitor the telemetry data on the iOSD Mark II, and be prepared to abort the operation and fly the sUAS manually should an emergency situation occur. The VO will also be observing the telemetry data on a ground station laptop.

For manually piloted flights, the PIC will fly the DJI S1000 and the VO will control the camera collecting high resolution still images.

Due to the fact that power lines are often adjacent to public highways, AIR will necessarily operate closer than 500 feet to non-participating individuals. In order to protect these individuals and provide suitable buffer zones and barriers, AIR will follow the principals set forth in Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD), as set out by the U.S. Department of Transportation Federal Highway Administration. AIR's flight crew will also rely on its own research and knowledge of the area when preparing an operation. Please refer to Exhibit 19, Section 8.6: Public Notification and Traffic Control and Section 8.7: Checklist for Work Zone Layout & Operation in Exhibit 19 for further information. AIR will work with the local FSDO to plan where it will be operating, and it will avoid flying in congested locations.

AIR has anticipated the possibility for a number of different emergencies, and has accounted for this in Exhibit 19, Section 12: Emergency Procedures. These procedures will include, prior to each flight, the setting of a "home spot" in the event of a lost connection with the DJI S1000.

IV. Privacy

There is little concern that the proposed flights will cause invasions of privacy because all flights will occur over public utilities on public or private rights of way. When the sUAS is being flown, the onboard cameras will be focused on the pipeline or overhead wire, and thus turned so as to be facing away from any occupied structures that may be in the area to minimize inadvertent video or still images of uninvolved persons. All data collected will be for private use only and will not be distributed through public channels. If such data is later made available for public view, all images containing uninvolved persons will be blurred or blacked-out. No attempt will be made to identify any individuals filmed during the flights except in cases where they are trespassing upon or damaging customer property, or interfering with the applicant's or its customers' operations.

V. Aircraft and Equivalent Level of Safety

AIR proposes that the exemption requested herein apply to civil aircraft that have the characteristics and that operate with the limitations listed herein. These limitations provide for at least an equivalent or higher level of safety to operations under the current regulatory structure.

These limitations and conditions to which AIR agrees to be bound when conducting commercial operations under an FAA issued exemption include:

1. The sUAS will weigh approximately 24.25 lbs. (11 kg.).

2. Flights will be operated within line of sight of a pilot and visual observer.

3. The PIC will have, at minimum, a private pilot's license.

4. Maximum total flight time for each operational flight will result in no less than a 20% battery reserve.

5. Flights will be operated at an altitude of no more than 400 feet AGL.

6. Minimum flight crew for each operation will consist of the sUAS pilot and the visual observer.

7. A briefing will be conducted in regard to the planned sUAS operations prior to each day's activities. It will be mandatory that all personnel who will be performing duties in connection with the operations be present for this briefing.

8. AIR will submit a written Plan of Activities, and any additional necessary paperwork, to the FSDO at least one day before the proposed operations begin.

9. Pilots are required to possess a second class medical certificate. Pilots are required to

possess, at minimum, a private pilot certificate, and VOs must have completed training with AIR prior to operations.

10. PICs will complete, at minimum, eight hours of sUAS flight training with AIR prior to operations, and will be required to participate in annual training thereafter.

11. Pilot and observer will have been trained in operation of sUAS generally and received up-to-date information on the particular sUAS to be operated.

12. Pilot and observer will at all times be able to communicate by voice.

13. Written and/or oral permission from the landowners/authorized agents of the landowners over which flights will be held.

14. All required permissions and permits will be obtained from territorial, state, county or city jurisdictions, including local law enforcement, fire, or other appropriate governmental agencies.

15. The sUAS will have the capability to abort a flight in case of unexpected obstacles or emergencies.

16. If the sUAS and its radio control link disconnect during flight, the system's failsafe protection will be triggered and the multirotor will return to home and land automatically, rather than flying off uncontrollably or landing at an unknown location

17. Approval of commercial flights as outlined in this petition presents no national security issue. PICs will possess, at minimum, a private pilot's certificate, so they will have been subject to security screenings by the Department of Homeland Security.

Satisfaction of the criteria provided in Section 333 of the Reform Act of 2012 – size, weight, speed, operating capabilities, proximity to airports and populated areas and operation within visual line of sight and national security – provide more than adequate justification for the grant of the requested exemption allowing commercial operation of applicant's sUAS in the pipeline and power line inspection industries, pursuant to AIR's rules of operation.

VI. Public Interest and Safety

The planned sUAS use will increase ground safety for power line and transmission tower inspections, and pipeline inspections.

A. Power Line and Transmission Tower Inspections

Use of the sUAS will increase ground safety. Currently, electrical companies conduct visual inspections using manned helicopters in very close physical proximity to power lines and transmission towers. Power lines transmit extremely high voltage electricity and are in both rural and heavily populated urban areas. All lines need to be inspected, both on the surface and internally.

As the FAA has recognized, use of manned helicopters to conduct tasks which could

otherwise be completed with sUASs can be dangerous, as they are large, operated by an onboard pilot in addition to other onboard crewmembers, carry highly flammable fuel, and are operated over large distances. Exhibit 10. Inspecting power lines with a manned helicopter is very dangerous for all the crew members involved as the aircraft is required to fly slowly and very close to the power lines. Manned helicopters are susceptible to weather patterns as well.

There have been several instances in recent years in which inspectors and crew members lost their lives performing such inspections. Three people were killed in an accident in Silt, Colorado in January 2014. The helicopter struck the power line and crashed, quickly killing all those on board. Exhibit 11. Two people lost their lives in a similar situation in August 2014 in Alabama. Exhibit 12. In Texas, in 2013, two transmission line inspectors that were suspended from the helicopter by large cables were killed when the cables struck the power line and snapped. Exhibit 13. Moreover, especially in populated areas, the use of manned helicopters to conduct these inspections creates a substantial risk of injury or death for individuals on the ground.

Additionally, use of manned helicopters can be expensive, and is not very reliable – "it can, in fact, provide images only of the upper part of the [electrical] cables, and critical specifications such as internal corrosion of the steel reinforced aluminum conductors (ACSR) cannot be detected." Exhibit 14 at 1.

The use of sUASs to conduct power line inspections will ameliorate many of these concerns. First, sUASs are significantly safer than manned aircraft. The DJI S1000 weighs no more than 25 lbs., which is orders of magnitude smaller than a manned helicopter. The pilot and crew are located on the ground, not hovering hundreds of feet in the air above electrical cables, risking their lives for the inspection. In the event of a sUAS collision with the power lines, the crew will be a safe distance from the site of the accident. Many sUASs, including the DJI S1000 that AIR will use, are battery-powered and do not contain flammable liquids. sUASs require less room for take-off and landings than do manned aircraft, and can be flown for short distances, which significantly decreases the potential for accidents. sUASs rely on GPS signals and flight control algorithms that can make them capable of handling more adverse weather safely.

Second, sUASs are significantly less expensive than manned aircraft to operate, and they use fuel more efficiently. Third, the DJI S1000 has significantly greater mobility to better examine the electrical cables and concrete transmission towers. Finally, using a sUAS will allow inspectors to inspect power lines and transmission towers more quickly than if they were to use a manned helicopter. This will also decrease the risk to the inspectors, and allow inspectors to respond more quickly in the event an emergency inspection is needed.

B. Pipeline Inspections

AIR also seeks to use the sUAS to conduct pipeline inspections. Currently, for above-ground operations, the inspectors must walk along the pipeline with sensor equipment. This can be time consuming, due to the length of pipelines. Inspectors may also have to traverse lengths of the pipeline in adverse weather and geographic conditions. Additionally, the inspectors may be exposed to hazardous materials, such as crude oil and natural gas.

Using a manned, fixed wing aircraft in an attempt to alleviate some of these concerns creates many of the same risks mentioned in the previous section. Manned aircraft weigh significantly more than the DJI S1000, and carry both onboard crewmembers, and highly

flammable fuel.

Using a DJI S1000 equipped with a high resolution camera and Lidar system, as AIR proposes, will be much safer. The proposed operations will provide a greater level of safety for inspectors because they are not subject to the hazards associated with manned aircraft, and because they can stand at a greater distance from the pipelines to avoid exposure from hazardous materials.

Additionally, AIR's inspections of underground pipes, conducted with the DJI S1000, will be important in preventing ruptures of the pipeline system. According to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), in 2014, there were 29 serious pipeline incidents, and an additional 268 significant pipeline incidents, with 19 fatalities and 96 injuries.[1] Exhibit 15. Additionally, in January 2015 alone, a ruptured pipeline in Montana spilled tens of thousands of gallons of oil into the Yellowstone River, contaminating the water for thousands of individuals for several days, forcing the city to rely on bottled water and empty fire hydrants. Exhibit 16. A ruptured pipeline in North Dakota spilled three million gallons of the saltwater byproduct produced by oil and natural gas. Exhibit 17.

AIR's proposed use of the DJI S10000 will greatly expand the ability to conduct inspections of pipelines. A two-man crew with a sUAS weighing less than 25lbs and which does not carry flammable fuel will be significantly more efficient in conducting these investigations than either using a manned helicopter, which will travel a greater distance to the inspection spot, or a team on foot which cannot move as quickly. This will lead to more area being covered and problems being identified before devastating ruptures occur.

VII. Regulations from Which Exemption is Requested

A. 14 C.F.R. 21(h): Airworthiness Certificates

AIR requests an exemption from 14 C.F.R. 21(h). This exemption meets the requirements for an equivalent level of safety pursuant to Section 333 based on the small size, light weight, relatively slow speed, and use in controlled rural environments on private land, as described previously in this petition.

Equivalent level of safety: AIR's proposed exemption meets the requirements for an equivalent level of safety of this section, pursuant to Section 333, based on the following factors:

- Small size: the DJI S1000 has a diagonal length of 1055 millimeters, 41.53 inches.
- Light weight: 24.25 lbs. (11 kg.).
- Relatively slow speed: 10 m/s (20 knots).

[1] The PHMSA defines "serious incidents" as those including a fatality or injury requiring in-patient hospitalization, but this data excludes first far incidents, which are gas distribution incidents with a cause of "other outside force damages" and sub-cause of "nearby fire/explosion" as the primary cause of incident. "Significant incidents" include any of the following conditions, excluding first fire incidents: (1) fatality or injury requiring in-patient hospitalization; (2) $50,000 or more in total costs, measured in 1984 dollars; (3) highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more; or (4) liquid releases resulting in an unintentional fire or explosion. Exhibit 15.

- Operational capacity: currently, with the largest battery AIR intends to use, the DJI S1000 has a maximum battery life of 25 minutes, and can travel no more than 2,000 meters from the PIC.
- Proximity to airports: flights will be in Class G airspace.
- Proximity to populated areas: AIR will avoid flying over congested areas, and will work with local FSDO to determine safe areas for operations. Local FSDO may carve out areas indicated as yellow in the sectional chart and allow AIR to fly in these specifically designated carved-out areas. Additionally, when, through necessity, the sUAS will be operating near power lines adjacent to populated areas and roads, AIR will follow procedures set out by the U.S. Department of Transportation's Federal Highway Administration to provide an adequate buffer and blockade area to protect non-participating individuals.
- Operation within visual line of sight: The PIC will always fly the sUAS within his line of sight.
- Location: operations will be along pipelines and power lines nationwide. AIR will work with local FSDO when planning flights.
- Altitude: no more than 400 feet AGL, but the majority of flights are anticipated at no more than 100 feet AGL.
- Restricted area in which the sUAS will be operated: AIR will restrict access to the flight operational area by setting out barriers that will prevent nonparticipating individuals and vehicles from entering the area. Flights will be aborted if a nonparticipating individual or vehicle enters the area.
- Substantial experience of the PIC: as outlined in Exhibit 19, the PIC will have, at minimum, a private pilot certificate and a second-class medical certificate. PICs will also go through training, as outlined in Exhibit 19, Section 9: Training and Exhibit 20.

B. 14 C.F.R. 43.7: Persons authorized to approve aircraft, airframes, aircraft engines, propellers, appliances, or component parts for return to service after maintenance, preventive maintenance, rebuilding, or alteration.

AIR requests an exemption from 14 C.F.R. 43.7. This part provides, inter alia, that the holder of a mechanic certificate or a repair station certificate may approve an aircraft, airframe, aircraft engine, propeller, appliance, or component part for return to service.

Equivalent level of safety: The nature of the sUAS is that of a model aircraft, and AIR's service technicians will conduct maintenance as outlined in Exhibit 19 and required by the manufacturer of the sUAS, DJI. Please refer to the following documents:

- Exhibit 19:
  - Section 5: Aircraft Handling, Service, and Maintenance;
  - Section 10.6: Logbooks; and
  - Section 11.6: Maintenance.
- Exhibit 1.

The capabilities of AIR's service technicians to maintain and repair the sUAS will meet the requirement for an equivalent level of safety pursuant to Section 333 for the type of sUAS, its intended use, and the operating environment.

C. 14 C.F.R. 43.11: Content, form, and disposition of records for inspections conducted under parts 91 and 125 and §§135.411(a)(1) and 135.419 of this chapter.

AIR requests an exemption from 14 C.F.R. 43.11. This part provides, inter alia, that maintenance record entries be maintained and for the listing of discrepancies and placards by inspectors. The sUAS, due to its small size, does not have room for placards to be placed in or on it and no inspections for sUAS have been certified by FAA at the present time.

Equivalent level of safety: AIR's flight crews will keep log books of all maintenance and repair at the ground station, as envisioned in the August 8, 2014 Memorandum, "Interpretation regarding whether certain required documents may be kept at an unmanned aircraft's control station." Exhibit 18. This request provides an equivalent level of safety as 14 C.F.R. 43.11 because the documentation will be at the ground station with the PIC, where it will be useable in case of an emergency, rather than with the sUAS.

D. 14 C.F.R. 45.11: Marking of products.

AIR requests an exemption from 14 C.F.R. 45.11. This part provides, inter alia, that the manufacturers of aircraft, engines, propellers, mark such aircraft, engines, or propellers with an approved fireproof identification plate. The sUAS, due to its small size, does not have room for fireproof placards to be placed in it. Any required placards could become hazardous, due to the additional weight and strain placed on the sUAS.

Equivalent level of safety: AIR's flight crew will keep information related to the sUAS, including the user manual, at the ground control station and affix its N-Number, once obtained from the FAA Registration Office, on the "arms" of the sUAS as large as practicably possible. This exemption provides an equivalent level of safety to 14 C.F.R. 45.11 because the relevant documentation will be at the ground station with the PIC, where it will be useable in case of an emergency, rather than with the sUAS. Additionally, the fuselage is marked with "DJI," the manufacturer of the sUAS.

E. 14 C.F.R. 45.27: Location of marks; nonfixed-wing aircraft

AIR requests an exemption from 14 C.F.R. 45.27. The FAA has stated:

> "The petitioner's [UAS] 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." Exhibit 10 at 14.

AIR is prepared to identify its sUASs by serial number, register them in accordance with 14 C.F.R. part 57, and have N-Number markings on the sUASs. However, 14 C.F.R. 45.27 requires that each operator of a rotorcraft must display on that rotorcraft horizontally on both surfaces of the cabin, fuselage, boom, or tail the marks required by §45.23. The DJI S1000, due to its small size, does not have a cabin, fuselage, boom or tail to display the marks required by §45.23.

Equivalent level of safety: Once AIR receives N-Numbers for its sUASs, it will display these marks on the "arms" of the aircraft as large as practicably possible. This exemption

provides an equivalent level of safety to 14 C.F.R. 45.27 because the sUASs will be registered with the FAA Aircraft Registration Branch. In the event of incident, the sUAS will be traceable to AIR.

F. 14 C.F.R. 45.29: Size of marks

The FAA has previously determined that relief from this section is not necessary, so long as the sUAS in question is registered with the FAA and markings are as large as practicably possible. Exemption No. 11136 at 13. AIR requests the FAA make the same determination for this petition.

Alternatively, AIR requests an exemption from 14 C.F.R. 45.27. This part provides, inter alia, at subpart (3) that the registration marks for rotorcraft must be at least 12 inches high. The sUAS, due to its small size, does not have any surface area large enough to display marks anywhere near 12 inches high.

Equivalent level of safety: AIRS will affix its registration numbers as large as practicably possible on its "arms" once it obtains N-Numbers for its sUASs. This exemption provides an equivalent level of safety to 14 C.F.R. 45.29 because the sUAS will be registered with the FAA Aircraft Registration Branch. In the event of incident, the sUAS will be traceable to AIR.

G. 14 C.F.R. 91.7(a): Civil aircraft airworthiness.

The FAA has previously stated that no exemption is required for this section. Exhibit 10 at 19. AIR requests the same determination to be made for this Petition.

Alternatively, AIR requests an exemption from 14 C.F.R. 91.7(a). The regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. As there will be no airworthiness certificate issued for the aircraft should this exemption be granted, no standard will exist for determining airworthiness.

Equivalent level of safety: AIR will keep the DJI S1000's maintenance and safety information at the ground station, where it will be readily accessible to the PIC and VO before, during, and after operations. The PIC will be able to reference this material when making the determination regarding airworthiness of the DJI S1000. This exemption provides an equivalent level of safety as 14 C.F.R. 91.7(a) because the PIC will be able to make the determination of whether the sUAS is in an airworthy mechanical and electrical condition, in accordance with 14 C.F.R. 91.7(b).

H. 14 C.F.R. 91.9(b)(2): Civil aircraft flight manual, marking, and placard requirements.

The FAA previously stated that exemption to this section was not necessary. Exhibit 10 at 19. AIR requests the same determination to be made for this Petition.

Alternatively, AIR requests an exemption from 14 C.F.R. 91.9(b)(2). This part provides:

"(b) No person may operate a U.S.-registered civil aircraft...

(2) For which an Airplane or Rotorcraft Flight Manual is not required by §21.5 of this chapter, unless there is available in the aircraft a current approved Airplane or Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof."

First, there does not currently exist a method of approving manuals for sUAS. Second, given the size and configuration of the sUAS, there is no space to carry such a flight manual on the aircraft. In addition, carrying the manual on the aircraft would be pointless, since there is no pilot or other person on board who could read or use it. On August 8, 2014, the FAA issued a memorandum entitled "Interpretation regarding whether certain required documents may be kept at an unmanned aircraft's control station." This document stated that in the case of sAUS, "maintaining these documents at the pilot's control station would meet the intent of the rule as the pilot would be able to produce the documents for his or her own information or to an FAA inspector." Exhibit 18.

Equivalent level of safety: AIR will keep its flight manual at the ground station, where both the PIC and VO can access it. An equivalent level of safety to 14 C.F.R. 91.9(b)(2) is provided because the intent of this rule – the pilot having access to this material during flight – is met.

I. 14 C.F.R. 91.9(c): Civil aircraft flight manual, marking, and placard requirements.

The FAA has previously determined that relief from this section is not necessary. Exemption No. 11136 at 16. AIR requests the FAA to make the same determination about its petition.

Alternatively, AIR requests an exemption from 14 C.F.R. 91.9(c). This part provides: "(c) No person may operate a U.S.-registered civil aircraft unless that aircraft is identified in accordance with part 45 of this chapter."

As stated above, AIR will obtain N-Numbers from the FAA Registration Office and the sUASs, due to its small size, does not have room to contain fireproof placard or to display aircraft marks in a conventional size. However, once AIR obtains its N-Numbers, it will place the number on the "arms" of the aircraft as large as practicably possible.

Equivalent level of safety: AIR will obtain N-Numbers from the FAA Registration Office and affix it to the "arms" of the aircraft as large as practicably possible. An equivalent level of safety to 14 C.F.R. 91.9(c) is met because the sUASs will be registered with the FAA and identifiable in the event of an incident.

J. 14 C.F.R. 91.103(b)(2): Preflight action.

AIR requests an exemption from 14 C.F.R. 91.103(b)(2) to the extent that it is applicable. This part provides:

"Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include—... (b) For any flight, runway lengths at airports of intended use, and the following

> takeoff and landing distance information: … (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."

AIR's flight crew in fact will, before beginning a flight, become familiar with all available information concerning that flight, as outlined in Section 11 of Exhibit 19. As the flights of the sUAS will not be at airports, the information required of Part 91.103(b)(2) does not apply.

Equivalent level of safety: AIR shall perform preflight operations as outlined previously in this petition, and flights will not be at airports. An equivalent level of safety to 14 C.F.R. 91.103(b)(2) will be met because the PIC and VO will become familiar with the conditions prior to the flight, as outlined in Exhibit 19, Section 11.2: Weather and 11.4: Planning.

K. 14 C.F.R. 91.105: Flight crewmembers at stations.

AIR requests an exemption from 14 C.F.R. 91.105 since this part is not applicable due to the sUAS carrying no flight crewmembers.

Equivalent level of safety: AIR will not operate the aircraft unless someone is at the radio controls at all times. This will provide an equivalent level of safety to 14 C.F.R. 91.105 because the flight crew will be at their stations at all times during the flight. The stations will not be on the aircraft but on the ground.

L. 14 C.F.R. 91.109: Flight instruction; Simulated instrument flight and certain flight tests.

The FAA has previously stated that relief from this section was unnecessary when there are no training scenarios in which a dual set of controls would be utilized or required. Exhibit 10 at 20. AIR requests the same determination to be made here.

Alternatively, AIR requests an exemption from 14 C.F.R. 91.109. Section 14 C.F.R. 91.109 provides that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls. Remotely piloted aircraft, including the DJI S1000 here, are designed and constructed without dual controls. Flight control will be accomplished through the use of a control box that communicates with the aircraft via a radio transmitter.

Equivalent level of safety: The requested exemption from 14 C.F.R. 91.109 will provide an equivalent level of safety to this section because AIR's training will not require dual controls. Rather, training will take place as outlined in Exhibit 19, Section 9: Training and in the AIR UAS Training Syllabus. Additionally, the DJI S1000 is a small sUAS and will carry neither a pilot nor passengers.

M. 14 C.F.R. 91.113(b): Right-of-way rules: Except water operations.

AIR requests an exemption from 14 C.F.R. 113(b) to the extent that it applies to overhead aircraft operating at or above 500 feet AGL as the sUAS will be operating no higher than 400

feet AGL. This part provides:

> "(b): General. When weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead of it unless well clear."

For example, if another aircraft is operating overhead at 10,000 feet AGL there is no danger posed to that other aircraft if the sUAS is operating under it or ahead of it at or beneath 400 feet AGL. Despite this, should another aircraft enter the area in which AIR is operation, because the flight will be within his or her line of sight, the PIC will be able to give right of way to that aircraft.

Equivalent level of safety: AIR will operate its sUAS to see and avoid and give way to other aircraft that might enter nearby airspace at or below 400 feet AGL, and will give right-of-way to manned aircraft. Additionally, inspections of power lines and transmission towers will not interfere with manned flight, because they are pre-existing structures that pilots will not be flying near.

Regardless of the type of inspection being conducted, this exemption will provide an equivalent level of safety to 14 C.F.R. 91.113(b) because the sUAS has significantly greater mobility than a much larger, manned aircraft. As a result, the PIC will be able to react and respond to avoid any collision much more quickly than the other pilot.

N. 14 C.F.R. 91.119(b) and (c): Minimum safe altitudes: General.

AIR requests an exemption from 14 C.F.R. 91.119 subpart (c). This regulation provides:

> "Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes...
>
> (b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.
>
> (c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure."

AIR will not operate the sUAS any higher than 400 feet AGL. Furthermore, AIR will necessarily operate its sUASs closer than 500 feet to the power lines and the pipelines it will be inspecting. As outlined in Exhibit 19, Section 8: Safety, AIR will follow the principals set forth in Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD), created by the U.S. Department of Transportation's Federal Highway Administration to ensure safety when it will necessarily be flying closer than 500 feet to traffic.

Equivalent level of safety: AIR will operate the sUAS no higher than 400 feet AGL. AIR's sUAS operations, as set out in Section 8 of Exhibit 19, will provide at least an equivalent level of safety to manned aircraft that are maintaining a distance of at least "500 feet to any person, vessel, vehicle, or structure." The 400 feet AGL maximum will provide an equivalent level of safety to 14 C.F.R. 91.119(c) because, since 1981 with AC 91-57, this height has been an operating standard for model aircraft.

As for flying closer than 500 feet to "any person, vessel, vehicle or structure," the proposed exemption will provide an equivalent level of safety to 14 C.F.R. 91.119(c) because non-participating individuals will be protected by barriers, as set out in Part 6 of the MUTCD. The barriers will sufficiently protect nonparticipating individuals in the event of an accident. The FAA has previously granted a similar exemption request in Exemption Nos. 11136 and 11138. Additionally, the flight crew will make a safety assessment prior to each operation regarding the risks of operating in a certain area, and only operate when the risk does not present an undue hazard to themselves or to others.

O. 14 C.F.R. 91.121: Altimeter Settings

AIR requests an exemption from 14 C.F.R. 91.121. This Part provides guidelines for altimeter use in maintaining the cruising altitude or flight level of the aircraft. AIR is not requesting a general exemption from the requirement that its sUAS have an Altimeter. The DJI S1000's flight controller will have an internal measurement unit ("IMU"). The IMU has a built-in internal sensor and a barometric altimeter that measures both attitude and altitude. Exhibit 5, page 12. Rather, AIR requests an exemption from the requirement to set its altimeter to a station along the route, or out of an airport, because the DJI S1000 is not traveling point-to-point and is limited in the distance it can travel from the PIC. Additionally, AIR will not be flying into or out of an airport.

Equivalent level of safety: The requested exemption provides an equivalent level of safety to 14 C.F.R 91.121 because AIR will not operate the sUAS above 400 feet AGL in a sustained cruising flight mode such as a manned aircraft will typically fly. The PIC will at all times be controlling the maximum height of the sUAS through the telemetry features of the DJI iOSD Mark II. Additionally, the sUAS will be operated within the line of sight of the PIC. The FAA has previously granted this exemption in the MPAA Exemptions. Exhibit 10.

P. 14 C.F.R. 91.151: Fuel requirements for flight in VFR conditions.

AIR requests an exemption from 14 C.F.R. Part 91.151. This Part provides that:

> "(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."

The sUAS AIR will fly is powered by electricity, using lithium polymer batteries that currently have a maximum flight time of 25 minutes. Therefore, due to the limitations of the batteries, it is currently impossible to comply with Part 91.151. However, the sUAS will be operated in a manner with at least the equivalent level of safety as a manned aircraft complying with Part 91.151.

Operation of a sUAS with less than 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was intended to alleviate. During the entire flight, the PIC will always have a visual line of sight of the sUAS, and be able to monitor the battery life via the telemetry display on the iOSD Mark II. For manually driven flights, the VO will also have a transmitter linked to the camera as well as an iOSD Mark II to monitor the telemetry display. For automatic flights, the VO will be monitoring the battery life via the telemetry display on the laptop at the ground station. Additionally, there will be a timer set to ensure that the flight time does not exceed 80% of the battery life of the sUAS. Thus, the sUAS will always have enough power to land safely, given the minimum level of reserve capacity of the batteries.

Granting an exemption from 14 CFR §91.151(a) is entirely consistent with similar exemptions already granted to other operations, including the MPAA Exemptions. Exhibit 10.

Equivalent level of safety: AIR will limit flights to 80% of battery power. The proposed exemption meets an equivalent level of safety to 14 C.F.R. 91.151 because, given the limitations on AIR's proposed operations and the location of those operations, a reduced minimum power reserve for flight in daylight VFR conditions is reasonable.

Q. 14 C.F.R. 91.203(a) and (b): Civil aircraft: Certifications required.

The FAA has previously determined that exemption from 14 C.F.R. 91.203(a) and (b) is not necessary. Exhibit 10 at 20.

Alternatively, AIR requests an exemption from 14 C.F.R. 91.203(a) and (b). This section provides 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…
>
> (2) An effective U.S. registration certificate issued to its owner…
>
> (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."

First, there are currently no procedures in effect for providing airworthiness certificates for sUAS. However, as a condition to the approval of exemption, AIR will display N-Numbers, once received, on the sUASs. Additionally, the flight crew will keep the DJI S1000 and the AIR UAS manuals at the ground station.

Second, AIR will use the DJI S1000, which has an equivalent level of safety as a manned aircraft with an airworthiness certificate. This sUAS provides a number of safety features, including the automatic return to home failsafe. This will be set as laid out in Exhibit 19, Section 4.4: DJI S1000 Preflight Checklist.

Because of the use of GPS with the sUAS, the operator will set the initial location of flight takeoff ("home position") and if the radio control link is broken, the autopilot system will recognize this broken control link and cause the sUAS to automatically return to the home position as recorded by the GPS instrumentation. Please refer to Exhibit 5, page 30 of that document for more information regarding this failsafe procedure. Additionally, because the sUAS team will mark off an area with traffic cones that has a 20 ft. radius, approximately 30 ft. from the operators, that will be used as the "home position" for the sUAS to return, no one will be standing in the way of the path.

These enhancements and procedures provide a greater degree of safety to the public and property owners than conventional operations conducted with airworthiness certificates issued under Subpart H. Application of these same criteria demonstrates that there is no credible threat to national security posed by the UAS, due to its size, speed of operation, location of operation, lack of explosive materials or flammable liquid fuels, and inability to carry a substantial payload.

In the restricted environment and under the conditions proposed, operation of the sUAS will be at least as safe as a conventional aircraft (fixed wing or rotorcraft) operating with an airworthiness certificate.

Equivalent level of safety: The DJI S1000 is less than 25 lbs. inclusive of batteries and technical payload, carries neither a pilot nor passengers, and carries no explosive materials or flammable liquid fuels. It will be tightly controlled and monitored by the operator and the observer, and in compliance with local public safety requirements, in order to provide security for the area of operation. The FAA will have advance notice of all operations because AIR will notify both ATC and the local FSDO prior to operations, as described previously in this petition. Granting the proposed exemption will achieve an equivalent level of safety to 14 C.F.R. 91.203(a) and (b) because the operators will be safely on the ground, rather than in a helicopter hovering above power lines or walking on foot in adverse weather along pipelines.

R. 14 C.F.R. 91.215: ATC Transponder and Altitude Reporting Equipment and Use

This section requires that installed Air Traffic Control (ATC) transponder equipment must meet specific performance and environmental requirements, and aircraft must be equipped with an operable coded radar beacon transponder.

There are presently no known commercially available ATC transponders that meet the payload requirements of a sUAS and are available at reasonable cost. However, because the sUASs used by AIR will not be flying into or near airports, and will fly no higher than 400 feet AGL, there is very low risk of collision with any manned aircraft. In addition, because there will be no need to have contemporaneous communication with ATC Control, due to the short distances, short flight times, and restricted altitude the sUASs will operate within, AIR requests an exemption from this section. Additionally, the sUAS is too small to contain ATC transponder equipment in any form that is known to be available commercially.

Equivalent level of safety: An equivalent level of safety to 14 C.F.R. 91.215 will be met because AIR will not fly its sUAS into or near airports, and all operations will be below 400 feet AGL, so there is very low risk of collision with any manned aircraft. AIR will contact local ATC before operations to issue a NOTAM, and the local FSDO with its flight plan, as described previously in this petition. AIR also will give right of way to any manned aircraft that do appear.

S. 14 C.F.R. 91.403: General

This section requires that the owner or operator of an aircraft is primarily responsible for maintaining that aircraft in an airworthy condition. AIR will adhere to this requirement. However, this Section also limits maintenance to that "prescribed in this subpart and other applicable regulations, including part 43 of this chapter." Because of this limitation, and because of the exemptions under Part 43 requested above, AIR requests an exemption from this Section.

This exemption meets the requirements for an equivalent level of safety pursuant to Section 333 based on the small size, light weight, relatively slow speed, controlled area, and use of barriers to protect nonparticipating individuals, as appropriate.

Equivalent level of safety: To achieve an equivalent level of safety to 14 C.F.R. 91.403, AIR will maintain its sUAS in an airworthy condition and adhere to all manufacturer requirements for inspecting and maintaining the DJI S1000. AIR's service technicians will conduct maintenance as outlined in Exhibit 19 and required by the manufacturer of the sUAS, DJI. Please refer to the following documents:

- Exhibit 19
    - 5: Aircraft Handling, Service, and Maintenance;
    - 10.6: Logbooks; and
    - 11.6: Maintenance.
- Exhibit 1

The maintenance records will be available to the flight crew before, during, and after operations.

T. 14 C.F.R. 91.405 (a) and (d): Maintenance Required

The FAA has previously determined that relief from 14 C.F.R. 91.405 is warranted. Exhibit 10 at 15. This section requires that aircraft be inspected as prescribed by Section E, 14 C.F.R. §§91.401-91.421. As shown below, AIR is applying for an exemption for these sections, due to the fact that its operators will inspect the sUAS prior to each flight and keep maintenance records of all parts that are replaced. Because the Sections discussed below are concerned with manned aircraft, and as such have inspection requirements designed for the safety of passengers, they are inapplicable to AIR.

AIR is also applying for an exemption to subpart (d) of this section, which requires a placard to be installed and references §43.11. As noted previously, AIR requests an exemption to the placard requirement, because, due to the small size of the sUAS, there is no room to place the placard.

Despite the requested exemption from subparts (a) and (d) of this section, AIR will follow subparts (b) and (c) of this subpart.

Equivalent level of safety: To achieve an equivalent level of safety to 14 C.F.R. 91.405(a) and (b), AIR will keep logbooks detailing all inspection, maintenance, and repairs to the sUAS. AIR will also follow DJI's guidelines for inspection and maintenance. As the FAA has determined in Exemption Nos. 11136 and 11138, following the manufacturer's guidelines will achieve an equivalent level of safety to 14 C.F.R. 91.405(a) and (d), because of the small size of the sUAS in question and the limited nature of operations.

U. 14 C.F.R. 91.407: Operation after maintenance, preventive maintenance, rebuilding, or alteration

The FAA has previously determined that relief from 14 C.F.R. 91.407 is warranted. Exhibit 10 at 14. This section prevents any aircraft from operation that "has undergone maintenance, preventative maintenance, rebuilding, or alteration unless (1) [i]t has been approved for return to service by a person authorized under § 43.7 of this chapter; and (2) [t]he maintenance record entry required by §43.9 or §43.11, as applicable, of this chapter has been made."

However, AIR has requested an exemption from §§ 43.7 and 43.11 as described previously. The capability of the operators to maintain and repair the sUAS meets the requirements for an equivalent level of safety pursuant to Section 333 for both the type of sUAS, its intended use, and the rural operating environment. Additionally, due to the small size of the sUAS, there is no room to place inspection placards.

Therefore, because AIR has requested an exemption from 43.7 and 43.11, AIR respectfully requests an exemption from 91.407.

Equivalent level of safety: The proposed exemption will meet an equivalent level of safety to 14 C.F.R. 91.407 because AIR will regularly inspect and maintain its sUASs in accordance with the DJI S1000 and AIR UAS manuals. AIR will keep detailed inspection and maintenance records that will be available to the flight crew before, during, and after operations. Please refer to the following sections of Exhibit 19 for further information:

- 5: Aircraft Handling, Service, and Maintenance;
- 10.6: Logbooks; and
- 11.6: Maintenance.

V. 14 C.F.R. 91.409: Inspections

The FAA has previously determined that relief from 14 C.F.R. 91.409 is warranted. Exhibit 10 at 15. This section lays out specific requirements for inspections of aircraft. AIR requests an exemption from these requirements because they are intended to maintain the safety of manned aircraft significantly larger and capable of significantly longer flights than is sUAS.

Equivalent level of safety: As discussed above and in Exhibit 19, AIR has an inspection procedure that provides an equivalent level of safety to 14 C.F.R. 91.409. Please refer to Exhibit 19, Section 5.3: Preventative Maintenance, and Section 11.1: Inspections for further information.

W. 14 C.F.R. 91.417: Maintenance records

The FAA has previously determined that relief from 14 C.F.R. 91.417 is warranted. Exhibit 10 at 15. AIR requests an exemption from this Section, as it is only applicable for aircraft with an airworthiness certificate. Because AIR will not have an airworthiness certificate, this Section is inapplicable.

Equivalent level of safety: The requested exemption will meet an equivalent level of safety to 14 C.F.R. 91.417 because AIR will keep detailed maintenance records, as described in Exhibit 19, Section 11.6: Maintenance. The detailed maintenance records will be accessible to the PIC and the VO before, during, and after operations.

SPREADING WINGS S1000 (http://www.dji.com/product/spreading-wings-s1000)

click and drag

SAFE AND STABLE

The S1000's V type mixer design provides large amounts of propulsion while improving power efficiency. Combined with DJI flight controllers like the A2, it is guaranteed to remain stable even with the loss of a rotor. Integrated into the center frame is a power distribution system using our patented coaxial cable connector.

It is more efficient, reliable and easy to install and it eliminates the need for soldering. All frame arms and the retractable landing gear are made from carbon fiber, ensuring a very light weight and high structural stability.

72-HOUR
FLIGHT TEST

Click to play video

(//www.youtube.com/embed/VhDAILW9UAE)

PORTABLE
EASY TO USE

All eight arms can be completely folded down and the folding propellers can be tucked away, minimizing the S1000's size for transportation. To fly, simply lift the frame arms up, lock them into place and power up the system. This greatly saves on pre-flight prep time.

PRE-FLIGHT PREP TIME

5 Mins

NEW FOLDING DESIGN
CONVENIENT FOR
TRANSPORTATION

SPARKPROOF PLUG

The main power cord uses an AS150 sparkproof plug and an XT150 plug, preventing creators from mixing up polarity when plugging in the battery and preventing short circuits.

A2 (/product/a2)
Flight Controller

PROFESSIONAL OCTOCOPTER

Flight time
15 Mins

Takeoff weight
6Kg~11Kg

Weighing approximately 4kg with a maximum takeoff weight of around 11kg, the S1000 can easily carry equipment as heavy as a 5D Mark III. Used with a 6S 15000mAh battery it can fly for up to 15 minutes.

iOSD (/product/iosd-mark-ii)
On Screen Display

DJI Lightbridge (/product/dji-lightbridge2)
2.4G HD Digital Video Downlink

Zenmuse Z15-5D (/product/zenmuse-z15-5d)
3-axis gimbal

LOW GIMBAL MOUNTING POSITION

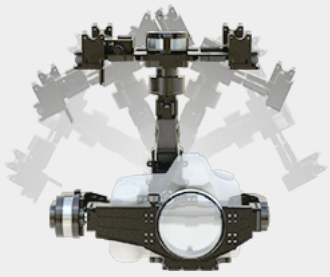
The gimbal is mounted low on the frame on a specifically designed bracket. Combined with the S1000's retractable landing gear, you have a clear, wide shooting angle.

RETRACTABLE LANDING GEAR

ZENMUSE
Z15-5D GIMBAL

For CANON 5D MKII and MKIII

The S1000's compatibility with our Zenmuse gimbal range offers advanced camera stabilization. This gives you smooth footage, precision control from the ground, and video downlink compatibility enabling you to see what the camera sees.



NEW
DAMPING DESIGN

Your gimbal and battery are mounted to the same bracket, with dampers placed between the bracket and the frame. This significantly reduces high-frequency vibrations and makes shots clearer and sharper. The battery tray's position also makes it more convenient to mount and unmount.

INNOVATIVE FRAME ARM DESIGN

Each frame arm is designed with an 8° inversion and a 3° inclination, making the aircraft more stable when rolling and pitching yet more flexible when rotating.

PROPULSION SYSTEM

A 40A electronic speed controller (ESC), our fastest available, is built in to each arm. The 4114 pro motors, high performance 1552 folding propellers, and V-type mixer design combine to give each arm of the S1000+ a maximum thrust of 2.5Kg.

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(http://www.dji.com/service)

SPREADING WINGS S1000 (http://www.dji.com/product/spreading-wings-s1000)

Frame	**Diagonal Wheelbase**	1045mm
	Frame Arm Length	386mm
	Frame Arm Weight (Including Motor, ESC, Propeller)	325g
	Center Frame Diameter	337.5mm
	Center Frame Weight (With Landing Gear Mounting Base, Servos)	1330g
	Landing Gear Size	460mm (Length) ×511mm (Width) ×305mm (Height), (Top width: 155 mm
Motor	**Stator Size**	41×14mm
	KV	400rpm/V
	Max Power	500W
	Weight(With Cooling Fan)	158g
ESC	**Working Current**	40A
	Working Voltage	6S LiPo
	Signal Frequency	30Hz ~ 450Hz
	Drive PWM Frequency	8KHz
	Weight(With Radiators)	35g
Foldable Propeller (1552/1552R)	**Material**	High strength performance engineered plastics
	Size	15×5.2inch
	Weight	13g

Flight Parameters	**Takeoff Weight**	6.0Kg ~ 11.0Kg
	Total Weight	4.2Kg
	Power Battery	LiPo (6S、10000mAh~20000mAh、15C(Min))
	Max Power Consumption	4000W
	Hover Power Consumption	1500W (@9.5Kg Takeoff Weight)
	Hover Time	15min (@15000mAh & 9.5Kg Takeoff Weight)
	Working Environment Temperature	-10 °C ~ +40 °C
Gain Value Settings	**For A2 Flight Controller**	Basic: Roll 120%, Pitch 120%, Yaw 120% Attitude: Roll 170%, Pitch 170%, Vertical 120%
	For WooKong-M Flight Controller	Basic: Roll 180%, Pitch 180%, Yaw 120% Attitude: Roll 180%, Pitch 180%, Vertical 120%

SPREADING WINGS S1000 (http://www.dji.com/product/spreading-wings-s1000)

DESIGNED FOR HIGH LEVEL PROFESSIONAL AERIAL PHOTOGRAPHY AND CINEMATOGRAPHY

INTRODUCING THE SPREADING WINGS S1000

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Gallery

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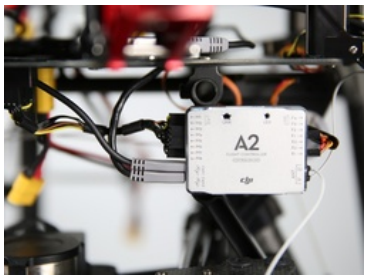

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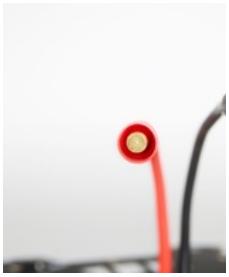

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Spreading Wings S1000 Features

- Safe And Stable
- Portable Easy To Use
- Sparkproof Plug

- Professional Octocopter
- Low Gimbal Mounting Position
- Retractable Landing Gear
- ZENMUSE Z15-5D Gimbal
- New Damping Design
- Innovative Frame Arm Design

Learn More

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MC

IMU

GPS

PMU

click and drag

9 TYPES OF MULTI-ROTOR AND A CUSTOMIZED MOTOR MIXER

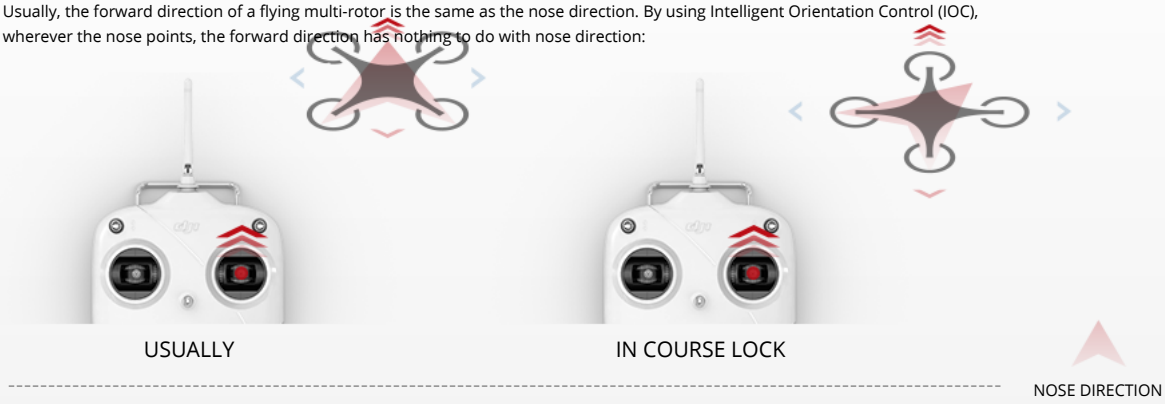
It's a UAS that's targeted at commercial and industrial multi-rotor platforms with simple configuration, easy installation and stable performance. It also supports customized motor mixing, which greatly meets the demands of particular users.

The A2 supports 9 types of traditional motor mixer:

INTELLIGENT ORIENTATION CONTROL (IOC)

In course lock flying, the forward direction is the same as a recorded nose direction. See the following figures

Usually, the forward direction of a flying multi-rotor is the same as the nose direction. By using Intelligent Orientation Control (IOC), wherever the nose points, the forward direction has nothing to do with nose direction:



In home lock flying, the forward direction is the same as the direction from home point to the multi-rotor. See the following figures

POINT OF INTEREST (POI)

A2 has a POI function: Point of Interest. When the GPS signal is good, users can record the current position of the aircraft as a point of interest by a preset switch on the remote control. The aircraft can achieve a circling flight around the point of interest with the nose pointing at the POI in an area of 5 meters to 500 meters radius, when the roll command is given. This function is easy to set and simple to operate, it is suitable for all-round shooting of a fixed scenic spot.

POINT OF INTEREST

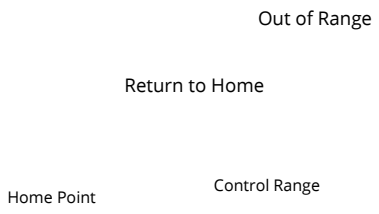
Click to play video

(//www.youtube.com/embed/HRF8lCtmb3Q)

point of interest

INTELLIGENT LANDING GEAR FUNCTION

Once you enabled the Intelligent Landing Gear function in the assistant software, the landing gear is default at the Lower position when the aircraft is on the ground; and the system will lower the landing gear in emergency, motor failure or auto landing, to protect the aircraft and gimbal; you can control to lower or retract the landing gear by a switch when the aircraft altitude is over 5m from the ground.



AUTO RETURN-TO-HOME /ONE-KEY GO-HOME

If the multirotor and its controller disconnects during flight, the system's failsafe protection will come to the rescue and if the signal is good enough, the multirotor will return to home and land automatically.

You can also setup a One Key Go Home function to activate this feature manually.

NEW "BANKED TURN" MODE

In this mode, the roll and yaw sticks are combined to help you perform banked turns with only one hand. The aircraft can perform fixed-wing-like maneuvers, bringing a brand new flight experience. Normal and FPV aerial photography in this mode is smooth and simple, giving a different visual feel to your work.

NEW CRUISE CONTROL FEATURE

Activate Cruise Control to lock your aircraft into its current horizontal speed when you release the control sticks. While cruising, the speed can be adjusted at any time through the remote controller. By maintaining steady flight, you can focus more on your shots and gimbal control, and your total flight time is increased by eliminating unnecessary speed changes.

MULTI-ROTOR ONE-MOTOR FAIL PROTECTION

This function means that when the aircraft is in attitude or GPS attitude mode, and one of the motors stops, the aircraft will retain good attitude and rotate around the frame arm with the stopped motor. In this condition, the aircraft is still under control and returns home safely and highly reducing the risk of a crash.

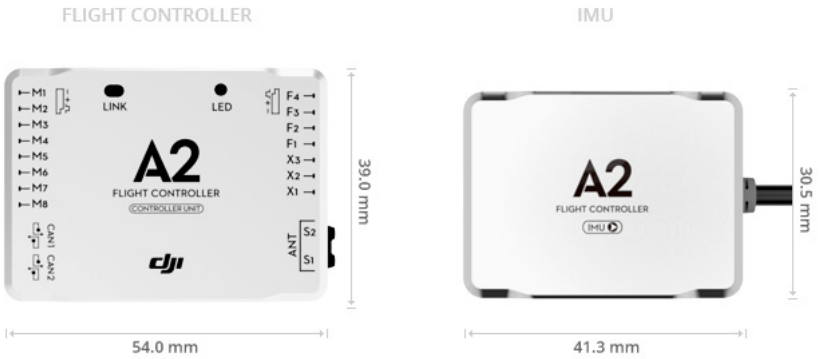
MULTI-ROTOR
ONE-MOTOR FAIL PROTECTION

Click to play video

(//www.youtube.com/embed/HQ7wa5cBT_w)

A2 (http://www.dji.com/product/a2)

Size and Weight



Flight Controller:
54mm x 39mm x 14.9mm

IMU:
41.3mm x 30.5mm x 26.3mm

GPS-COMPASS PRO:
62 mm (diameter) x 14.3 mm

PMU:
39.5mm×27.6mm×9.8mm

LED-BTU-I:
30mm x 30mm x 7.9mm

Peripheral	**Supported Multi-Rotor**	Quad-Rotor: +4,x4; Hex-Rotor +6,x6,Y6,Rev Y6; Octo-Rotor +8,x8,V8
	Supported ESC Output	400Hz refresh frequency
	Supported Transmitter For Built-In Receiver	Futaba FASST Series and DJI DESST Series
	External Receiver Supported	Futaba S-Bus, S-Bus2, DSM2
	Recommended Battery	2S ~ 6S LiPo
	Operating Temperature	-5°C to +60°C
	Assistant Software System Requirement	Windows XP SP3 / 7 /8 (32 or 64 bit)
	Other DJI Products Supported	Z15, H3-2D, H3-3D, iOSD, 2.4G Data Link, S800 EVO, S900, S1000, S1000+
Flight Performance	**Hovering Accuracy(In GPS Mode)**	Vertical: ± 0.5m Horizontal: ± 1.5m
	Maximum Wind Resistance	< 8m/s (17.9mph/28.8km/h)
	Max Yaw Angular Velocity	150 deg/s
	Max Tilt Angle	35°
	Ascent/Descent	±6m/s
Electrical & Mechanical	**Power Consumption**	MAX 5W (Typical Value: 0.3A@12.5V）
	Built-In Functions	Built-in Receiver Multiple Control Modes 2-axis Gimbal Supported Low Voltage Protection PC & Bluetooth Ground Station External Receiver Supported Intelligent Orientation Control Sound Alarm 4 Configurable Output
	Total Weight	Total Weight: <= 224g(overall)
	Dimensions	Flight Controller: 54mm x 39mm x 14.9mm IMU: 41.3mm x 30.5mm x 26.3mm GPS-Compass Pro: 62mm (diameter) x 14.3mm LED-BTU-I: 30mm x 30mm x 7.9mm PMU: 39.5mm x 27.6mm x 9.8mm

Notice: Flight Performance can be effected by mechanical performance and payloads

A2 (http://www.dji.com/product/a2)

IMPOSSIBLY PRECISE

A NEW STANDARD IN FLIGHT CONTROL

Main Controller

- Dual CAN-Bus system
- 12 output channels
- Built-in 2.4GHz DR16 receiver which supports Futaba FASST series transmitters.
- Reserved JR and SPEKTRUM satellite

IMU

- High sensitive built-in damper IMU module

GPS

- High gain antenna
- High precision satellite receiver

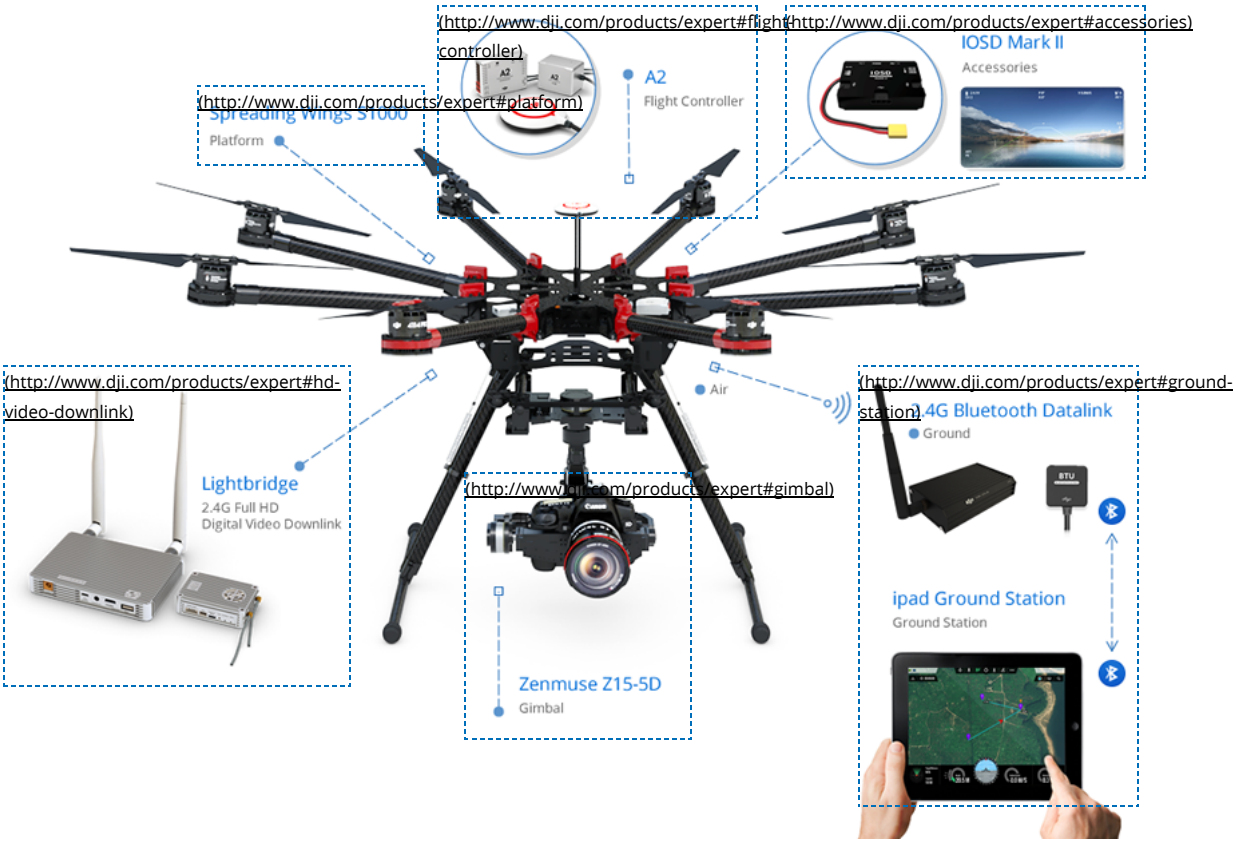
PMU

- Voltage detection and alarming
- An extendable CAN BUS port

LED

- Equipped with an LED Bluetooth indicator(LED-BT-I) adjusting parameters is more convenient than ever
- Internet connection to your smartphone will still be available when one is adjusting parameters via LED-BT-I module

Our Most Advanced Multirotor Stabilization Controller Ensures Total Ease Of Flight, Reliability And Stability In Any Situation.



Total Solution
For Aerial Photography

- Supports all multirotor platforms.
- Ideal for DJI video downlink, iOSD, Ground Station, Zenmuse gimbals. Compatible with future products.
- All modules can be upgraded online through Assistant to offer more functionalities.

Gallery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A2 Features

- 9 TYPES OF MULTI-ROTORAND A CUSTOMIZED MOTOR MIXER
- INTELLIGENT ORIENTATION CONTROL (IOC)

- POINT OF INTEREST (POI)
- INTELLIGENT LANDING GEAR FUNCTION
- AUTO RETURN-TO-HOME /ONE-KEY GO-HOME
- MULTI-ROTOR ONE-MOTOR FAIL PROTECTION

Learn More

(/topics/phantom)

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Exemption No. 11062

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, DC 20591

In the matter of the petition of **ASTRAEUS AERIAL** for an exemption from part 21; §§ 45.23(b); 61.113(a) and (b); 91.7(a); 91.9(b)(2); 91.103; 91.109; 91.119; 91.121; 91.151(a); 91.203(a) and (b); 91.405(a); 91.407(a)(1); 91.409(a)(2); and 91.417(a) and (b) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2014-0352**

GRANT OF EXEMPTION

By letter dated May 27, 2014, Jonathan B. Hill, Cooley LLC, Counsel for Astraeus Aerial, and John McGraw, Aerospace Consulting, LLC, Agent for Astraeus Aerial, 1299 Pennsylvania Avenue, NW., Suite 700, Washington, DC 20004 petitioned the Federal Aviation Administration (FAA) on behalf of Astraeus Aerial (Astraeus) for an exemption from part 21, §§ 45.23(b), 61.113(a) and (b), 91.7(a), 91.9(b)(2), 91.103, 91.109, 91.119, 91.121, 91.151(a), 91.203(a) and (b), 91.405(a), 91.407(a)(1), 91.409(a)(2), and 91.417(a) and (b) of Title 14, Code of Federal Regulations (14 CFR). The proposed exemption, if granted, would allow operation of unmanned aircraft systems (UAS) for the purpose of scripted, closed-set filming for the motion picture and television industry.

The petitioner requests relief from the following regulations:

> Part 21 prescribes, in pertinent part, the procedural requirements for issuing and changing design approvals, production approvals, airworthiness certificates, and airworthiness approvals.
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> Section 45.23(b) prescribes, in pertinent part, that 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 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.

Section 61.113(a) and (b) prescribes that—

(a) no person who holds a private pilot certificate may act as a pilot in command of an aircraft that is carrying passengers or property for compensation or hire; nor may that person, for compensation or hire, act as pilot in command of an aircraft.

(b) a private pilot may, for compensation or hire, 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.

Section 91.7(a) prescribes, in pertinent part, that no person may operate a civil aircraft unless it is in an airworthy condition.

Section 91.9(b)(2) prohibits operation of U.S.-registered civil aircraft unless there is available in the aircraft a current approved Airplane or Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof.

Section 91.103 prescribes, in pertinent part, that each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight, to include—

(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which the pilot in command has been advised by ATC;

(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.

Section 91.109 prescribes, in pertinent part, that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls.

Section 91.119 prescribes that, except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) Helicopters, powered parachutes, and weight-shift-control aircraft. If the operation is conducted without hazard to persons or property on the surface—

(1) A helicopter may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section, provided each person operating the helicopter complies with any routes or altitudes specifically prescribed for helicopters by the FAA; and

(2) A powered parachute or weight-shift-control aircraft may be operated at less than the minimums prescribed in paragraph (c) of this section.

Section 91.121 requires, in pertinent part, each person operating an aircraft to maintain cruising altitude by reference to an altimeter that is set "to the elevation of the departure airport or an appropriate altimeter setting available before departure."

Section 91.151(a) prescribes that 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. [emphasis added]

Section 91.203(a) prohibits, in pertinent part, any person from operating a civil aircraft unless it has within it (1) an appropriate and current airworthiness certificate; and (2) an effective U.S. registration certificate issued to its owner or, for operation within the United States, the second copy of the Aircraft Registration Application as provided for in § 47.31(c). Section 91.203(b) prescribes, in pertinent part, that no person may operate a civil aircraft unless the airworthiness certificate 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.

Section 91.405(a) requires, in pertinent part, that an aircraft operator or owner shall have that aircraft inspected as prescribed in subpart E of the same part and shall, between required inspections, except as provided in paragraph (c) of the same section, have discrepancies repaired as prescribed in part 43 of the chapter.

Section 91.407(a)(1) prohibits, in pertinent part, any person from operating an aircraft that has undergone maintenance, preventive maintenance, rebuilding, or alteration unless it has been approved for return to service by a person authorized under § 43.7 of the same chapter.

Section 91.409(a)(2) prescribes, in pertinent part, that no person may operate an aircraft unless, within the preceding 12 calendar months, it has had an inspection for the issuance of an airworthiness certificate in accordance with part 21 of this chapter.

Section 91.417(a) and (b) prescribes, in pertinent part, that—

> (a) Each registered owner or operator shall keep the following records for the periods specified in paragraph (b) of this section:
>
> > (1) Records of the maintenance, preventive maintenance, and alteration and records of the 100-hour, annual, progressive, and other required or approved inspections, as appropriate, for each aircraft (including the airframe) and each engine, propeller, rotor, and appliance of an aircraft. The records must include—
> >
> > (i) A description (or reference to data acceptable to the Administrator) of the work performed; and
> >
> > (ii) The date of completion of the work performed; and

(iii) The signature, and certificate number of the person approving the aircraft for return to service.

(2) Records containing the following information:

(i) The total time in service of the airframe, each engine, each propeller, and each rotor.

(ii) The current status of life-limited parts of each airframe, engine, propeller, rotor, and appliance.

(iii) The time since last overhaul of all items installed on the aircraft which are required to be overhauled on a specified time basis.

(iv) The current inspection status of the aircraft, including the time since the last inspection required by the inspection program under which the aircraft and its appliances are maintained.

(v) The current status of applicable airworthiness directives (AD) and safety directives including, for each, the method of compliance, the AD or safety directive number and revision date. If the AD or safety directive involves recurring action, the time and date when the next action is required.

(vi) Copies of the forms prescribed by § 43.9(d) of this chapter for each major alteration to the airframe and currently installed engines, rotors, propellers, and appliances.

(b) The owner or operator shall retain the following records for the periods prescribed:

(1) The records specified in paragraph (a)(1) of this section shall be retained until the work is repeated or superseded by other work or for 1 year after the work is performed.

(2) The records specified in paragraph (a)(2) of this section shall be retained and transferred with the aircraft at the time the aircraft is sold.

(3) A list of defects furnished to a registered owner or operator under § 43.11 of this chapter shall be retained until the defects are repaired and the aircraft is approved for return to service.

The petitioner supports its request with the following information:

The petitioner has provided the following information – contained in its petition and supplemental proprietary Flight Operations and Procedures Manual (hereafter FOPM) and Motion Picture and Television Operations Manual (hereafter MPTOM) – in support of its exemption request. The petitioner submitted additional information in response to the FAA's August 7, 2014 request which is posted to the docket. The FAA has organized the petitioner's information into three sections: 1) the unmanned aircraft system, 2) the UAS Pilot In Command (PIC), and 3) the UAS operating parameters.

Unmanned Aircraft System

The UAS proposed by the petitioner is a proprietary design, conceived and constructed by Astraeus Aerial, and referred to as the Astraeus Aerial Cinema System V.3CS UAS aircraft variant, serial #001 onward (hereafter referred to as V.3). This aircraft has eight rotors and eight motors in a quadcopter configuration (X8). The petitioner states that given the size, weight, speed, and limited operating area associated with the aircraft to be utilized by the applicant, an exemption from 14 CFR part 21, Subpart H (Airworthiness Certificates), subject to certain conditions and limitations, is warranted and meets the requirements for an equivalent level of safety under 14 CFR part 11 and Section 333 of the FAA Modernization and Reform Act of 2012 (PL 112-95). The petitioner further states that UAS operated without an airworthiness certificate in the restricted environment and under the conditions and limitations proposed by the petitioner will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) operating with an airworthiness certificate issued under 14 CFR part 21, Subpart H and not subject to the proposed conditions and limitations.

The petitioner states that the unmanned aircraft (UA) to be operated under this request is less than 55 lbs. fully loaded, flies at a speed of no more than 50 knots, carries neither a pilot nor passenger, carries no explosive materials or flammable liquid fuels, and operates exclusively within a secured area as set out in the MPTOM. In addition, the petitioner has integrated safety features into the design of the UAS, as described in the petitioner's FOPM, to ensure the safety of persons and property within and surrounding the limited operating area. The petitioner further describes that, in the event the UAS loses communications or its GPS signal, the UA will have the capability to return to a pre-determined location within the Security Perimeter and land. It will also have the capability to abort a flight in the event of unpredicted obstacles or emergencies.

The petitioner states that even though its UAS will have no airworthiness certificate, an exemption may be needed from 14 CFR § 45.23 as the UA will have no entrance to the cabin, cockpit, or pilot station on which the word "experimental" can be placed. Given the size of the UA, the petitioner notes that the two-inch lettering will be impossible. The petitioner asserts that an equivalent level of safety will be provided by having the UA marked with the word "experimental" on the fuselage in compliance with 14 CFR § 45.29(f), in a location where the pilot, observer, and others working with the UA will see the identification.

The petitioner states that the maintenance requirements in the pertinent sections of 14 CFR part 91 are only applicable to aircraft with an airworthiness certificate in accordance with part 43. The petitioner states that its V.3 UAS does not have specific maintenance instructions; therefore the petitioner has developed and documented in its MPTOM and FOPM an "on-condition" maintenance process for the V.3 UAS affected by this exemption. The petitioner has also stated that it intends to follow any manufacturers' recommended instructions and procedures when those procedures exist for certain components of its V.3 UAS.

UAS Pilot In Command (PIC)

The petitioner asserts that since the UA will not carry a pilot or passengers on board, the proposed operations will not adversely affect safety by requiring the PIC operating the aircraft to have a private pilot's license rather than a commercial pilot's license. In support of its position, the petitioner argues that, since there are no standards for either private or commercial UAS pilot certificates, knowledge of airspace regulations and dexterity in the control and operation of the UAS acquired from actual operation of the aircraft will be the most important factors in establishing an equivalent level of safety. Furthermore, the petitioner explains that, given the restricted and controlled airspace within which operations will take place, the key factors needed by the PIC are knowledge of the airspace within which the "closed-set filming" operation will take place and how that airspace fits into the National Airspace System (NAS). The petitioner also states that it cannot be assumed that a commercial pilot, approved to operate a helicopter or fixed wing aircraft, has the skill or ability to safely operate an unmanned aerial vehicle, operating at 400 feet AGL or lower, within strictly controlled pre-approved airspace. The petitioner asserts that there are relatively few certificated pilots who are also qualified to fly the type of UAS utilized in motion picture industry image-capture operations. Astraeus further asserts that there are even fewer commercially certificated pilots that can fly these UAS, to the point that to do both is considered rare.

Additionally, the petitioner states that the aircraft will be operated within a secure environment, which no one will be allowed to enter unless they are part of the production, have been fully briefed of the risks prior to operation of the UAS, and have consented to the risks associated with being in the operating area. Should there be a mishap, the UA being flown pose significantly less of a threat than the helicopters and fixed wing aircraft now being employed because they are a fraction of the size, carry no flammable fuel, and do not carry crew or passengers. This is in stark contrast to conventional aircraft that are flown to the site, carry flammable fuel, carry passengers and crew, and operate in a much larger area.

UAS Operating Parameters

The petitioner states that all flights will be operated within visual line of sight (VLOS) of a pilot and/or observer, and that the UA flights will be limited to a maximum altitude of 400 feet AGL. The petitioner further states that an operator will ensure that only consenting production personnel will be allowed within 100 feet of the UA operation, but this radius may be reduced to 30 feet based upon an equivalent level of safety determination, as stated in their MPTOM, with the advance permission of the local Flight Standards District Office (FSDO). The petitioner asserts that an equivalent level of safety can be achieved given the size, weight,

and speed of the UAS, as well as the location where it is operated. The petitioner states that the UAS will be operated within a safe operating perimeter, the boundaries of which will be determined by production personnel and the UAS PIC based on the site-specific filming activities and speed of the UAS required for the operation, and coordinated with the jurisdictional FAA FSDO and local government officials as applicable, as outlined in the MPTOM and FOPM. The petitioner states that only participating and consenting production personnel will be allowed within this perimeter; the petitioner also states their intention to comply with the guidelines outlined in Order 8900.1 V3, C8, S1 with regard to nonparticipating personnel outside the safety perimeter. The petitioner argues that, compared to flight operations with aircraft or rotorcraft weighing far more than its maximum 55 lb. UA, and the lack of flammable fuel, any risk associated with its UAS operations is far less than those with conventional aircraft operating at or below 500 feet AGL in the movie industry.

With respect to preflight actions, the petitioner notes it may need an exemption from 14 CFR § 91.103, because it will not have approved rotorcraft flight manuals. The petitioner asserts that an equivalent level of safety will be achieved by the PIC taking all preflight actions as set forth in their MPTOM and FOPM, including reviewing weather, flight battery requirements, landing and takeoff distances, and aircraft performance data before initiation of flight. Additionally, the petitioner states that a briefing will be conducted prior to each day's filming regarding planned UAS operations, and all personnel who will be performing duties within the boundaries of the safety perimeter will be required to attend.

With respect to the fuel requirements, the petitioner notes that, in order to meet the 30 minute reserve requirements in 14 CFR § 91.151, UAS flights would have to be limited to approximately 10 minutes. The petitioner argues that, given the limitations on the UA's proposed flight area and the location of its proposed operations within a predetermined area, a longer time frame for flight in daylight or night VFR conditions is reasonable. The petitioner believes that an equivalent level of safety can be achieved by limiting flights to 30 minutes or 25% of battery power, whichever occurs first.

The petitioner notes that it may need an exemption from 14 CFR § 91.121, as its UAS may have a GPS altitude read out instead of a barometric altimeter. The petitioner asserts that an equivalent level of safety will be achieved, as outlined in its MPTOM. Specifically, the altitude information will be provided to the UAS PIC via a digitally encoded telemetric data feed. Prior to each flight, a zero altitude initiation point will be established and confirmed for accuracy by the PIC.

Public Interest

The petitioner states that, given the small size of the UA involved and the restricted sterile environment within which it will operate, its proposed operation "falls squarely within that zone of safety (an equivalent level of safety) in which Congress envisioned that the FAA must, by exemption, allow commercial operations of UAS to commence immediately." Also due to the size of the UA and the restricted areas in which the UAS will operate, approval of the application presents no national security issue. The petitioner states that, given the clear direction in Section 333, the strong equivalent level of safety surrounding the proposed operations, and the significant public benefit, including enhanced safety, reduction in

environmental impacts, and including reduced emissions associated with allowing UAS for movie and television operations, granting the requested exemptions is in the public interest.

Discussion of Public Comments:

A summary of the petition was published in the Federal Register on June 26, 2014 (79 FR 36378). Eighty-six comments were received.

Of the 86 comments received, including eight from associations, 50 comments supported the exemption request, 22 opposed, and 14 were neutral. The petition received comments on the following topics: economic impact, UAS, PIC, operational capabilities, airspace, privacy, sense and avoid, and data link.

Comments supporting the exemption request came from individuals and industry groups, including the Association of Unmanned Vehicle Systems International (AUVSI), Aerospace Industries Association (AIA), the National Association of Realtors, the News Media Coalition, and the National Press Photographers Association. Supporting comments cited the petitioner's intent to use controlled access airspace, licensed airmen, and preflight safety briefings, as well as the economic benefits of UAS.

Several trade organizations submitted letters to the docket, expressing various issues and concerns with the Astraeus petition for exemption, including the Air Line Pilots Association International (ALPA), the National Agricultural Aviation Association (NAAA), and the United States Hang Gliding and Paragliding Association (USHPA).

ALPA expressed concern regarding certain conditions outlined in Astraeus' petition. ALPA notes that the proposed operations will be for "compensation or hire," and ALPA believes that the pilot must hold at least a current FAA Commercial Pilot Certificate with an appropriate category and class rating for the type of aircraft being flown as well as specific and adequate training on the UAS make and model intended to be used. Similarly, a current 2nd Class FAA Medical certificate should be required for a UAS pilot operating an aircraft for compensation or hire commercial operations as is required in the NAS today. NAAA and USHPA also commented on pilot qualification. Specifically,

> NAAA believes that the Part 61 regulations currently in effect do not address the licensing of pilots of an unmanned aircraft used for commercial purposes. We believe it is necessary for the FAA to evaluate pilots of these aircraft on their knowledge and skills in UAV operations. Requirements for this licensing should be developed along with other rigorous rules and qualifications to ensure safe integration of the unmanned aircraft into the NAS.

The FAA has carefully reviewed the knowledge and training required by holders of both private and commercial certificates, as well as the separation of Astraeus' proposed operations from other manned operations. Additional details are available in the ensuing analysis of this issue with regards to 14 CFR § 61.113.

ALPA commented that although the anticipated operation is expected to occur below 400 feet above the surface, the petition also makes reference to operations 200 feet above structures of unspecified and therefore unlimited height. This would put the aircraft at the same altitude

strata as other aircraft in the NAS, with only geographic separation to mitigate the risk of collision. However, in subsequent materials posted to the docket, Astraeus has removed operation from elevated platforms. All operations will be limited to 400 feet AGL, which is specified in the conditions and limitations below.

ALPA further notes that the aircraft "may not have a barometric altimeter" so the ability to accurately maintain altitude must be addressed. NAAA noted the same in its comments. The FAA agrees with ALPA and NAAA and addresses this concern in its analysis of the exemption from 14 CFR § 91.121, finding that the alternative means of compliance proposed by Astraeus does not adversely affect safety.

ALPA and an individual comment that Command and Control (C2) link failures are one of the most common failures on a UAS, and that lost link mitigations should require safe modes to prevent fly-aways or other scenarios. The FAA agrees and carefully examined the proposed operation to ensure that the vehicle design and the petitioner's MPTOM and FOPM addressed potential hazards related to C2 failure. The FAA finds that the UAS to be operated by Astraeus has sufficient design features to address these hazards. The FAA also finds that the MPTOM and FOPM have incorporated safety procedures to be followed by all operational participants should a C2 failure occur. Further detail is contained in the analysis of the UAS below.

NAAA stated that it represents the interests of small business owners and pilots licensed as commercial applicators. NAAA members operate in low-level airspace, and clear low-level airspace is vital to the safety of these operators.

NAAA stated that seeing and avoiding other aircraft and hazardous obstructions is the backbone for agricultural safety, and agricultural pilots depend on pilots of other aircraft to perform their see and avoid functions needed to prevent collisions. NAAA believes that UA operations at low altitudes will increase the potential of collision hazards with agricultural aircraft. In its comments, the USHPA submitted similar concerns relative to activities of other low altitude user groups including ballooning, skydiving, powered ultralights, etc.

NAAA acknowledged Astraeus' plan to submit a written Plan of Activities to the FSDO three days before the proposed operations, as required by the petitioner's MPTOM. However, NAAA maintains, as does the USHPA, that in addition to this, issuance of a NOTAM advising nonparticipating pilots of the planned activity is vital to disseminating this safety information. The FAA agrees and has incorporated this into the conditions and limitations of this exemption. Further detail is contained in the analysis of the operating parameters below.

NAAA commented that UA should have assigned numbers that can be read from a suitable distance to aid in identification when enforcement of flight regulations is required. The USHPA commented similarly, noting that while the current identification standards are not feasible on small UA given their reduced size, identification appropriate for these design parameters could be defined and created without undue burden or negative impacts on UAS operations. The FAA partially agrees with NAAA and USHPA. UA operated under this exemption will be marked in accordance with 14 CFR part 45 or as otherwise authorized by the FAA. Further detail is contained in the analysis of the UAS below.

USHPA states that it is a nonprofit member organization with the specific and primary purpose to engage exclusively for scientific and educational purposes in the development, study, and use of fuel-less flight systems and aircraft capable of being launched by human power alone. USHPA commented that it believes with proper notification of time and place, along with other considerations, safety can be maintained. USHPA's notification concerns will be addressed by the conditions and limitations that will require an Air Traffic Organization issued Certificate of Waiver or Authorization (COA) to address airspace requirements and notification. Further detail is contained in the analysis of the UAS operating parameters below.

Related to the operation of the UA within visual line of sight (VLOS) of the pilot and/or observer, USHPA believes operation of any UA in three-dimensional space presents unique challenges in accurately determining position in relation to stationary or mobile objects. USHPA comments that utilization of an observer for operational redundancy is prudent and encouraged, but should not be considered a viable replacement for the pilot in command. USHPA believes that the identification of navigational requirements and accurately conveying them to the pilot in command would not be provided with adequate precision or sufficient response time in a crisis situation and recommends that dual control systems be utilized as a redundant safety measure common in commercial aviation environments. The FAA notes USHPA's concerns; additional detail is provided in the analysis of the UAS below.

USHPA also asserts that manned flight should always maintain right of way over all UA operations. The FAA agrees and has incorporated this into the conditions and limitations of this exemption.

Several comments noted that small UAS can be hard to see during the day, due to their small size and factors such as sun glare. Commenters also noted concerns with regard to weather and wind conditions affecting operations. The FAA addressed these concerns by adding operating restrictions in the conditions and limitations regarding stand-off distance from clouds, altitude restrictions, and operating distance from non-participating personnel. Further detail is contained in the analysis of the UAS operating parameters below.

The petition received several comments suggesting that UAS operated under this exemption should have the ability to monitor and communicate with other aircraft or install transponders, or that the UAS should not operate until they can sense and avoid other aircraft. One commenter suggested that the FAA should implement a buffer between these UAS operations and manned operations, while another raised concern with near misses with other aircraft. Two comments noted that UAS are susceptible to accidents and GPS jamming. The FAA believes the limitations under which the petitioner will operate (i.e. VLOS and at or below 400 feet AGL) and the UAS emergency procedures as outlined in the petitioner's FOPM and MPTOM are sufficient mitigations to this risk so that the operations will not adversely affect safety. Further information is contained in the analysis of the UAS below.

One commenter suggested that the FAA should require testing of software and systems prior to operation, including testing to RTCA standards. The FAA believes the preflight checks discussed in the analysis of the UAS operating parameters are sufficient to mitigate this risk, and addresses this in the conditions and limitations below.

The FAA also received comments not related to the UA and its operation as proposed by the petitioner, but rather addressing more general UAS issues, which are discussed below.

The FAA received two comments asking how the FAA plans to monitor or conduct surveillance of the petitioner's UAS operations. The FAA expects operators to comply with its regulations and the terms of the exemption. The jurisdictional FSDO will be the primary office responsible for oversight of the operations.

The FAA received several comments that integrating UAS operations via a broadly applicable rule was a more suitable method than the exemption process, and that industries other than the motion picture industry should be allowed to participate. Section 333 provides interim authority to the Secretary of Transportation, which facilitates limited, controlled UAS operations prior to the completion of a UAS regulatory structure. The FAA is using its exemption process to facilitate implementation of Section 333 and to address FAA rules that would be applicable to the proposed operations. We have received and are considering exemption petitions from a broad array of industries and applications for this technology. Additionally, the FAA is engaged in a rulemaking process that will allow broader applications of UAS operations.

Two commenters suggested this exemption process should be available to anybody, regardless of organizational size or resources. The FAA will consider any request for exemption submitted to it, no matter the source.

One commenter stated that meaningful public review of the petition was not possible because some of the documents submitted by the petitioner are confidential. The FAA routinely considers confidential materials in its exemption process. The FAA reviewed and considered the petitioner's information in its analysis of the petition.

The petition received several comments on privacy. A commenter expressed concern that the UAS could be used for spying. Other commenters stated that there are strong privacy regulations in place. Specifically, a commenter states that the petitioner addressed privacy issues in its request by mandating that all filming be within a contained environment with all participants fully aware that they are being filmed. The petitioner states that all UAS flights will occur over private or controlled access property with the property owner's prior consent and knowledge, and that only people who have consented or otherwise have agreed to be in the area where filming will take place will be filmed. The FAA notes that the terms of this grant of exemption are consistent with the petitioner's proposal in this area.

The FAA's analysis is as follows:

Unmanned aircraft system (UAS)

Regarding the petitioner's requested relief from 14 CFR part 21 Certification procedures for products and parts, the FAA finds that, based on the limited size, weight, operating conditions, design safety features, and the imposed conditions and limitations, the petitioner has demonstrated that its operations would not adversely affect safety compared to similar

operations conducted with aircraft that have been issued an airworthiness certificate under 14 CFR part 21, Subpart H.

Commercial motion picture and television aerial filming operations with manned aircraft are typically conducted with aircraft holding standard airworthiness certificates issued under part 21, subpart H. These aircraft are normally modified via the Supplemental Type Certificate (STC) process to install cameras and other equipment not included in the original aircraft design.

Manned helicopters conducting motion picture and television aerial filming can weigh 6,000 lbs. or more and are operated by an onboard pilot, in addition to other onboard crewmembers, as necessary. The petitioner's UA will weigh less than 55 lbs. with no onboard pilot or crew. The pilot and crew will be remotely located from the aircraft. The limited weight significantly reduces the potential for harm to participating and nonparticipating individuals or property in the event of an incident or accident. The risk to an onboard pilot and crew during an incident or accident is eliminated with the use of a UA for the aerial filming operation.

Manned aircraft are at risk of fuel spillage and fire in the event of an incident or accident. The UA carries no fuel, and therefore the risk of fire following an incident or accident due to fuel spillage is eliminated.

During motion picture and television aerial filming with manned aircraft under the conditions of an FAA issued Certificate of Waiver, aircraft can be operated in very close proximity to participating persons. The safety of these individuals is maintained through use of an aircraft with standard airworthiness certification under 14 CFR part 21, Subpart H, operation of the aircraft by a qualified and competent pilot, and operating according to limitations necessary to ensure safety. In these situations, the filming subject and production personnel are exposed to risk by virtue of their close proximity to an aircraft in flight. Compared to manned aircraft, the UA being operated by the petitioner reduces the risk to participating persons in close proximity to the aircraft due to the limited size, weight, operating conditions, and design safety features of the UAS.

This exemption does not require an electronic means to monitor and communicate with other aircraft, such as transponders or sense and avoid technology. Rather the FAA is mitigating the risk of these operations by placing limits on altitude, requiring stand-off distance from clouds, permitting daytime operations only, and requiring that the UA be operated within visual line of sight and yield right of way to all other manned operations. Additionally, the exemption provides that the operator will request a NOTAM prior to operations to alert other users of the NAS.

The petitioner's UAS has the capability to operate safely after experiencing certain in-flight failures. The UA is also able to respond to a lost-link event with a pre-coordinated, predictable, automated flight maneuver. With regard to USHPA's concerns about dual control systems, current FAA regulations permit motion picture and television filming operations by manned aircraft that do not require a copilot. Additionally, under this exemption, the FAA requires that the UAS PIC hold a current third class medical certificate. Historically, instances of complete PIC incapacitation are rare. In all other cases other than complete incapacitation,

the PIC has the ability to terminate the flight operation or initiate the automated return to home procedure outlined within the FOPM. The FAA also believes that the multiple control redundancies described in the petitioner's FOPM are sufficient to mitigate risks associated with the loss of GPS signal. In consideration of these factors and the UA size, weight, speed and other operating limitations associated with this aerial filmmaking operation, the FAA finds that there is no adverse safety affect relative to similar operations conducted by manned aircraft with a flight crew complement of one.

These safety features also provide for no adverse safety affect to participating and nonparticipating individuals compared to a manned aircraft that holds a standard airworthiness certificate performing a similar operation.

In accordance with the statutory criteria provided in Section 333 of PL 112-95 in reference to 49 USC 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, and any associated noise certification and testing requirements of part 36, is not necessary.

Regarding the petitioner's requested relief from 14 CFR § 45.23(b) Display of marks, the petitioner's request is made under the assumption that marking with the word "experimental" will be required as a condition of an exemption request. This marking is reserved for aircraft that are issued experimental certificates under § 21.191. Since the petitioner's UAS will not be certificated under 14 CFR § 21.191, a grant of exemption for 14 CFR § 45.23(b) is not necessary.

The petitioner's UA 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.

Regarding the petitioner's requested relief from 14 CFR §§ 91.405(a) Maintenance required, 91.407(a)(1) Operation after maintenance, preventive maintenance, rebuilding, or alteration, 91.409(a)(2) Inspections, and 91.417(a) and (b) Maintenance records, the FAA has determined that relief from 91.409(a)(1) is also necessary, because it is an alternate inspection requirement of 91.409(a)(2).

The petitioner's FOPM contains the maintenance requirements for the V.3 UAS, to include "on-condition" maintenance and modifications. The petitioner's MPTOM and FOPM were reviewed and do not sufficiently support the regulatory relief sought under 14 CFR part 91, Subpart E. The FAA has carefully considered the petitioner's supplemental information and determined that its operations will not adversely affect safety with regard to the regulatory maintenance and alteration requirements of 14 CFR §§ 91.405(a)(1), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), provided changes are made to the MPTOM and FOPM as required by the conditions and limitations included in this exemption. These changes include: requirements to develop and document maintenance, overhaul, replacement, and inspection requirements in the absence of manufacturer's requirements; procedures to document and maintain maintenance records with regard to the petitioner's UAS; and UAS

technician qualification criteria. They also require the petitioner's FOPM to include preflight inspection procedures that account for any discrepancies not already covered in the manual. The FAA finds these additional requirements are necessary to ensure the petitioner's proposed UAS operations do not adversely affect safety in the NAS and of people and property on the ground. Therefore, the FAA finds that exemption from 14 CFR §§ 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b) is warranted subject to the conditions and limitations below.

Pilot In Command of the UAS

Regarding the petitioner's requested relief from 14 CFR § 61.113(a) and (b) Private pilot privileges and limitations, comments were received that voiced concerns about pilot certification. One such comment came from ALPA, which states that one of the "areas that must be addressed to ensure safe operations" is Astraeus' proposal to use a private pilot with a third class medical as its UAS PIC. ALPA believes that the UAS pilot should possess a commercial pilot certificate with appropriate category and class rating for the type of aircraft being flown and the corresponding second class medical certificate, as well as specific and adequate training on the UAS make and model intended to be used. Similar concerns were also raised by other associations such as USHPA and NAAA.

Given these grounds, the FAA must determine the appropriate level of pilot certification for Astraeus' proposed operation. Title 14 CFR part 61 requires that operations conducted for compensation or hire necessitate a commercial pilot certificate and at least a second class medical certificate. In considering the petitioner's requested relief from 14 CFR § 61.113(a) and (b), the FAA must consider the following factors as they relate specifically to Astraeus' proposed operations:

Separation from manned aircraft operations: Astraeus proposes operations in a "sterile environment" of closed-set motion-picture filming. In this controlled environment, their operations will remain within visual line of site (VLOS) and below 400 feet AGL. Additionally, the FAA has added further conditions and limitations that will require a Certificate of Waiver or Authorization (COA) from the FAA Air Traffic Organization to address airspace requirements and notification requiring Astraeus to request a Notice to Airman (NOTAM) not more than 72 hours in advance, but not less than 48 hours prior to the operation. Astraeus will also be required to avoid and yield right-of-way to all manned operations.

The current aeronautical knowledge requirements for a private pilot compared to a commercial pilot: The FAA analyzed the areas of knowledge specified in 14 CFR part 61 for that of a commercial pilot versus a private pilot. The results show that the required areas of knowledge for a commercial versus private pilot cover the same fundamental principles, as shown in the following table.

Commercial Knowledge	Private Knowledge
****Airplane Single Engine Land (ASEL) used for comparison****	
§ 61.125 Aeronautical knowledge. *(a) General.* A person who applies for a commercial pilot certificate must receive and log ground training…	**§ 61.105 Aeronautical knowledge.** *(a) General.* A person who is applying for a private pilot certificate must receive and log ground training…
(b) **Aeronautical knowledge areas.**	(b) **Aeronautical knowledge areas.**
(1) Applicable Federal Aviation Regulations of this chapter that relate to commercial pilot privileges, limitations, and flight operations;	(1) Applicable Federal Aviation Regulations of this chapter that relate to private pilot privileges, limitations, and flight operations;
(2) Accident reporting requirements of the National Transportation Safety Board;	(2) Accident reporting requirements of the National Transportation Safety Board;
(3) Basic aerodynamics and the principles of flight;	(10) Principles of aerodynamics, powerplants, and aircraft systems;
(4) Meteorology to include recognition of critical weather situations, windshear recognition and avoidance, and the use of aeronautical weather reports and forecasts;	(6) Recognition of critical weather situations from the ground and in flight, windshear avoidance, and the procurement and use of aeronautical weather reports and forecasts;
(5) Safe and efficient operation of aircraft;	(7) Safe and efficient operation of aircraft, including collision avoidance, and recognition and avoidance of wake turbulence;
(6) Weight and balance computations;	(9) Weight and balance computations;
(7) Use of performance charts;	(8) Effects of density altitude on takeoff and climb performance;
(8) Significance and effects of exceeding aircraft performance limitations;	**Related to other areas within the private requirements but not referenced specifically**
(9) Use of aeronautical charts and a magnetic compass for pilotage and dead reckoning;	(4) Use of aeronautical charts for VFR navigation using pilotage, dead reckoning, and navigation systems;
(10) Use of air navigation facilities;	(4) Use of aeronautical charts for VFR navigation using pilotage, dead reckoning**, <u>and navigation systems</u>**; (5) Radio communication procedures;
(11) Aeronautical decision making and judgment;	(12) Aeronautical decision making and judgment; and
(12) Principles and functions of aircraft systems;	(10) Principles of aerodynamics, powerplants, and aircraft systems;
(13) Maneuvers, procedures, and emergency operations appropriate to the aircraft;	(7) Safe and efficient operation of aircraft, including collision avoidance, and recognition and avoidance of wake turbulence; (11) Stall awareness, spin entry, spins, and spin recovery techniques for the airplane and glider category ratings;
(14) Night and high-altitude operations; **	**Although not mentioned in § 61.105, 3 hours of night flight training is required for the private per § 61.107 and § 61.109. For this comparison, high-altitude operations are considered not applicable.**
(15) Procedures for operating within the National Airspace System; and	(3) Use of the applicable portions of the "Aeronautical Information Manual" and FAA advisory circulars; (13) Preflight action that includes— (i) How to obtain information on runway lengths at airports of intended

	use, data on takeoff and landing distances, weather reports and forecasts, and fuel requirements; and (ii) How to plan for alternatives if the planned flight cannot be completed or delays are encountered.
(16) Procedures for flight and ground training for lighter-than-air ratings.**	**For this comparison (ASEL), these operations are considered not applicable.**
§ 61.127 Flight proficiency. (a) *General.* A person who applies for a commercial pilot certificate must receive and log **ground** and flight training	**§ 61.107 Flight proficiency.** (a) *General.* A person who applies for a private pilot certificate must receive and log **ground** and flight training
(b) *Areas of operation.* (1) For an airplane category rating with a single-engine class rating:	(b) *Areas of operation.* (1) For an airplane category rating with a single-engine class rating:
(i) Preflight preparation;	(i) Preflight preparation;
(ii) Preflight procedures;	(ii) Preflight procedures;
(iii) Airport and seaplane base operations;	(iii) Airport and seaplane base operations;
(iv) Takeoffs, landings, and go-arounds;	(iv) Takeoffs, landings, and go-arounds;
(v) Performance maneuvers;	(v) Performance maneuvers;
(vi) Ground reference maneuvers;	(vi) Ground reference maneuvers;
(vii) Navigation;	(vii) Navigation;
(viii) Slow flight and stalls;	(viii) Slow flight and stalls;
(ix) Emergency operations;	(x) Emergency operations;
(x) High-altitude operations; and	**For this comparison, high-altitude operations are considered not applicable.**
(xi) Postflight procedures.	(xii) Postflight procedures.
Not referenced specifically	(ix) Basic instrument maneuvers;
Not referenced specifically	(xi) Night operations, except as provided in §61.110 of this part; and

The specific UAS airmanship skills required for Astraeus' PIC(s): Some of the requirements for Astraeus' PIC(s) are provided in their proprietary documents. However, as with other exemptions that contain specific pilot qualifications, e.g. Exemption Nos. 7830, 6802K, and 6540N, those pilot requirements become conditions and limitations within the grant of exemption. An abbreviated summary of those PIC requirements include the following:

a. The PIC must possess a Private Pilot's Certificate and a valid third-class medical certificate;

b. The PIC must have accumulated and logged a minimum of 200 flight cycles and 25 hours of total time as a UAS rotorcraft pilot and at least 10 hours logged as a UAS pilot with a similar UAS type (single blade or multirotor).

c. The PIC must have accumulated and logged a minimum of five hours as UAS pilot with the make and model of UAS to be utilized for operations under the exemption and three take-offs and landings in the preceding 90 days.

d. The PIC must have successfully completed the qualification process as specified in the MPTOM and FOPM, to include a knowledge and skill test.

The FAA's analysis regarding PIC requirements: The parallel foundation of aeronautical knowledge required for private and commercial pilots is shown in the above table. Private

pilot airmanship skills are furthered through manned flights in the NAS. Commercially certificated pilots build additional experience through these manned flights as well. The additional experience and airmanship skills obtained by commercially certificated airmen contribute to their ability to overcome adverse situations that could be encountered in flights conducted for compensation or hire. However, the experience obtained beyond a private pilot certificate in pursuit of a commercial pilot certificate in manned flight does not necessarily aid a pilot in the operational environment proposed by the petitioner; the FAA considers the overriding safety factor for the limited operations proposed by the petitioner to be the airmanship skills acquired through UAS-specific flight cycles, flight time, and specific make and model experience, culminating in verification through testing.

The FAA shares ALPA's concerns regarding appropriate training on the UAS being utilized. The FAA has reviewed the petitioner's knowledge and experience criteria for its PICs. The FAA finds that the combination of aeronautical knowledge, UAS airmanship skills, and verification through testing is a sufficient method for Astraeus to evaluate a pilot's qualifications, given that operations will be conducted within the limitations outlined in this exemption.

The knowledge and airmanship test qualifications have been developed by Astraeus for the UAS operations proposed in their petition for exemption. There are no established practical test standards that support a jurisdictional FAA FSDO evaluation and approval of company designated examiners. The petitioner will conduct these tests in accordance with its FOPM and the conditions and limitations noted below. Given the constraints of the proposed operations, the FAA believes this would not adversely affect the safety of the NAS.

The petitioner plans to operate in a unique and limited environment. Given the 1) separation of these closed-set filming operations from other manned operations, 2) the parallel nature of private pilot aeronautical knowledge requirements to those of commercial requirements, and 3) the UAS airmanship skills of Astraeus' PICs, the FAA finds that the additional manned airmanship experience of a commercially certificated pilot would not correlate to the airmanship skills necessary for Astraeus' specific proposed operations. Upon consideration of the overall safety case presented by the petitioner and the concerns of the commenters, the FAA finds that granting the requested relief from 14 CFR § 61.113(a) and (b), provided the conditions and limitations outlined below, would not adversely affect the safety of the NAS.

Another consideration supporting the certificate requirement is that pilots holding a private pilot certificate are subject to security screening by the Department of Homeland Security. This requirement should ameliorate security concerns over UAS operations under this exemption.

Operating parameters of the UAS

Astraeus has stated that it plans to comply with the waiver process as described in FAA Order 8900.1, Volume 3, Chapter 8, Section 1 (V3, C8, S1) Issue a Certificate of Waiver for Motion Picture and Television Filming. The FAA agrees with this philosophy; however, the current section of Order 8900.1 has specific processes that preclude a jurisdictional FAA FSDO from issuing the required Certificate of Waiver, because the section did not originally provide for

UA operations. One example of this is the minimum pilot qualifications – the pertinent section of Order 8900.1 provides no way to relieve Astraeus from the pilot requirements. Also, the sample form 7711-1 used for issuing the Certificate of Waiver specifically states "this section not used for Unmanned Air Vehicle authorizations."

Therefore, the FAA will exempt Astraeus from the applicable regulations normally waived during that process. The FAA will then include the required notifications and coordination with jurisdictional FSDOs through the conditions and limitations listed below. Motion picture and television filming waivers similar to Astraeus' operation are normally issued from one jurisdictional FSDO and can be used in locations covered by other geographically responsible FSDOs through notification. Those local FSDOs then have the ability to review the proposed plan of activities and associated operations manual(s) and levy any additional local special provisions. Since Astraeus' operation deals specifically with UAS, this exemption will take the place of the Certificate of Waiver normally issued by a jurisdictional FSDO under 8900.1 V3, C8, S1. Every FSDO with jurisdiction over the area that Astraeus plans to operate within must still be notified, just as with manned filming operations, and those FSDOs will have the ability to coordinate further conditions and limitations with the UAS Integration Office to address any local concerns, as stated below in the conditions and limitations section of this exemption.

The petitioner must also obtain a Certificate of Waiver or Authorization (COA) from the FAA's Air Traffic Organization (ATO) prior to conducting any operations. This is an existing process that not only makes local Air Traffic Control (ATC) facilities aware of UAS operations, but also provides ATO the ability to consider airspace issues that are unique to UAS operations. The COA will require the operator to request a Notice to Airman (NOTAM), which is the mechanism for alerting other users of the NAS to the UAS activities being conducted. Therefore, the FAA believes that adherence to this process is the safest and most expeditious way to permit Astraeus to conduct their proposed UAS operations. The conditions and limitations below prescribe the requirement for Astraeus to obtain an ATO-issued COA.

Regarding the petitioner's requested relief from 14 CFR § 91.7(a) Civil Aircraft Airworthiness, Astraeus' request is based on the fact that no airworthiness certificate will be issued for the UAS. As previously noted, the petitioner's UAS will not require an airworthiness certificate in accordance with 14 CFR part 21, Subpart H. Based on the fact that an airworthiness certificate will not be issued, exemption from § 91.7(a) is not necessary.

In accordance with the pertinent part of 14 CFR § 91.7(b), the PIC of the UAS is responsible for determining whether the aircraft is in condition for safe flight. The petitioner's manuals for maintenance and operations include safety checklists to be used prior to each flight.

Regarding the petitioner's requested relief from 14 CFR § 91.9(b)(2) Civil aircraft flight manual, marking, and placard requirements and § 91.203(a) and (b) Civil aircraft: Certifications required, the original intent of these regulations was to display an aircraft's airworthiness, certification, and registration documents so they would be easily available to inspectors and passengers. Based on the FAA Memorandum subject "Interpretation regarding whether certain required documents may be kept at an unmanned aircraft's control station,"

dated August 8, 2014, the requested relief from 14 CFR §§ 91.9(b)(2) and 91.203(a) and (b) is not necessary.

Regarding the petitioner's requested relief from 14 CFR § 91.103 Preflight action, although there will be no approved Airplane or Rotorcraft Flight Manual as specified in paragraph (b)(1), the FAA believes that the petitioner can comply with the other applicable requirements in 14 CFR § 91.103(b)(2). The procedures outlined in the petitioner's MPTOM and FOPM address the FAA's concerns regarding compliance with § 91.103(b). The petitioner has also stated its intent to comply with § 91.103(a): "The PIC will take all actions including reviewing weather, flight battery requirements, landing and takeoff distances and aircraft performance data before initiation of flight." The FAA has imposed stricter requirements with regard to visibility and distance from clouds; this is to both keep the UA from departing VLOS and to preclude the UA from operating so close to a cloud as to create a hazard to other aircraft operating in the NAS. The FAA also notes the risks associated with sun glare; the FAA believes that the PIC's and VO's ability to still see other air traffic, combined with the PIC's ability to initiate a return-to-home sequence, are sufficient mitigations in this respect. The PIC will also account for all relevant site-specific conditions in their preflight procedures. Therefore, the FAA finds that exemption from 14 CFR § 91.103 is not necessary.

Regarding the petitioner's requested relief from 14 CFR § 91.109 Flight instruction; Simulated instrument flight and certain flight tests, the petitioner did not describe training scenarios in which a dual set of controls would be utilized or required, i.e. dual flight instruction, provided by a flight instructor or other company-designated individual, that would require that individual to have fully functioning dual controls. Rather, Astraeus evaluates the qualification of its PICs based on their experience with the UAS to be operated and verifies through testing, in lieu of formalized training. As such, the FAA finds that the petitioner can conduct its operations without the requested relief from 14 CFR § 91.109.

Regarding the petitioner's requested relief from 14 CFR § 91.119 Minimum safe altitudes, the petitioner failed to specify the pertinent part of 14 CFR § 91.119 from which they require relief. Relief from 14 CFR § 91.119(a) , which requires operating at an altitude that allows a safe emergency landing if a power unit fails, is unprecedented and unwarranted. Relief from § 14 CFR 91.119(b), operation over congested areas, is not applicable, because the petitioner states that operations will only be conducted within the sterile area described in the MPTOM.

Although the petitioner specifically mentioned relief from 14 CFR § 91.119(d), the FAA finds that relief is only needed from 14 CFR § 91.119(c), which is consistent with the relief typically provided to manned operations in FAA Order 8900.1 V3, C8, S1 Issue a Certificate of Waiver for Motion Picture and Television Filming. This Order allows for relief from § 91.119(c) with respect to those participating persons, vehicles, and structures directly involved in the performance of the actual filming. In accordance with the petitioner's stated intention to adhere to Order 8900.1 V3, C8, S1, persons other than participating persons[1] are not allowed

[1] Per Order 8900.1 V3, C8, S1, participating persons are all persons associated with the filming production, and they must be briefed on the potential risk of the proposed flight operation(s) and must acknowledge and accept those risks. Nonparticipating persons are the public, spectators, media, etc., not associated with the filming production.

within 500 feet of the operating area. This provision may be reduced to no less than 200 feet if an equivalent level of safety can be achieved and the Administrator has approved it. For example, an equivalent level of safety may be determined through evaluation by an aviation safety inspector of the filming production area to note terrain features, obstructions, buildings, etc. Such barriers may protect nonparticipating persons (observers, the public, news media, etc.) from debris in the event of an accident.

The FAA notes the petitioner's additional guidelines in its MPTOM to protect its participating production personnel, and finds that relief from 14 CFR § 91.119(c) is warranted, provided adherence to the procedures outlined in the petitioner's MPTOM and FOPM, and the FAA's additional conditions and limitations outlined below. However, all nonparticipating personnel will be required to be at least 500 feet from flight operations, with possible relief to allow reductions to 200 feet, as specified above.

Regarding the petitioner's requested relief from 14 CFR § 91.121 *Altimeter Settings*, the FAA believes that an altitude reading is a critical safety component of the petitioner's proposed operation. Although the petitioner will not have a typical barometric altimeter onboard the aircraft, the FAA finds the petitioner's intention to operate the UA within VLOS and at or below 400 feet AGL, combined with the petitioner's intention to provide altitude information to the UAS pilot via a digitally encoded telemetric data feed, which downlinks from the aircraft to a ground-based on-screen display, to be a sufficient method for ensuring the UAS operations do not adversely affect safety. The altitude information will be generated by equipment installed onboard the aircraft, as specified using GPS triangulation, or digitally encoded barometric altimeter, or radio altimeter, or any combination thereof. Prior to each flight, a zero altitude initiation point will be established and confirmed for accuracy by the UAS PIC. The FAA has determined that good cause exists for granting the requested relief to 14 CFR § 91.121.

Regarding the petitioner's requested relief from 14 CFR § 91.151(a) Fuel requirements for flight in VFR conditions, relief has been granted for manned aircraft to operate at less than the minimums prescribed in 14 CFR § 91.151(a), including Exemption Nos. 2689, 5745, and 10650. In addition, similar UAS-specific relief has been granted in Exemption Nos. 8811, 10808, and 10673 for daytime, Visual Flight Rules (VFR) conditions. The petitioner states that its UAS operations will be conducted in a controlled closed-set filming environment, with UA under 55 pounds, at speeds below 50 Knots, and within VLOS. These factors, combined with Astraeus' stated intention to terminate flights after 30 minutes or with 25% remaining battery power (whichever occurs first), provides the FAA sufficient reason to grant the relief from 14 CFR § 91.151(a) as requested in accordance with the conditions and limitations proposed by Astraeus.

With respect to the petitioner's request to operate at night, the FAA finds that the petitioner has not provided a sufficient safety case and mitigations, per FAA Order 8900.1 V16, C5, S3 General Operational Requirements, to avoid collision hazards at night. All previous UAS-specific grants of relief from 14 CFR § 91.151(a) have restricted flights to daytime VFR conditions only. While the FAA acknowledges the petitioner's stated film set lighting techniques to mitigate the risks of nighttime operations, the petitioner has not provided

sufficient data and analysis regarding the PICs' and VOs' ability to maintain VLOS with the UA and conduct their functions to see and avoid other potential obstacles and air traffic, relative to the lighting configuration on the film set. There is a limitation outlined below that precludes nighttime UAS operations. The petitioner may provide additional data and seek an amendment to its exemption to permit night operations.

Additionally, in evaluating the petitioner's proposed operating parameters with regard to VLOS and a safe operating perimeter, the FAA considered operations from a moving device or vehicle. Since the petitioner did not discuss provisions for these circumstances, the conditions and limitations below preclude operations from moving devices or vehicles.

Public Interest

The FAA finds that a grant of exemption is in the public interest. The enhanced safety achieved using a 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. The FAA also finds that UAS provide an additional tool for the filmmaking industry, adding a greater degree of flexibility, which supplements the current capabilities offered by manned aircraft.

The table below summarizes the FAA's determinations regarding the relief sought by the petitioner:

Relief sought by petitioner (14 CFR)	**FAA determination (14 CFR)**
Part 21	Not necessary
45.23(b)	Not necessary
61.113(a) and (b)	Granted with conditions and limitations
91.7(a)	Not necessary
91.9(b)(2)	Not necessary
91.103	Not necessary with conditions and limitations
91.109	Not necessary
91.119	Paragraph (c) granted with conditions and limitations
91.121	Granted with conditions and limitations
91.151(a)	91.151(a)(1), day, granted with conditions and limitations; 91.151(a)(2), night, denied
91.203(a) and (b)	Not necessary
91.405(a)	Granted with conditions and limitations
91.407(a)(1)	Granted with conditions and limitations

91.409(a)(2)	Granted with conditions and limitations; relief from 91.409(a)(1) also granted with conditions and limitations
91.417(a) and (b)	Granted with conditions and limitations

The FAA's 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, Astraeus Aerial is granted an exemption from 14 CFR §§ 61.113(a) and (b); 91.119(c); 91.121; 91.151(a); 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 Astraeus to operate unmanned aircraft systems (UAS) for the purpose of scripted, closed-set filming for the motion picture and television industry. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

Relative to this grant of exemption, Astraeus is hereafter referred to as the operator.

The Flight Operations and Procedures Manual (FOPM) and Motion Picture and Television Operations Manual (MPTOM) are hereafter collectively referred to as the operator's manual.

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.

The operator proposed the following conditions and/or limitations, which were accepted by the FAA.[2]

1. The unmanned aircraft (UA) must weigh less than 55 pounds (25 Kg), including energy source(s) and equipment. Operations authorized by this grant of exemption are limited to the following aircraft described in the operator's manual: Astraeus Aerial Cinema System V.3CS UAS aircraft variant, serial #001 onward (V.3). Proposed operations of any other aircraft will require a new petition or a petition to amend this grant.

2. The UA may not be flown at a ground speed exceeding 50 knots.

3. Flights must be operated at an altitude of no more than 400 feet above ground level (AGL), as indicated by the procedures specified in the operator's manual. All altitudes reported to ATC must be in feet AGL.

[2] Conditions and limitations outlined by the operator may have been modified for clarity.

4. 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 medical certificate.

5. All operations must utilize a visual observer (VO). 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.

6. The operator's manual is considered acceptable to the FAA, provided the additional requirements identified in these conditions and limitations are added or amended. The operator's manual and this grant of exemption must be maintained 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 operator's manual, the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operator's manual.

   The operator may update or revise its operator's manual. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator upon request. The operator must also present updated and revised documents if it petitions for extension or amendment. If the operator determines that any update or revision would affect the basis for which the FAA granted this exemption, then the operator must petition for amendment to their exemption. The FAA's UAS Integration Office (AFS-80) may be contacted if questions arise regarding updates or revisions to the operator's manual.

7. Prior to each flight the PIC must inspect the UAS to ensure it is in a condition for safe flight. 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. The Ground Control Station, if utilized, must be included in the preflight inspection. All maintenance and alterations must be properly documented in the aircraft records.

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 in accordance with the operator's manual. The PIC who conducts the functional test flight must make an entry in the UAS aircraft records of the flight. The requirements and procedures for a functional test flight and aircraft record entry must be added to the operator's manual.

9. The operator must follow the manufacturer's UAS aircraft/component, maintenance, overhaul, replacement, inspection, and life limit requirements. When unavailable, aircraft maintenance/component/overhaul, replacement, and inspection/maintenance requirements must be established and identified in the operator's manual. At a minimum, requirements for the following must be included in the operator's manual:

a. Actuators / Servos;

b. Transmission (single rotor);

c. Powerplant (motors);

d. Propellers;

e. Electronic speed controller;

f. Batteries;

g. Mechanical dynamic components (single rotor);

h. Remote command and control;

i. Ground control station (if used); and

j. Any other components as determined by the operator;

10. The Pilot In Command (PIC) must possess at least a private pilot certificate and at least a current third-class medical certificate. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

11. Prior to operations conducted for the purpose of motion picture filming (or similar operations), the PIC must have accumulated and logged, in a manner consistent with 14 CFR § 61.51(b), a minimum of 200 flight cycles and 25 hours of total time as a UAS rotorcraft pilot and at least ten hours logged as a UAS pilot with a similar UAS type (single blade or multirotor). Prior documented flight experience that was obtained in compliance with applicable regulations may satisfy this requirement. Training, proficiency, and experience-building flights can also be conducted under this grant of exemption to accomplish the required flight cycles and flight time. 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.

12. Prior to operations conducted for the purpose of motion picture filming (or similar operations), the PIC must have accumulated and logged, in a manner consistent with 14 CFR § 61.51(b), a minimum of five hours as UAS pilot operating the make and model of UAS to be utilized for operations under the exemption and three take-offs and three landings in the preceding 90 days. Training, proficiency, experience-building, and take-off and landing currency flights can be conducted under this grant of exemption to accomplish

the required flight time and 90 day currency. During training, proficiency, experience-building, and take-off and landing currency flights all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

13. Prior to any flight operations authorized by this grant of exemption, the PIC and VO must have successfully completed a qualification process, as outlined in the operator's manual. As this is a requirement stipulated by the operator, the test must be developed and implemented by a qualified person designated at the sole discretion of the operator. A record of completion of this qualification process must be documented and made available to the Administrator upon request.

14. Prior to operations conducted for the purpose of motion picture filming (or similar operations), a flight demonstration, administered by an operator-approved and -qualified pilot must be successfully completed and documented. This documentation must be available for review upon request by the Administrator. Because the knowledge and airmanship test qualifications have been developed by the operator, and there are no established practical test standards that support a jurisdictional FAA FSDO evaluation and approval of company designated examiners, the petitioner will conduct these tests in accordance with the operator's manual.

15. The UA may not be operated directly over any person, except authorized and consenting production personnel, below an altitude that is hazardous to persons or property on the surface in the event of a UAS failure or emergency.

16. Regarding the distance from participating persons, the operator's manual has safety mitigations for authorized and consenting production personnel. At all times, those persons must be essential to the closed-set film operations. Because these procedures are specific to participating persons, no further FSDO or aviation safety inspector approval is necessary for reductions to the distances specified in the petitioner's manuals. This is consistent with the manned aircraft procedures described in FAA Order 8900.1, V3, C8, S1 Issue a Certificate of Waiver for Motion Picture and Television Filming.

17. Regarding distance from nonparticipating persons, the operator must ensure that no persons are allowed within 500 feet of the area except those consenting to be involved and necessary for the filming production. This provision may be reduced to no less than 200 feet if it would not adversely affect safety and the Administrator has approved it. For example, an equivalent level of safety may be determined by an aviation safety inspector's evaluation of the filming production area to note terrain features, obstructions, buildings, safety barriers, etc. Such barriers may protect nonparticipating persons (observers, the public, news media, etc.) from debris in the event of an accident. This is also consistent with the same FAA Order 8900.1, V3, C8, S1.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the security perimeter and land or be recovered in accordance with the operator's manual.

19. The UAS must abort the flight in the event of unpredicted obstacles or emergencies in accordance with the operator's manual.

20. Each UAS operation must be completed within 30 minutes flight time or with 25% battery power remaining, whichever occurs first.

In addition to the conditions and limitations proposed by the operator, the FAA has determined that any operations conducted under this grant of exemption must be done pursuant to the following conditions and limitations:

21. The operator must obtain an Air Traffic Organization (ATO) issued Certificate of Waiver or Authorization (COA) prior to conducting any operations under this grant of exemption. This COA will also require the operator to request a Notice to Airman (NOTAM) not more than 72 hours in advance, but not less than 48 hours prior to the operation.

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. The operator must develop procedures to document and maintain a record of the UAS maintenance, preventative maintenance, alterations, status of replacement/overhaul component parts, and the total time in service of the UAS. These procedures must be added to the operator's manual.

24. Each UAS operated under this exemption must comply with all manufacturer Safety Bulletins.

25. The operator must develop UAS technician qualification criteria. These criteria must be added to the operator's manual.

26. The preflight inspection section in the operator's manual must be amended to include the following requirement: The preflight inspection must account for all discrepancies, i.e. inoperable components, items, or equipment, not covered in the relevant preflight inspection sections of the operator's manual.

27. Before conducting operations, the radio frequency spectrum used for operation and control of the UA must comply with the Federal Communications Commission (FCC) or other appropriate government oversight agency requirements.

28. At least three days before scheduled filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local 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 filming production 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 filming production event;

    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.

29. The 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.

30. The UA must remain clear and yield the right of way to all other manned operations and activities at all times (including, but not limited to, ultralight vehicles, parachute activities, parasailing activities, hang gliders, etc.).

31. 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.

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

33. 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.

34. The UA may not operate in Class B, C, or D airspace without written approval from the FAA. The UA may not operate within 5 nautical miles of the geographic center of a non-towered airport as denoted on a current FAA-published aeronautical chart unless a letter of agreement with that airport's management is obtained, and the operation is conducted in accordance with a NOTAM as required by the operator's COA. The letter of agreement with the airport management must be made available to the Administrator upon request.

35. 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. Further flight operations may not be conducted until the incident, accident, or transgression is reviewed by AFS-80 and authorization to resume operations is provided.

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 September 30, 2016, unless sooner superseded or rescinded.

Issued in Washington, DC, on September 25, 2014. .

/s/
Michael J. Zenkovich
Deputy Director, Flight Standards Service

3 killed in crash when helicopter hits power lines near Silt in western Colorado

Chopper crew was inspecting power lines

BY: Brian Hernandez (mailto:brian.hernandez@kmgh.com)
POSTED: 12:57 PM, Jan 27, 2014
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TAG: denver (/topic/denver) | crash (/topic/crash) | 7news (/topic/7news) | kmgh (/topic/kmgh) | helicopter (/topic/helicopter)

SILT, Colo. - Authorities say a helicopter conducting a power line inspection tour near Silt in western Colorado hit power lines and crashed on Monday, killing all three people on board.

The Garfield County Sheriff's Office said the crash occurred at around 11:20 a.m. near Dry Hallow Road -- about 2 miles off Interstate 70.

The helicopter crashed when it struck power lines while performing survey work for a power company, said Allen Kenitzer, a spokesman for the Federal Aviation Administration.

Sheriff's Office spokesman Walt Stowe said witnesses saw the crash and drove to the scene to help, but all three occupants were dead. Stowe said the crash debris was in a tight area, no more than 50-feet wide.

"The terrain is kind of hilly, ravines and draws" covered by sage brush, Stowe said.

A deputy is guarding the crash site until National Transportation Safety Board and FAA officials arrive.

Kenitzer says a preliminary report will likely be completed by the NTSB in the next week or two.

7NEWS has learned that the chopper was registered to DBS Helicopters (http://www.dbshelicopters.com/) in Rifle, Colo.

According to the company's website, it operates the Bell LongRanger L3 helicopter.

The names of the victims have not been released.

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BIRMINGHAM, ALA.

Power-line-inspection copter crashes in Alabama; 2 killed

From wire reports • Wednesday August 20, 2014 5:37 AM

Two people died when a helicopter crashed yesterday during a flight to inspect power lines in rural western Alabama, authorities said.

The helicopter was being used to monitor high-voltage power lines in a remote area about 30 miles west of Birmingham when it crashed, killing both the pilot and a worker for Alabama Power Co., authorities said.

The helicopter, a McDonnell Douglas 369E, was owned by RotorWorks, a Georgia-based contracting firm that also employed the pilot, he said.

Turlock man killed in power line accident

Sabra Stafford
sstafford@turlockjournal.com
August 8, 2013

A Turlock man working as a line inspector in Texas died Monday when the helicopter cable he was tethered to snapped.

David Edward Oliveira, 26, of Turlock and Christopher Geoffrey Breed, 27, of Moscow, Idaho, were killed in the accident in Martin County, Texas.

Both men were attached to a cable that was suspended from a helicopter that was flying over a rural section of Texas to do line inspections. The men fell more than 100 feet to their death when the cable struck a power line, according to the Martin County Sheriff's Office.

Oliveira and Breed were employed with Haverfield Aviation, based in Pennsylvania. The two men were conducting an aerial inspection of power lines that transfer windmill energy for Wind Energy Transmission Texas.

The helicopter pilot was able to land nearby and was taken to an area hospital with an unspecified injury.

The accident is under investigation by the Federal Aviation Administration, the National Transportation Safety Board and the Occupational Safety and Health Administration.

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8th CIRP Conference on Intelligent Computation in Manufacturing Engineering

A roadmap for automated power line inspection. Maintenance and repair.

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Abstract

Electrical power companies usually perform regular visual inspection to check the status of their transmission lines mainly using helicopter equipped with external gimbals housing infrared and ultraviolet camera to detect hot spots and corona discharges. This solution is quite expensive, dangerous for the crew and not very reliable. Focus of this paper is, presenting the state of the art of the most important current projects concerning the two main categories of robots offering a solution of automation, vertical take-off and landing (VTOL) unmanned aerial vehicles (UAVs) and rolling on wires robots (RWR), to create a simple roadmap that can guide researchers and industries in the implementation of a *"FULLY AUTOMATED LIVE LINE POWER LINE INSPECTION CONCEPT"*: a rigorous live line inspection strategy based on a completely autonomous mobile platform capable of a meaningful payload and a power line data management system including specific tool for image and signal data processing to automatically detect defects or abnormal conditions.

Keywords: Fully Automated Power Line Inspection Concept; RWR; VTOL UAVs; Power Line Data Management System.

1. Introduction

Especially nowadays, considering the progressive development of new green power generation plants, the need for a higher and more reliable electrical transport capacity is growing up in Europe (fig. 1). Since new electric power transmission line installations are usually not accepted by the public, the existing systems must be upgraded. The consequence is that the lines are always operated at the maximum and there are no redundancies or reserves to compensate breakdowns. Preventive maintenance is therefore of extreme importance.

In particular the high-voltage lines, usually, crossing thousands of kilometers in suburban environments, mountains and forests, are often exposed for long period to strenuous working condition such as thermal excursions, rain, ice, wind induced vibration, heavy temperatures, etc.. and contaminated environment (sour rains). These causes, together to the corrosion, more remarkable in areas affected by high pollution and sudden changing in temperature and humidity [2], induce fatigue ruptures that reduce the life time of the lines and high losses. In addition lightning bolts can also cause severe damaging as ruptures in strands and melting of wires.

Electrical power companies perform regular visual inspection mainly using helicopter equipped with external gimbals housing visual (daylight) camera, infrared camera to detect hot spots (damages on the cables and insulators have usually a direct consequence on their electrical resistance and therefore cause a local increasing in temperature) and ultraviolet camera to detect corona discharge (defective components cause a local electrical field increment and when it exceeds a critical value the air is ionized leading to emission of UV radiation) [3]. However this solution is quite expensive (≈1000 €/h), dangerous for the crew (the flight regime is low, slow and near the live line) and not very reliable. It can, in fact, provide images of only the upper part of the cables, and critical specifications such as internal corrosion of the steel reinforced aluminium conductors (ACSR) cannot be detected.

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Considering this background, focus of this project is to create a simple roadmap that can guide researchers and industries in the implementation of a "*FULLY AUTOMATED POWER LINE INSPECTION CONCEPT*": a rigorous live-line inspection strategy based on a completely autonomous mobile platform capable of a meaningful payload and a power line data management system including specific tool for image and signal data processing to automatically detect defects or abnormal conditions. In this way the reliability of the electric power supply will be increased and in the same time the costs reduced.

Fig. 1. 110 kV overhead lines [1]

In [4] e [5], power line robots are considered as "high-value applications" and key components in the developing a "smart transmission grid". In addition it is also examined that the main economical benefits of this new technology will be received not in the replacing linemen but in how it can extend the linemen´s own capabilities, in order to make optimal maintenance decisions.

2. Power line inspection robots

In the current state-of-the-art there are two main categories of power line inspection robots: vertical take-off and landing (VTOL) unmanned aerial vehicles (UAVs) and rolling on wires robots (RWR).

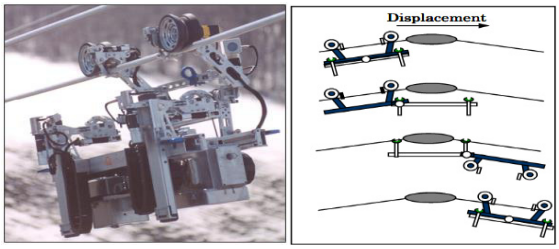
2.1. Rolling on wires robots - research projects -

In North America, at Hydro-Québec´s research institute (IREQ), a division of Hydro-Québec TransÉnergie that generates, transmits and distributes electricity, three different robotic technologies on complete systems have been developed since 1998 [6].

The first, LineROVer Technology, a remotely operated trolley, operative in 2000, is described in [7] [8]. Although, initially developed for de-icing is also used on live 315-kV for visual and infrared inspections, measuring compression splice electrical resistance, and replacing old conductors and overhead ground wires using the cradle-block stringing method [6].

The second technology, 2003, was designed to operate on two-, four-, and six- conductor bundles. It can cross obstacles found on the wires, including space-dampers and suspension clamps, in about 1 s [9].

The third, LineScout Technology, (fig. 2, a) presented in [11], [12], [13] was first used on the Hydro-Québec transmission network in 2006 in a teleoperated control. It is designed to travel along single energized conductors, including one of the conductors of a conductor bundle, and is immunized to electromagnetic and radio-frequency interferences (EMI/RFI) from lines of up to 735 kV [6].



(a) (b)

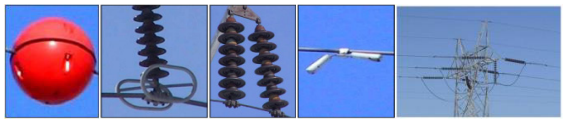
Fig. 2. (a) LineScout Technology; (b) obstacle-clearing sequence [10]

Its mechanical structure, capable to cross warning spheres (0,76m diameter), corona rings, double insulator strings and vibration dampers (fig. 3), is based on two "extremity frames" and a "centre frame" (fig. 2, b). All are independent from each other. The "extremity frames" are constituted by a "wheel frame" (dark frame) and an "arm frame" (light frame). The "wheel frame" includes two rubber "traction wheels" and a camera mounted on a pan-and-tilt unit. The "arm frame", besides two arms and two grippers includes other two cameras on a pan-and-tilt unit and most of the possible application modules. The "centre frame" (white circle) hosts the electronics on board and the battery pack. In addition it links the "extremity frames" and allow them to slid and rotate. In proximity of an obstacle in fact, the "arm frame" slides, so that the two arms and grippers can temporarily support the robot while the "wheel frame", rotated under the obstacle slides until it reaches the other side of the obstacle [10]. The obstacle-crossing sequence takes less than 2 min. The mechanical system is capable to overcome obstacles up to 0,76 m in diameter (warning spheres) and it is not limited to a specific distance between adjacent obstacles. This makes the system very versatile, but however crossing dead end structures and jumper cables (fig. 3, e) were not included in the design specifications [6]. More detail about the geometrical analysis focalized on the optimization of the platform's structure can be found in [14].

LineScout has a top linear speed of 1 m/s, weights 98 (112??)kg and has an autonomy of 5 hours.

In fig. 4 [6] are showed three installation methods developed and validated by line maintenance personnel, using insulated boom truck on a 69-kV circuit (fig. 4, a), insulated rope on a 735-kV (fig. 4, b), and an installation

on the overhead ground wire (OGW) above double 315-kV circuits (fig. 4, c).



(a) (b) (c) (d) (e)

Fig. 3. (a) warning spheres, (b) corona rings, (c) double insulator strings, (d) vibration dampers [10], (e) jumper cable located at an angle tower [6]

A fruitful collaboration between IREQ and the Research and Development Department of the British Columbia Transmission Corporation (BCTC) started in 2006 [15] (video).

BCTC that plan, build, operate and maintain British Columbia's electricity transmission system with over 18,000 km of power transmission lines established a Technology Roadmap [16] (video) concerning four broad categories: *Energy Security; Conservation, Efficiency and Environmental Leadership; Smart Grid; Future Grid*. In particular, in the latter, is outlined the implementation of automated inspection applications utilizing advanced technologies: line robots, UAVs, tele-operated arms, utilizing inspection devices such as high resolution visual, infrared and hyper-spectral cameras, corona probes, resistance measurements and other non-destructive test (NDT) methods, are considered as an important opportunity to improve in the field working methods productivity and worker safety [17].

The cooperative work between BCTC R&D and IREQ resulted in highly valuable data for BCTC and in improvement of the LineScout Technology being tested in different geographical, meteorological and operational environments [18]. Splash-proof feature became necessary: Hydro-Québec operates in fact in a cold, dry environment while in British Columbia sudden rain showers are common even in seasons considered dry. In addition new installation and removal methods were developed and new sensors were utilized [18].

(a) (b) (c)

Fig. 4. installation methods: (a) on a 69-kV circuit, (b) on a 735-kV, (c) on OGW above double 315-kV circuits [6].

In June 2010 this collaboration earned the highest electrical utility award from the Edison Electrical Institute, the Edison Award in the International Affiliate category [18].

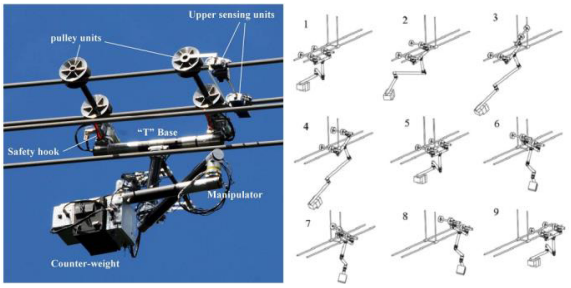
In Japan, HiBot Corp., in a joint project with Kansai Electric Power Corporation (KEPCO) and Tokyo Institute of Technology, has developed in 2008 Expliner [19].

This robot is designed for inspection up to 4 cables grouped in a bundle, and has been extensively tested in live lines up to 500kV. Its mechanical carbon fiber structure (fig. 5, a) is made by two pulley units, a T-shaped base, a counter-weight and a manipulator with 2 degrees of freedom.

Expliner carries 4 sensing units to inspect up to 4 cables simultaneously. The sensing units incorporates visual camera able to get images of the entire surface of the cables and laser sensors capable to identify changes in the diameter in the order of 0.5mm to detect internal corrosion along the line.

In fig. 5, b is showed the obstacle-overcoming sequence. In proximity of a suspender clamp, the front pulleys are lifted up by moving its counter-weight to the rear side, and then rotated outside so that Expliner can move forward until the front pulley have crossed the obstacles. The front pulleys are then rotated back inside, the manipulator moves the counter-weight until the center of mass is back to the center and the front pulleys are back on the transmission lines but after the obstacle. The same procedure is repeated with the rear pulleys by moving the counter weight forward.

Expliner weights 80 kg and has an autonomy of 6 hours.

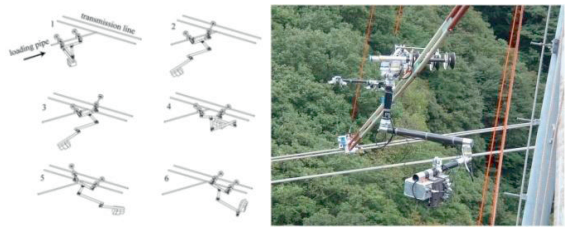


(a) (b)

Fig. 5. (a) Expliner and its main components [19]; (b) obstacle-overcoming sequence [19].

Original is the operational procedure to position Expliner on transmission lines. Instead of lifting the robot and using very long insulated rods to adjust his relative position on the live-line, a tower is connected to the line with a pipe called “loading pipe”. Expliner, assembled on the ground and placed on the tower, rolls on the loading pipe until it reaches the final extremity. At this point, since the loading pipe and the line are not each other aligned, Expliner performs a complex

obstacle-crossing motion called “Acrobatic Mode” (fig. 6). It is always based on the changing the position of the counter-weight backward/forward and lifting and rotating (this time the rotational angle depends on the angle formed between the loading pipe and the transmission line) respectively the front/ the rear pulleys.



(a) (b)

Fig. 6. (a) Expliner´s Acrobatic Mode; (b) Expliner moving on the loading pipe

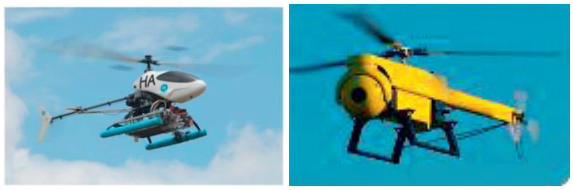
In total 2h35min are required to set the loading pipe and all necessary infrastructure, and 45 minutes are necessary for Expliner to move along the loading pipe and to enter in the transmission line. However pre-equipping the line the overall time could be strongly decreased.

Expliner is the winner of the 4th Robot Award (Japan Ministry of Economy, Trade and Industry).

2.2. Vertical take-off and landing unmanned aerial vehicles for power line inspection - research projects -

In Australia, researchers at the Australian Research Centre for Aerospace Automation (ARCAA), a joint venture between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Information & Communication Technologies (ICT) and the Queensland University of Technology (QUT), have been working on automated sensing, control and navigations systems in order to develop an autonomous helicopter for power line inspection which requires minimal operator input (for control) [20] [21]. The helicopters used as platform (fig. 7, a), are a commercial Radio Controlled helicopter, powered by a 23cc two-stroke gas engine, 1.8 m rotor diameter, 55 min. endurance with 1,2 l fuel, maximum takeoff weight of 12,3 kg (base platform 7,7 kg, 4,6 kg for fuel, sensors and flight computers) [22], and an autonomous helicopter (T21) (fig. 7, b) [23] [24], powered by micro-turbine, 2,2 m rotor diameter, 1 – 1,5 hrs endurance, maximum take off 30 kg (empty weight 15 kg).

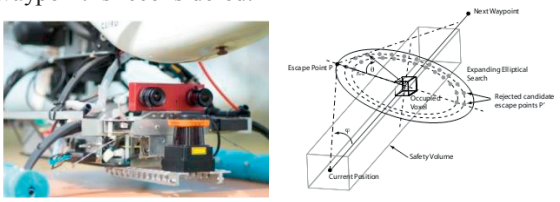
Their activity in particular has concentrated to develop obstacle detection and path planning for avoidance using stereo vision and laser scanning (fig. 8, a) to generate a 3D Occupancy Map of the environment [22].



(a) (b)

Fig. 7. (a) commercial radio controlled helicopter [22]; (b) T21 [23]

The stereo camera (8mm lens, field of view 27°×20°) can detect obstacles such as trees and steel towers at 30m with an error of approx 2m. The laser scanning (270° field of view, maximum range of 30m, 40 Hz update rate) can detect steel structures at 30 m but trees and bushes at only approximately 20 m depending on the reflexive properties of the feature being sensed. The concept (the obstacle detection and avoidance) is illustrated in fig. 8, b. From the UAV´s current position, a “*safety volume*” is projected forwards along the current flight path until the next waypoint is reached. If an obstacles O is detected within the Safety Volume, an “*Escape Point*” P is searched in free space expanding ellipses having a radius at least r_{min} from the detected obstacles, centered in O, and perpendicular to the vector joining the current UAV position to the goal waypoint. Once that the Escape Point is reached the original goal waypoint is reconsidered.



(a) (b)

Fig. 8. (a) stereo camera and laser scanner [22]; (b) safety volume, escape point P, expanding elliptical search [22]

In Spain, at the Polytechnic University of Madrid research activities are focalized on development of techniques that use visual information as main input for autonomous navigations of UAVs towards features of interest when GPS signals are not reliable or sufficient. [25]. The platforms used are a gas powered Industrial Twim 52 c.c helicopters and a Rotomotion SR20 UAV with an electric motor of 1,300 W, 8A. More precisely by GPS signals the UAV is directed and aligned in proximity of the structure of interest and from there visual tracking is used to determine position or velocity relative to the target. Image processing algorithms as Harris Corner detector, or SIFT (scale invariant feature transform) detector are used to extract characteristics, called features, from the images that are then used as

reference for the visual flight control. Feature tracking algorithms, as Lukas-Kanade, are used to track features in consecutive images, giving to the UAV the capability to follow objects. A visual stereo system is used on board the helicopter in a configuration looking down, perpendicular to the ground, and in another looking forward. The estimated distance, calculated matching features between left and right images and then using the disparity principle, corresponds thus in the first (looking down) configuration to the UAV altitude and in the second (looking forward) configuration to the distance between the UAV and an object. Image processing and feature tracking are fundamental aspects in the visual control loop, the fourth in the flight control system. In fact, the first control loop governs the attitude of the helicopter interacting directly over the servomotors. The second, a velocity-based control, is responsible to generate the references for the attitude control. The third, a position based control, is designed to receive the GPS coordinates. By a switching layer, it is possible to switch between the latter and the visual based control achieving so visual servoing.

3. Conclusions

UAVs, especially for military operations, are a technology already worldwide widespread and several are their possible dimensions and characteristics (payload, endurance, ecc…). Several are also the available commercial VTOL UAVs and the academic research projects. Nevertheless UAVs dedicated (customized) to completely autonomous inspection of electrical power line, are still an emerging technology. Many concrete results are reached but however further improvements are still necessary. Further projects, considering in particular the specific constraints for a completely autonomous live line inspection can be in the following areas:

- Visual servoing for power line tracking (just a GPS system is not sufficient for an autonomous navigation capable to follow the lines, but must be complemented with other systems)
- Obstacle detection and avoidance (considering the consequence of a crash in a live line , this become an essential aspect for a reliable autonomous inspection system)
- Robust control algorithms for flight dynamics, ensuring a very high stability and positioning capability for close and precise inspections in particular in case of adverse weather conditions like strong lateral wind (in [26] BCTC identifies as requirement for a power line inspection UAV the capability to operate in 60 km/h wind)

Rolling on wires robots are more recent technologies but slowly are proving to be a very practical and valuable means to become part of the inspection standard working methods. The state-of-the-art in fact shows that many goal as, a compact, reliable remotely operated locomotion system capable to cross most of the obstacles present on the lines, a significant payload, a sufficient autonomy (about 18 km), and the capability to work without de-energizing high voltage lines (electromagnetic immunity) are reached. There are also other indisputable advantages and potentiality. Being, in fact, able to detect the status of the cable from close distances and allowing also contact measurements achieve a higher level of inspection data completeness, made possible also thank a high payload capability. In addition they have the potentiality to increase the level of autonomy being powered directly from the live lines. However there are (also for the rolling on wires robots) some critical aspects that must be still developed to obtain a completely autonomous mobile inspection platform that does not imply any human intervention. Future research projects can be to achieve:

- A completely autonomous navigation system capable to detect, identify and cross obstacles. Particular attention must be paid for broken strands. They, in fact, unlike the typical obstacles (warning spheres, dampers, insulators, ecc.) are present in unpredictable locations and do not have a well definite shape.
- A battery recharging system from the live line that can extend the autonomy up to several days combined with a more versatile mechanical concept capable to cross all types of obstacles (like jumper cable) .With a traditional manned helicopter, in fact, usually 120 – 170 km of lines per day are inspected [27] and the cruising speed of a rolling on wires robots cannot be significantly incremented for safety reasons in case of broken strands. A good compromise to optimize the economic impact could be to extend properly the autonomy and maybe to design an energy management system that during the night (dark) hours can recharge the robots being so ready to work with the first lights of the day.
- A fast and automated installation method on the line. In [5] the authors consider that to maximize the benefits the installation on the live line should be within 30 minutes. For this point and for the inspection of other critical components of the line, like the insulators and the support structures, the UAVs VTOL, being able of quasi-static positioning could play a fundamental auxiliary role anchoring the rolling on wires robots on the lines contributing to make the entire process completely automated.

To complete the entire process, independent from the mobile platform utilized (UAVs VTOL or RWR), fundamental becomes also to develop a data

management system including specific tool for image and signal data processing to automatically detect defects or abnormal conditions. In fact, huge quantity of data will be collected (the power lines runs for thousands and thousands of kilometers) and it is also important to consider that the value of these mobile platforms lies properly in the payload namely in the completeness and accuracy of the data collected : visual, electrical, thermal, audible, ecc. Thus, an automated system capable to elaborate all the data stored gives an essential additional value to optimize the benefits (advantages) making a further difference with respect to the traditional inspection methods.

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Pipeline Incident 20 Year Trends

Pipeline Incidents

PHMSA has collected pipeline incident reports since 1970. The reporting regulations and incident report formats have changed several times over the years. PHMSA merged the various report formats to create pipeline incident trend lines going back 20 years.

The trend links to the right will initially present reports including all data for the incident type. The reports can be filtered by State and by System Type:

Gas Distribution	Hazardous Liquid
Gas Gathering	Liquefied Natural Gas (LNG)
Gas Transmission	

PHMSA also provides data about the causes of the incidents. Each link appearing with a trend line report leads to a new screen showing the incident causes. From this screen, you can also select a link to view details about the location of the incidents.

When a single System Type is selected, additional filters can be applied to the trend lines. Filters include Onshore/Offshore and Commodity (for Hazardous Liquid only).

Send Feedback or Ask a Question

SERIOUS INCIDENT 20 YEAR TREND – Serious Incidents include a fatality or injury requiring in-patient hospitalization. From 2004 forward, gas distribution incidents caused by a nearby fire or explosion that impact the pipeline system are excluded.

SIGNIFICANT INCIDENT 20 YEAR TREND – Significant Incidents are those including any of the following conditions, but gas distribution incidents caused by a nearby fire or explosion that impacted the pipeline system are excluded:

- Fatality or injury requiring in-patient hospitalization
- $50,000 or more in total costs, measured in 1984 dollars
- Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more
- Liquid releases resulting in an unintentional fire or explosion

ALL-REPORTED INCIDENT 20 YEAR TREND – Includes all reports submitted to PHMSA. Changes to PHMSA reporting regulations have caused large shifts in the trend line.

SIGNIFICANT INCIDENT CONSEQUENCES – Since 2005, incident reports classify each fatality, injury, and cost as either Public or Pipeline Industry.

INCIDENT DATA ACCESS

OPERATOR SUBMISSION – Incident report data submitted to PHMSA by pipeline operators since 1970.
FLAGGED FILES – Incident report data submitted to PHMSA by pipeline operators plus data needed to replicate the pipeline incident trends.

Related Links

- Additional PHMSA Pipeline Data and Statistics
- Pipeline Mileage and Facilities

Back to Top

Reports showing details about each incident are available by clicking on any blue link in the report below.

Serious Pipeline Incidents By Cause

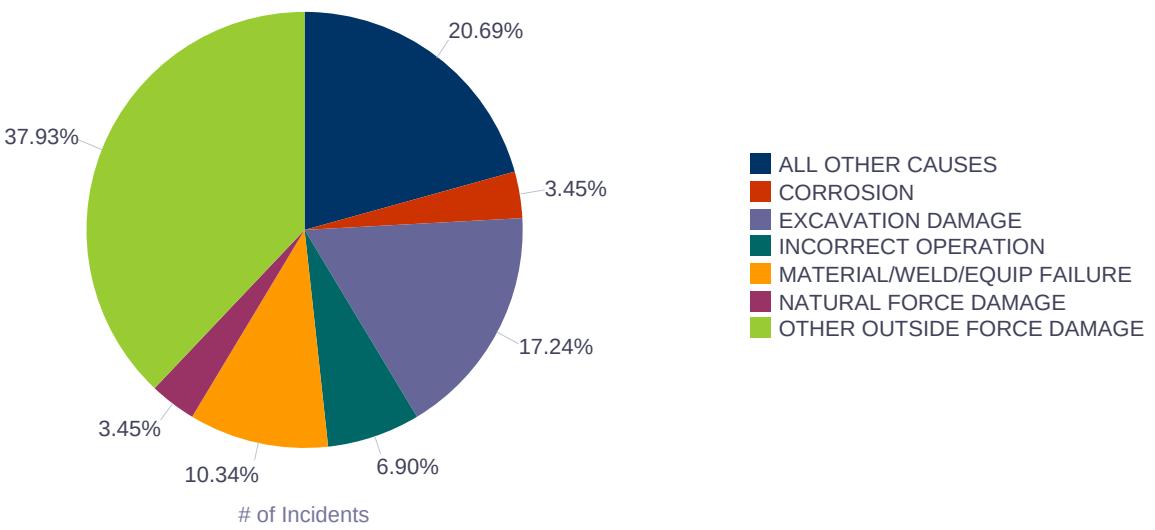
Date run: 1/26/2015

Portal - Data as of **1/25/2015**
Data Source: US DOT Pipeline and Hazardous Materials Safety Administration

PHMSA Serious Pipeline Incidents- Listing By Cause
Serious Incident Cause Breakdown - 2014 Year-To-Date
System Type: ALL **State:** ALL

Calendar Year	Reported Cause of Incident	Incident Cause SubType	Number	%	Fatalities	Injuries	Property Damage As Reported	Property Damage Current Year Dollars	Barrels Spilled	Net Barrels Lost
2014	**ALL OTHER CAUSES**	MISCELLANEOUS	1	3.4%	0	3	$145,474	$142,904	0	0
		UNKNOWN	5	17.2%	9	54	$3,546,874	$3,484,220	0	0
	ALL OTHER CAUSES Total		**6**	**20.7%**	**9**	**57**	**$3,692,348**	**$3,627,124**	**0**	**0**
	CORROSION	EXTERNAL	1	3.4%	0	1	$32,501	$31,927	0	0
	CORROSION Total		**1**	**3.4%**	**0**	**1**	**$32,501**	**$31,927**	**0**	**0**
	EXCAVATION DAMAGE	OPERATOR/CONTRACTOR EXCAVATION DAMAGE	3	10.3%	0	3	$150,050	$147,410	0	0
		THIRD PARTY EXCAVATION DAMAGE	2	6.9%	1	12	$15,098,766	$14,832,077	0	0
	EXCAVATION DAMAGE Total		**5**	**17.2%**	**1**	**15**	**$15,248,816**	**$14,979,487**	**0**	**0**
	INCORRECT OPERATION	OTHER INCORRECT OPERATION	2	6.9%	1	3	$13,118	$12,888	0	0
	INCORRECT OPERATION Total		**2**	**6.9%**	**1**	**3**	**$13,118**	**$12,888**	**0**	**0**
	MATERIAL/WELD/EQUIP FAILURE	OTHER EQUIPMENT FAILURE	1	3.4%	0	1	$72,424,800	$71,212,455	14,270	0
		THREADED CONNECTION/COUPLING FAILURE	2	6.9%	1	1	$1,362,679	$1,339,147	0	0
	MATERIAL/WELD/EQUIP FAILURE Total		**3**	**10.3%**	**1**	**2**	**$73,787,479**	**$72,551,603**	**14,270**	**0**
	NATURAL FORCE DAMAGE	TEMPERATURE	1	3.4%	0	1	$375,540	$368,906	0	0
	NATURAL FORCE DAMAGE Total		**1**	**3.4%**	**0**	**1**	**$375,540**	**$368,906**	**0**	**0**
	OTHER OUTSIDE FORCE DAMAGE	INTENTIONAL DAMAGE	1	3.4%	0	6	$33,348	$32,759	0	0
		OTHER OUTSIDE FORCE DAMAGE	2	6.9%	1	1	$674,601	$662,706	0	0
		VEHICLE NOT ENGAGED IN EXCAVATION	8	27.6%	6	10	$638,764	$627,514	0	0
	OTHER OUTSIDE FORCE DAMAGE Total		**11**	**37.9%**	**7**	**17**	**$1,346,713**	**$1,322,979**	**0**	**0**
		Grand Total	**29**	**100.0%**	**19**	**96**	**$94,496,515**	**$92,894,913**	**14,270**	**0**

Serious Incident Cause Breakdown - 2014 Year-To-Date
System Type: ALL **State:** ALL



Reports showing details about each incident are available by clicking on any blue link in the report below.

Significant Pipeline Incidents By Cause

Date run: 1/26/2015

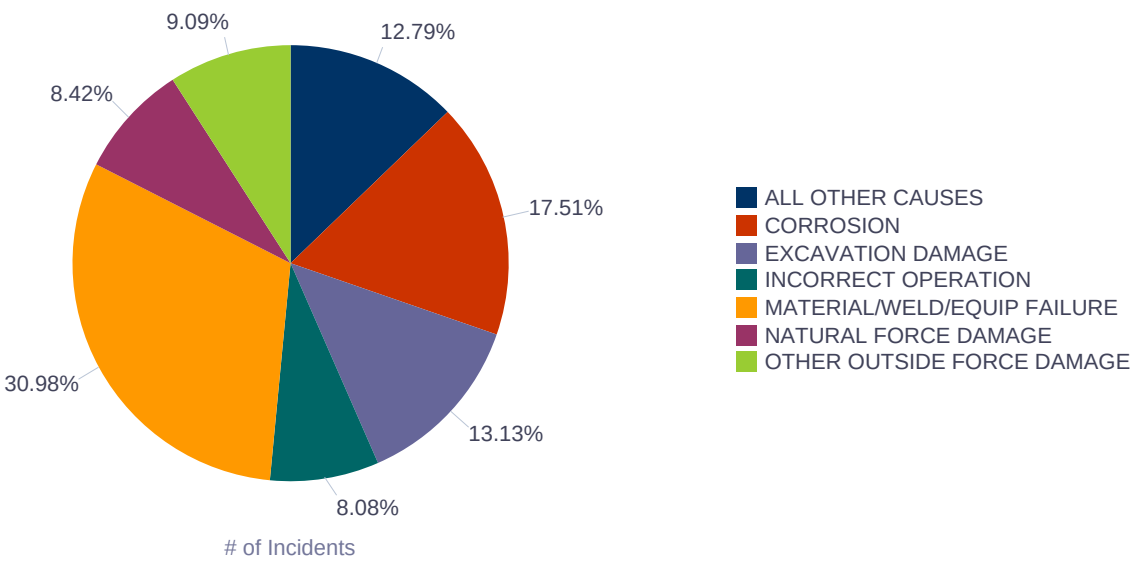
Portal - Data as of **1/25/2015**
Data Source: US DOT Pipeline and Hazardous Materials Safety Administration

PHMSA Significant Pipeline Incidents- Listing By Cause
Significant Incident Cause Breakdown - 2014 Year-To-Date
System Type: ALL **State:** ALL

Calendar Year	Reported Cause of Incident	Incident Cause SubType	Number	%	Fatalities	Injuries	Property Damage As Reported	Property Damage Current Year Dollars	Barrels Spilled	Net Barrels Lost
2014	**ALL OTHER CAUSES**	MISCELLANEOUS	9	3.0%	0	3	$4,072,291	$4,000,355	73	2
		UNKNOWN	29	9.8%	9	54	$23,811,057	$23,390,554	2,618	675
	ALL OTHER CAUSES Total		**38**	**12.8%**	**9**	**57**	**$27,883,348**	**$27,390,909**	**2,690**	**677**
	CORROSION	EXTERNAL	23	7.7%	0	1	$9,177,721	$9,026,915	2,050	859
		INTERNAL	29	9.8%	0	0	$14,442,438	$14,187,922	2,307	207
	CORROSION Total		**52**	**17.5%**	**0**	**1**	**$23,620,159**	**$23,214,837**	**4,357**	**1,065**
	EXCAVATION DAMAGE	OPERATOR/CONTRACTOR EXCAVATION DAMAGE	5	1.7%	0	3	$2,992,750	$2,939,888	429	0
		PREVIOUS DAMAGE DUE TO EXCAVATION	4	1.3%	0	0	$1,191,245	$1,170,408	0	0
		THIRD PARTY EXCAVATION DAMAGE	30	10.1%	1	12	$36,828,191	$36,195,083	6,056	4,153
	EXCAVATION DAMAGE Total		**39**	**13.1%**	**1**	**15**	**$41,012,186**	**$40,305,379**	**6,485**	**4,153**
	INCORRECT OPERATION	DAMAGE BY OPERATOR OR OPERATOR'S CONTRACTOR	1	0.3%	0	0	$324,003	$318,279	0	0
		INCORRECT EQUIPMENT	1	0.3%	0	0	$108,846	$107,073	0	0
		INCORRECT INSTALLATION	4	1.3%	0	0	$8,271,911	$8,125,773	1,086	673
		INCORRECT VALVE POSITION	5	1.7%	0	0	$991,812	$976,928	1,809	414
		OTHER INCORRECT OPERATION	10	3.4%	1	3	$7,279,997	$7,151,658	181	5
		OVERFILL/OVERFLOW OF TANK/VESSEL/SUMP	2	0.7%	0	0	$93,400	$91,750	200	40
		PIPELINE/EQUIPMENT OVERPRESSURED	1	0.3%	0	0	$66,092	$64,924	186	0
	INCORRECT OPERATION Total		**24**	**8.1%**	**1**	**3**	**$17,136,061**	**$16,836,384**	**3,462**	**1,132**
	MATERIAL/WELD/EQUIP FAILURE	BODY OF PIPE	1	0.3%	0	0	$3,021,050	$2,967,679	0	0
		COMPRESSOR OR COMPRESSOR-RELATED EQUIPMENT	1	0.3%	0	0	$71,871	$71,871	0	0
		CONSTRUCTION, INSTALLATION OR FABRICATION-RELATED	12	4.0%	0	0	$5,261,545	$5,173,629	944	606
		DEFECTIVE OR LOOSE TUBING/FITTING	4	1.3%	0	0	$999,886	$982,221	165	-340
		ENVIRONMENTAL CRACKING-RELATED	5	1.7%	0	0	$23,438,973	$23,034,634	4,976	465
		FAILURE OF EQUIPMENT BODY	6	2.0%	0	0	$3,071,840	$3,017,592	2,038	617
		MALFUNCTION OF CONTROL/RELIEF EQUIPMENT	25	8.4%	0	0	$8,874,478	$8,751,100	9,143	8,612
		MANUFACTURING-RELATED	5	1.7%	0	0	$2,607,882	$2,565,314	41	26
		MECHANICAL FITTING	1	0.3%	0	0	$265,000	$260,336	0	0
		NON-THREADED CONNECTION FAILURE	6	2.0%	0	0	$1,558,686	$1,531,882	3	0
		OTHER EQUIPMENT FAILURE	7	2.4%	0	1	$73,709,810	$72,475,890	14,831	14,377
		PUMP OR PUMP-RELATED EQUIPMENT	8	2.7%	0	0	$1,124,328	$1,104,465	369	34
		THREADED CONNECTION/COUPLING FAILURE	11	3.7%	1	1	$4,323,676	$4,251,418	1,476	382
	MATERIAL/WELD/EQUIP FAILURE Total		**92**	**31.0%**	**1**	**2**	**$128,329,025**	**$126,188,031**	**33,986**	**24,780**
	NATURAL FORCE DAMAGE	EARTH MOVEMENT	5	1.7%	0	0	$25,178,235	$24,736,290	7	0
		HEAVY RAINS/FLOODS	3	1.0%	0	0	$2,233,400	$2,193,943	584	0
		LIGHTNING	7	2.4%	0	0	$1,620,500	$1,596,818	37	35
		OTHER NATURAL FORCE DAMAGE	2	0.7%	0	0	$520,200	$511,817	0	0
		TEMPERATURE	8	2.7%	0	1	$1,469,060	$1,458,192	120	13
	NATURAL FORCE DAMAGE Total		**25**	**8.4%**	**0**	**1**	**$31,021,395**	**$30,497,059**	**748**	**47**

Calendar Year	Reported Cause of Incident	Incident Cause SubType	Number	%	Fatalities	Injuries	Property Damage As Reported	Property Damage Current Year Dollars	Barrels Spilled	Net Barrels Lost
2014	**OTHER OUTSIDE FORCE DAMAGE**	ELECTRICAL ARCING FROM OTHER EQUIPMENT/FACILITY	2	0.7%	0	0	$4,339,386	$4,262,723	30	8
		FIRE/EXPLOSION AS PRIMARY CAUSE	1	0.3%	0	0	$1,862,300	$1,829,399	0	0
		FISHING OR MARITIME ACTIVITY	1	0.3%	0	0	$2,093,296	$2,056,329	0	0
		INTENTIONAL DAMAGE	1	0.3%	0	6	$33,348	$32,759	0	0
		MARITIME EQUIPMENT OR VESSEL ADRIFT	1	0.3%	0	0	$101,460	$99,677	0	0
		OTHER OUTSIDE FORCE DAMAGE	5	1.7%	1	1	$2,371,737	$2,329,950	0	0
		VEHICLE NOT ENGAGED IN EXCAVATION	16	5.4%	6	10	$7,458,059	$7,326,460	65	0
	OTHER OUTSIDE FORCE DAMAGE Total		**27**	**9.1%**	**7**	**17**	**$18,259,586**	**$17,937,297**	**95**	**8**
		Grand Total	**297**	**100.0%**	**19**	**96**	**$287,261,760**	**$282,369,897**	**51,824**	**31,863**

All Reported Significant Incident Cause Breakdown - 2014 Year-To-Date
System Type: ALL **State:** ALL



Montana city gets OK to drink water after oil spill in river

By Associated Press

Published: 19:15 EST, 22 January 2015 | Updated: 19:16 EST, 22 January 2015

BILLINGS, Mont. (AP) — Thousands of people in a Montana city can resume drinking from their taps after a federal official said there are no further signs of contamination from a weekend crude oil spill into a nearby river.

Paul Peronard with the Environmental Protection Agency said test results received Thursday no longer show elevated levels of cancer-causing benzene in the municipal water supply of Glendive.

Officials had detected the benzene levels after 40,000 gallons of oil spilled on Saturday from a pipeline break beneath the Yellowstone River upstream from the city.

Environmental Protection Agency contractor Megan Adamczyk checks a water sample in Glendive, Mont., as water is drained from fire hydrants, Wednesday, Jan. 21, 2015. Workers recovered about 10,000 gallons of oil from a ruptured pipeline that spilled crude into Yellowstone River and contaminated the drinking water supply of the eastern Montana city downstream. An estimated 40,000 gallons is still in the river and will be difficult to remove because of a thick layer of ice. (AP Photo/The Billings Gazette, Larry Mayer)

Peronard says residents should run the water from their taps to flush any residual contamination.

Officials are struggling to clean the crude, most of which is believed trapped beneath ice on the river.

Water fountains at Glendive, Mont., schools are off limits after a Bridger Pipeline broke under the Yellowstone River, Wednesday, Jan. 21, 2015. Workers recovered about 10,000 gallons of oil from a ruptured pipeline that spilled crude into Yellowstone River and contaminated the drinking water supply of the eastern Montana city downstream. An estimated 40,000 gallons is still in the river and will be difficult to remove because of a thick layer of ice. (AP Photo/The Billings Gazette, Larry Mayer)

Free bottled water for Glendive, Mont., residents fills the EPEC Center after a Bridger Pipeline spilled oil under the Yellowstone River near the city, Wednesday, Jan. 21, 2015. Workers recovered about 10,000 gallons of oil from a ruptured pipeline that spilled crude into Yellowstone River and contaminated the drinking water supply of the eastern Montana city downstream. An estimated 40,000 gallons is still in the river and will be difficult to remove because of a thick layer of ice. (AP Photo/The Billings Gazette, Larry Mayer)

Glendive water is flushed from fire hydrants and tested by the EPA and the Center for Toxicology and Environmental Health Wednesday, Jan. 21, 2015, in Mont. Workers recovered about 10,000 gallons of oil from a ruptured pipeline that spilled crude into Yellowstone River and contaminated the drinking water supply of the eastern Montana city downstream. An estimated 40,000 gallons is still in the river and will be difficult to remove because of a thick layer of ice. (AP Photo/The Billings Gazette, Larry Mayer)

Glendive Schools superintendent Ross Farber checks bottled water where Washington Middle School students keep their water cups after a Bridger Pipeline broke under the Yellowstone River, in Mont., Wednesday, Jan. 21, 2015. Workers recovered about 10,000 gallons of oil from a ruptured pipeline that spilled crude into Yellowstone River and contaminated the drinking water supply of the eastern Montana city downstream. An estimated 40,000 gallons is still in the river and will be difficult to remove because of a thick layer of ice. (AP Photo/The Billings Gazette, Larry Mayer)

Crews work to contain an oil spill from Bridger Pipeline's broken pipeline near Glendive, Mont., in this aerial view showing both sides of the river on Monday, Jan. 19, 2015. Officials said that they were bringing truckloads of drinking water to Glendive after traces of 50,000 gallons of oil that spilled into the Yellowstone River were found in the city's water supply. (AP Photo/The Billings Gazette, Larry Mayer)

Cleanup workers cut holes into the ice on the Yellowstone River near Crane, Mont. on Monday, Jan. 19, 2015 as part of efforts to recover oil from an upstream pipeline spill that released up to 50,000 gallons of crude. (AP Photo/Matthew Brown)

Bob Sarver and his wife, Melvina, load water into their car trunk, Tuesday, Jan. 20, 2015, in Glendive, Mont. A cancer-causing component of oil has been detected in the Glendive drinking water supply, just downstream from a crude oil spill that entered the Yellowstone River. (AP Photo/Matthew Brown)

Find this story at http://www.dailymail.co.uk/wires/ap/article-2921204/Montana-oil-spill-renews-worry-safety-old-pipelines.html

The New York Times | http://nyti.ms/1JfsgEx

U.S. | NATIONAL BRIEFING | PLAINS

North Dakota: Pipeline Rupture Spills 3 Million Gallons of Saltwater

By THE ASSOCIATED PRESS JAN. 22, 2015

Earthen barriers have been set up across a creek and water was being tested Thursday around the site of a nearly three-million-gallon leak of saltwater generated by oil drilling, the largest spill of its kind in North Dakota's current oil rush. The berms were built at Blacktail Creek to prevent potentially contaminated water from flowing out of the creek and into a bigger body of water that leads into the Missouri River. The pipeline operator, Summit Midstream Partners, and state inspectors will keep testing the soil and water at Blacktail Creek and the larger Little Muddy Creek. The saltwater produced by oil and natural gas production is much saltier than seawater and may also contain petroleum and residue from hydraulic fracturing. The spill was detected Jan. 6 during a periodic inspection by the company, which said Thursday that the cause of the rupture in the pipeline and when exactly it happened were still unknown.

A version of this brief appears in print on January 23, 2015, on page A15 of the New York edition with the headline: North Dakota: Pipeline Rupture Spills 3 Million Gallons of Saltwater.

Federal Aviation Administration

Memorandum

Date: AUG -8 2014

To: John Duncan, Director, Flight Standards Service, AFS-1

From: Mark W. Bury, Assistant Chief Counsel for International Law, Legislation and Regulations, AGC-200

Prepared by: Dean E. Griffith, Attorney, AGC-220

Subject: Interpretation regarding whether certain required documents may be kept at an unmanned aircraft's control station.

This memorandum addresses whether the pilot of an unmanned aircraft may keep airworthiness certificates, aircraft manuals, and aircraft registration certificates at the unmanned aircraft's ground control station and satisfy the regulatory requirements of sections 91.9(b), 91.203(a) and (b), 47.3(b)(2), and 47.31(c) of Title 14, Code of Federal Regulations. This question has been brought to our attention because of the impracticality of placing these documents on a small aircraft with no pilot on board. As discussed below, we find that the intent of these regulations is met if the pilot of the unmanned aircraft has access to these documents at the control station from which he or she is operating the aircraft.

Section 91.9(b) prohibits operation of U.S.-registered civil aircraft unless "there is available in the aircraft" an Airplane or Rotorcraft Flight Manual or other material, markings and placards. The FAA stated that the purpose of this rule is to "insure that the information is readily available to the pilot" for use during operations. *See* 40 Fed. Reg. 24665 (June 9, 1975), 37 Fed. Reg. 20022 (Sept. 23, 1972). The text of the rule and preamble to subsequent revisions of the rule confirm the intent that the pilot is to have access to the material during flight. Accordingly, we find that the intent of the rule is met if the information is maintained at the pilot's control station such that it is available to the pilot.

Section 91.203(a) prohibits operation of a civil aircraft "unless it has within it" an appropriate and current airworthiness certificate and the aircraft's registration certification. Section 91.203(b) requires that the airworthiness certificate be "displayed at the cabin or cockpit entrance so that it is legible to passengers or crew." Similarly, sections 47.3(b)(2) and 47.31(c) allow an applicant for aircraft registration to carry "in the aircraft" the second copy of the registration application as temporary authority to operate without registration. These documents demonstrate that the aircraft is appropriately certificated and registered, or is in the process of being registered. Additionally, the FAA has previously addressed the requirement to display the

airworthiness certificate and found that the regulation permits displaying the certificate so that it is only legible to the flight crew even if not legible to passengers. *See* Legal Interpretation to Leonard A. Ceruzzi, from Donald P. Byrne, Acting Assistant Chief Counsel, Regulations and Enforcement Division (Aug. 7, 1990). Accordingly, we find that maintaining these documents at the pilot's control station would meet the intent of the rule as the pilot would be able to produce the documents for his or her own information or to an FAA inspector.

We note that this memorandum is to be narrowly construed to unmanned aircraft systems and is not intended to apply to operation of manned aircraft or optionally piloted aircraft with a pilot on board.