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

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

July 21, 2015

Exemption No. 12100
Regulatory Docket No. FAA–2015–0989

Mr. Brian Meier
XWorks, Corporation
PO Box 9663
Tulsa, OK 74157

Dear Mr. Meier:

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

By letter dated December 22, 2014, you petitioned the Federal Aviation Administration (FAA) on behalf of XWorks, Corporation (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct market research, aerial surveys, mapping, and inspections that consist of still photographs, video, and other data taken by onboard sensors.

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

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

**Airworthiness Certification**

The UAS proposed by the petitioner is an XWORKS X-81.

[1] Petitioners exemption request is dated December 24, 2014, it posted to the regulations docket on April 13, 2015.

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

**The Basis for Our Decision**

You have requested to use a UAS for aerial data collection[1]. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

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

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

**Our Decision**

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, XWorks, Corporation 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

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

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, XWorks, Corporation 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 XWORKS X-81 when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

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

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

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

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

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

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating

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

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

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

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

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

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

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal

government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

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

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

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

17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Sincerely,

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

Enclosures

XWorks, Corporation
2626 Overcrest Ln.
Sapulpa, Oklahoma 74066

December 22, 2014

U.S. Department of Transportation, Docket Management System
West Building Ground Floor, Room w12-140
1200 New Jersey Ave., SE
Washington, DC 20590

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

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R. Part 11, XWorks, Corporation. ("XWorks"), the developer and operator of the XWORKS X-81 small Unmanned Aircraft Systems ("sUAS") seeks an exemption from the Federal Aviation Regulations ("FARs") listed below and discussed in Appendix A. Details of XWorks and the XWORKS X-81 sUAS are described in Appendix B. Attached as Appendix C is a summary of this request.

The requested exemption would permit XWorks commercial operation of XWORKS X-81 (see details in Appendix B), which weighs (7,428g) 17 lbs. with imaging payload, to perform market research, aerial surveys, mapping, and inspections that consist of still photographs, video, and other data taken by onboard sensors. The XWORKS X-81 produces high quality imagery and data that can be used independently. Applications for these sUASs include inspection of sensitive infrastructure including oil and gas pipelines and flare stacks, power lines and towers, wind turbines, and surveying tasks such as precision agriculture, mining, transportation, and forestry. Use of the XWORKS X-81 for these inspection and surveying applications reduces the need to operate conventional aircraft, providing data more quickly, accurately, economically, safely, and with reduced environmental impact.

Operations under the exemption will be subject to strict operating requirements and conditions to ensure at least an equivalent level of safety to currently authorized operations using manned aircraft and under conditions as may be modified by the FAA as required by Section 333.

As described more fully below, the requested exemption would authorize XWorks to perform market research and commercial operations of aerial inspections and survey using the XWORKS X-81, which at 17 lbs. is small in size and powered electrically by battery. The XWORKS X-81 will be operated under controlled conditions at low altitude in airspace that is limited in scope, as described more fully herein; it will have automated control features, as described below. The XWORKS X-81 is designed to be operated by one person but flight operations will involve two people: an operator and an observer. The operator is responsible for flying the sUAS, monitoring its status and flight dynamics

while maintaining visual line of sight, and keeping the flight within the specified limits (in terms of wind, flight range, battery life, etc) to ensure safe operation of the sUAS itself. The observer is responsible for monitoring the airspace for other aircraft and hazards and instructing the operator before and during flight as necessary to ensure safe separation and possible conflict avoidance with these aircraft and hazards. The operator also will be an individual who has passed an authorized XWorks training program for the XWORKS X-81. The airspace that XWorks will operate its XWORKS X-81 in will be primarily Class G.

XWorks respectfully submits that because this small, unmanned aerial system – the XWORKS X-81 – will be used in lieu of comparatively hazardous operations now conducted with fixed wing and rotary conventional aircraft, the FAA can have confidence that the operations will achieve at least an equivalent level or greater level of safety. Approval of this exemption would thereby enhance safety and fulfill the Secretary of Transportation's (the FAA Administrator's) responsibilities under Section 333(c) of the Reform Act to "establish requirements for the safe operation of such aircraft systems in the national airspace system."

- The name and address of the applicant are:

XWORKS, CORPORATION.
Attn: Brian Meier
Ph: 918-851-5692
Email: bbull789@gmail.com
Address: PO Box 9663 Tulsa, Oklahoma 74157

The primary contact for this application is: Brian Meier (same as above)

- The regulations from which the exemption is requested are as follows: 14 C.F.R. Part 21; 14 C.F.R. 45.23(b); 14 C.F.R. 91.7(a); 14 C.F.R. 91.9(b)(2) & (c); 14 C.F.R. 91.103; 14 C.F.R. 91.109(a); 14 C.F.R. 91.319; 14 C.F.R. 91.119; 14 C.F.R. 91.151(a); 14 C.F.R. 91.203(a) & (b); 14 C.F.R. 91.405(a); 14 C.F.R. 91.407(a)(1); 14 C.F.R. 91.409(a)(2); 14 C.F.R. 91.417(a).

- Appendix A discusses each rule listed above and explains why exemptions pursuant to the proposal set forth in this letter are appropriate, provide an equivalent level of safety, and are in the public interest.

- XWorks request for exemption benefits the public as a whole due to the following
    - The X-81 is safer than current means of performing the same tasks. The X-81 caries no fossil fuels and is thus less flammable. Traditionally some of the evaluative tasks that we will be performing with the X-81 require risks to be taken by humans, such as climbing a ladder, to perform the evaluation. The inspections performed by XWorks X-81 will eliminate that risk by allowing the same observations to be performed remotely with all persons remaining on the ground.
    - The X-81 will cause companies to operate more efficiently thereby

reducing energy costs for the public. The X-81 will be able to inspect flare stacks without shutting them down. Traditionally this costs millions of dollars each year to inspect these flare stacks because the flare stacks themselves had to be shutdown for inspection which caused an interruption in production; this in turn causes a lack of efficient operation. Additional efficiencies will be realized due to the lower cost of operation of the X-81 in comparison to the helicopter that is now used for these same inspections.

- Further evaluation of forest and grass fires for quicker extinguishment. The X-81 will perform research in remote areas for the purposes of detecting hotspots within grass and forest fires. This will ultimately assist fire fighters with the rapid extinguishment of fires reducing expenses to the general public and increasing safety for the general public.
- The X-81 will also be fitted for search and rescue in remote areas to further increase safety for the general public. The X-81 will assist in the search and rescue

- XWorks would further like to request privileges in the exemption for operating outside of the United States. Our flare stack and well site inspection technology would be very useful to the energy sector as well as to regulators all over the world. At this time, our customers are global; many of their well sites are located in Pakistan, Mexico, the Gulf Waters, and many other countries. XWorks would like to serve them in all locations.

**THE APPLICABLE LEGAL STANDARD UNDER SECTION 333**

XWorks submits that grant of this exemption application for use of the XWORKS X-81 in market research, surveying, mapping and inspection operations will advance the Congressional mandate in Section 333 of the Reform Act to accelerate the introduction of sUASs into the national airspace system ("NAS") if it can be accomplished safely. This law directs the Secretary of Transportation to consider whether certain sUASs may operate safely in the NAS before completion of the rulemaking required under Section 332 of the Reform Act. In making this determination, the Secretary is required to determine which types of sUASs do not create a hazard to users of the NAS or the public or pose a threat to national security in light of the following:

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

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

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

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

49 U.S.C. §44701(f). *See also* 49 USC §44711(a); 49 USC §44704; 14 CFR §91.203(a)(1).

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

**Mandatory Operating Conditions**

Grant of the exemption to XWorks will be subject to the following mandatory conditions, which are based upon operating conditions set forth for operation of sUAS by public entities pursuant to Certificates of Authorization, with additional restrictions:

- All operations to occur in Class G airspace.
- Operations to avoid congested or populated areas, which are depicted in yellow on VFR charts.
- Permission from land owner/controller required before commencing any flight over privately owned land.
- Operations to occur during Visual Flight Rules Meteorological Conditions (VMC).
- Aircraft to remain within Visual Line of Sight (VLOS).
    - VLOS guaranteed with a cylinder of operation around operator of 1/2 nautical miles (NM).
    - Cylinder walls may be expanded by an observer with ability to control aircraft.
- Operations to occur between morning civil twilight and evening civil twilight.
- Above Ground Level (AGL) altitude to be restricted to 400 feet.
- All operations conducted in 5 nautical miles of airport to remain more than 2.5 NM from centerline azimuth of runway centerline measured from runway thresholds.
- Operator will file a NOTAM for each flight occurring within 5 nautical miles of an airport.
- All operations will include one pilot for flight control and one observer for VLOS enhancement of surrounding area near the aircraft

**Operator Requirements**

XWorks respectfully proposes that operator requirements should take into account the characteristics of the particular sUAS. Certain sUASs, such as the XWORKS X-81, are characterized by a high degree of pre-programmed control and various built-in technical capabilities that limit the potential for operation outside of the operating conditions set forth above. The XWORKS X-81 sUAS also provides many built-in functional and safety features to assist the operator in safe and reliable operation.

The XWORKS X-81 provides one semi-autonomous flight mode using a point-and-click map. At all times during flight operations, the operator can intervene a programmed flight and take immediate control.

Additional automated safety functions and safety enhancing features of the XWORKS X-81 include the following:

- Automated pre-flight system performance checks
- User pre-flight checklist
- Automated condition or fault detection, warnings, and pre-defined responses to a number of flight and system conditions.
    - Low battery with system and user defined safety thresholds
    - Lost-link communication
- In the case of lost GPS, a manual user flight mode is enabled which allows the operator to provide manual navigation inputs to assist in landing the vehicle.
- Operators of the XWORKS X-81 will be required to:
    - Hold at least a private pilot certification
    - Have completed XWorks' authorized training program for operation and maintenance of the sUAS.

In summary, XWorks seeks an exemption from the FARs set forth above and in Appendix C to allow market research and commercial operations of a small unmanned vehicle in surveying, mapping and inspection operations.

Approval of the exemption allowing commercial operations of the XWORKS X-81 for surveying, mapping and inspection operations will enhance safety by reducing risk. Conventional aerial survey and inspection operations using manned aircraft involve very heavy aerial vehicles carrying significant quantities of combustible fuels, and a multi-person crew in piloting and observation roles. These operations require transit to and from the location of the activity, and often take place in congested environments including proximity to physical obstacles and/or presence of the general public. By contrast, the XWORKS X-81 weighs 17 lbs including payloads and uses a battery for power, is carried to/from the area of activity, removes the need for airborne pilots/observers, and poses less risk to people and infrastructure on the ground.

Additionally, no national security issue is raised by the grant of the requested exemptions. Given the size, load carrying capacity, speed at which it operates, and the fact that it carries no explosives or other dangerous materials, the XWORKS X-81 poses

no threat to national security.

The operation of the XWORKS X-81 for market research, surveying, mapping and inspection operations in accordance with the strict conditions outlined above, will provide an equivalent level of safety supporting the grant of the exemptions requested herein, including exempting XWorks from the requirements of Part 21.

The XWORKS X-81's satisfaction of the criteria set forth in Section 333 of the Reform Act—size, weight, speed, operating capabilities, lack of proximity to airports and populated areas, operation within visual line of sight, and national security - provide adequate justification for the grant of the requested exemptions allowing XWorks commercial operation of the XWORKS X-81 in market research, surveying, mapping and inspection operations.

Very truly yours,

Brian Meier
XWorks, Corporation.

## APPENDIX A

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

XWorks requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the XWORKS X-81:

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

Section 91.203(a)(1) requires all civil aircraft to have a certificate of airworthiness. Part 21, Subpart H, entitled Airworthiness Certificates, establishes the procedural requirements for the issuance of airworthiness certificates as required by FAR § 91.203(a)(1). Given the size of the aircraft (17 lbs.) and the limited operating area associated with its utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H to achieve or exceed current safety levels.

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

In this case, an analysis of these criteria demonstrates that the XWORKS X-81 operated without an airworthiness certificate, under the conditions proposed herein, will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) with an airworthiness certificate. The XWORKS X-81 weighs 17 lbs. fully loaded. It will not carry a pilot or passenger, will not carry flammable fuel, and will operate exclusively within an area pre-disclosed and in compliance with conditions set forth herein. Operations under this exemption will be tightly controlled and monitored by both the operator, pursuant to the conditions set forth above, and by local public safety requirements. The FAA will have advance notice of all operations through the filing of NOTAMs. Receipt of the prior permission of the land owner, the size of the aircraft, the lack of flammable fuel, and the fact that the aircraft is carried to the location and not flown there all establish the equivalent level of safety.

### 14 C.F.R. § 45.23 & 91.9(c): Marking of the Aircraft

Regulation 45.23 provides: (a) Each operator of an aircraft must display on that aircraft marks consisting of the Roman capital letter “N” (denoting United States registration) followed by the registration number of the aircraft. Each suffix letter used in the marks displayed must also be a Roman capital letter. (b) 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.

Regulation 91.9(c) provides: No person may operate a U.S.-registered civil aircraft unless that aircraft is identified in accordance with part 45 of this chapter.

The XWORKS X-81 has no entrance to the cabin, cockpit, or pilot station on which the markings can be placed. Given the size of the sUAS, two-inch lettering will be impossible. Official marking systems for small UAS have not yet been established for operations inside the NAS. XWorks is prepared to mark the inspection system with the name of the organization and location or origin and fulfill any other request by the FAA to this topic in accordance to § 45.29(f) where the pilot, observer, and others working with the sUAS will see the identification of the sUAS.

The FAA has issued the following exemptions to this regulation, see Exemption Nos. 8738, 10167, 10167A and 10700.

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

This regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. Should the exemption be granted allowing commercial operation of the XWORKS X-81 without an airworthiness certificate, no standard will exist for airworthiness of the XWORKS X-81. Given the size of the aircraft an equivalent level of safety will be achieved by ensuring compliance with the XWorks checklists and manufacturers manuals prior to each flight.

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

The regulation provides: 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.

Given the size and configuration of the XWORKS X-81, it has no ability or place to carry such a flight manual on the aircraft, not only because there is no pilot on board, but because there is no room or capacity to carry such an item on the aircraft.

The equivalent level of safety will be achieved by keeping the user manual (*see*, *e.g.*, User Manual, Exhibit 1) at the ground control point where the pilot flying the sUAS will have immediate access to it. The FAA has issued to others the following exemptions to this regulation: Exemption Nos. 8607, 8737, 8738, 9299, 9299A, 9565, 9565B, 10167, 10167A, 10602, 32827, and 10700.

**14 C.F.R. § 91.103: Preflight action**

This regulation requires each pilot in command to take certain actions before flight to insure the safety of flight. As FAA approved rotorcraft flight manuals will not be provided for the aircraft an exemption will be needed. An equivalent level of safety will be provided as set forth in the XWORKS X-81 User Manual (exhibit 1) and XWork's

checklist under the 'Before Takeoff' section. The PIC will take all actions including reviewing weather, flight battery requirements, landing and takeoff distances and aircraft performance data before initiation of flight.

**14 C.F.R. § 91.109(a) & 91.319(a)(1): Flight Instruction**

These regulations provide 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.

The XWORKS X-81 is a remotely piloted aircraft and by design, does not have fully functional dual controls. Flight control is accomplished through the use of a control box that communicates with the aircraft via radio communications. The flight plan is either manually controlled through point-and-click touchscreen navigation or pre-programmed as way points or an AutoGrid into the auto pilot before or during flight and only in unusual circumstances will the pilot input control functions to alter the pre-programmed flight. If instruction is accomplished through a training program, as set forth in Exhibit 2, an equivalent level of safety will be assured. The FAA has approved exemptions for flight training without fully functional dual controls for a number of aircraft and for flight instruction in experimental aircraft. *See* Exemption Nos. 5778K & 9862A. The equivalent level of safety will be achieved by the manufacturer providing the training as outlined, for example, in Exhibit 2 and through the use of experienced and qualified pilots familiar with the XWORKS X-81.

**14 CFR § 91.119: Minimum Safe Altitudes**

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

As set forth herein, the XWORKS X-81 will never operate at higher than 400 feet AGL. Because aerial survey, mapping and inspection work must be accomplished at relatively low altitudes and at altitudes less than 500 feet AGL, an exemption from Section 91.119(c) is needed.

The equivalent level of safety will be achieved given the size, weight, speed, and material with which the XWORKS X-81 is built. Also, no flight will be taken without the permission of the land owner or those who control the land. Because of the advance notice to the landowner, all affected individuals will be aware of the flights. Compared to aerial survey operations conducted with aircraft or rotorcraft weighing far more than 17 lbs. and carrying flammable fuel, any risk associated with these operations will be far less than those currently allowed with conventional aircraft operating at or below 500 feet AGL. Indeed, the low-altitude operations of the sUAS will maintain separation between these sUAS operations and the operations of conventional aircraft that must comply with Section 91.119.

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

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

The XWORKS X-81 batteries provide approximately 50 minutes of powered flight. Without an exemption from § 14 CFR 91.151, the sUAS's flights would be limited to approximately 20 minutes in length. Given the limitations on its proposed operations and the location of those proposed operations, a longer time frame for flight in daylight VFR conditions is reasonable.

XWorks believes that an exemption from 14 CFR § 91.151(a) is safe and within the scope of a prior exemption. *See* Exemption 10673 (allowing Lockheed Martin Corporation to operate without compliance with 91.151(a)). Operating the sUAS, without 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was meant to prevent given the size and speed at which the sUAS operates. The fact that it carries no pilot, passenger, or cargo also enhances its safety. Additionally, limiting XWORKS X-81 flights to 20 minutes would greatly reduce their utility. In the unlikely event that the XWORKS X-81 should run out of fuel, it would simply land. Given its weight and construction material, the risks are less than contemplated by the current regulation.

XWorks believes that an equivalent level of safety can be achieved by maintaining 10 minutes of reserve fuel, which, allowing 40 minutes of flight time, would be more than adequate to return the sUAS to its planned landing zone from anywhere in its operating area.

The FAA has granted similar exemptions to others, including Exemptions 2689F, 5745, 10673 and 10808.

**14 C.F.R. § 91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration**

This regulation provides as follows:

(a) ... no person may operate a civil aircraft unless it has ... an appropriate and current airworthiness certificate. (b) No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

The XWORKS X-81 fully loaded weighs approximately 17 lbs. As such, there is no ability or place to carry certification and registration documents or to display them on the sUAS. In addition, there is no pilot on board the aircraft.

An equivalent level of safety will be achieved by keeping these documents at the ground

control point where the pilot flying the sUAS will have immediate access to them. The FAA has issued numerous exemptions to this regulation. A representative sample of other exceptions includes Exemption Nos. 9565, 9665, 9789, 9789A, 9797, 9797A, 9816A, and 10700.

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

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

The XWORKS X-81 is nearly maintenance free, it performs automatic pre-flight checks and the failure of any check will prevent take-off. Checks which cannot be done by the system will be performed by a qualified person prior to each flight and at predefined intervals as part of the Maintenance Schedule in the User Manual (see Exhibit 1).

Pre-flight checklist includes: 1.Visual inspection of the airframe 2.Visual inspections of rotor integrity 3.Check charge of all batteries (aerial vehicle, command station, radio repeater station)

An equivalent level of safety will be achieved because the sUAS is small in size, will operate only in restricted predetermined areas, and is not a complex mechanical devise. As provided in the attached User Guide (System Maintenance section), the operator of XWORKS X-81 will ensure that the sUAS is in working order prior to initiating flight, perform required maintenance, and keep a log of any maintenance that is performed. Moreover, the operator is the person most familiar with the aircraft and is best suited to maintain the aircraft in an airworthy condition and to ensure an equivalent level of safety.

The XWORKS X-81's Maintenance guidelines ensure an equivalent level of safety to the maintenance requirements in Part 91. In addition, any component failure detectable by the system will be reported to the control station and will cause the UAV to perform a Fatal Condition Response (FCR) or Non-Fatal Conditioned Response (NFCR), depending on the type of failure.

**APPENDIX B**

**SMALL UNMANNED AERIAL SYSTEM DESCRIPTION**

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**XWorks Corporate Overview**: XWorks, Corporation is a United Staes company located in Tulsa, Oklahoma. XWorks is focused on providing unmanned aerial systems and is a technology leader in this space.

**XWORKS X-81 Overview**: The XWORKS X-81 can carry payloads up to 15 lbs. The XWORKS X-81 flies with a maximum wind threshold of 35 M.P.H. for sustained winds and wind gusts up to 45 M.P.H.. What is unique about the XWORKS X-81 is the system automatically compensates for wind versus relying on the operator's 'sense of feel' for what the impact of the wind is at the altitude the system is flying. The end result is a system capable of gathering high quality aerial intelligence at much higher wind thresholds. A trait that is imperative for many aerial inspection operations.

The XWORKS X-81 has an operational range of up to 3 km (1.6 NM) with the standard offering and up to 5 km (2.7 NM).

All flight operations are GPS controlled making the system extremely easy to navigate. At any point if the operator is not explicitly commanding the system to move, the system automatically holds its GPS position (i.e. GPS hold for reliable location hover). Camera positioning is also GPS controlled allowing for the most sophisticated camera targeting available. The flight control system employs not only GPS positioning but a variety of sensors including sonar, barometric pressure, temperature, wind speed and others to ensure the most stability of any system in its class-regardless of the wind.

The XWORKS X-81 can be operated in both semi and fully autonomous flight modes. Creating preplanned flight paths to fly in autonomous mode is as simple as clicking on the map to create a preplanned flight path. In semi-autonomous mode, the operator clicks on the map and the XWORKS X-81 automatically flies to the point on the map where the operator is pointing. Pre-mission waypoints, Landing zone points and flight area dimensions can all be entered during preflight ensuring the XWORKS X-81 operates only within specified parameters.

The XWORKS X-81 includes many advanced safety features that makes the XWORKS X-81 the safest choice for both urban and non-urban environments. Built-in intelligent fault handling allows the XWORKS X-81 to detect a system fault while in the air, and to automatically fly back to its take-off location and land. Faults that can be detected include: loss of communication; and low battery levels. In addition, the operator can create no fly zones or maximum flight ranges and altitudes so the system cannot enter areas deemed unsafe or unnecessary to fly over. And before every take-off automated flight checks ensure the system is flight ready before it takes off.

The XWORKS X-81 can be operated entirely by a touch-screen, map based interface. This means the operator only needs to command the system where to go, and the system does all the flying for the operator. Maps can be saved and flight plans can be made or

recalled with no internet connection required.

**XWORKS X-81 Operating Manual** - System user manual available upon request.
**Physical Characteristics Measurements** – 134 cm diameter deployed, 46 cm height
**Weight** (with payload) – 7.71 Kg (17.0 lbs)

**Fuel** – Lithium polymer batteries are self-contained high duration systems with "SMART" intelligence on-board. This includes cycle charge times, locations, GPS antenna, chemical management, and real-time data feeds to ensure maximum flight duration and sub-system safety processes. Charging is done in the included XWorks Battery charger and can be charged via standard wall outlet, or via a vehicle.

**Landing style/type** – Autonomous vertical lift

**Propulsion System**

- Engines – The XWORKS X-81 is powered by 8 electric brushless DC motors.

- Batteries – Lithium polymer batteries are self-contained high duration systems with SMART intelligence on-board. This includes cycle charge times, locations, GPS antenna, chemical management, and real-time data feeds to ensure maximum flight duration and sub-system safety processes. Charging is done in the included XWorks Battery charger and can be charged via standard wall outlet, or via a vehicle. **Performance Characteristics**

    - Maximum Altitude – 12,000 ft MSL (operated no higher than 400 feet AGL).

    - Maximum Endurance – 50 minutes

    - Maximum Range – 3 km

    - Weather Minimums - Day VFR only

    - Winds Maximum – 40 MPH sustained, 45 mph gusts

    - Minimum cloud ceiling: 500 ft

    - Minimum visibility: 1 SM

    - Icing conditions – no icing conditions

    - Precipitation – no visible moisture **Maintenance** – The UAS is nearly maintenance free, it performs automatic pre-flight checks and the failure of any check will prevent take-off. Checks which cannot be done by the system will be performed by a qualified person prior to each flight.

Pre-flight checklist includes:

- Visual inspection of the airframe
- Visual inspections of rotor integrity
- Check charge of all batteries (aerial vehicle, command station, radio repeater station) **Reliability** – The system is designed for maximum reliability and to maintain performance over its life. The only components experience routine wear are rotors, batteries, motors, and legs. Battery and motor conditions are monitored by the system with deviations reported to the operator. Contact with other objects during flight may cause other components, particularly rotors, and motor arms, to become damaged. Damaged components are likely to be detected during the full visual inspection of the airframe performed before each flight. Structural damage affecting flight characteristics will be detected by on-board sensors. The UAV system detects numerous conditions which may make flying unsafe, such as reduced GPS accuracy, magnetic anomalies, low battery charge, battery cell imbalances, temperature fluctuations. Automatic pre-flight checks prevent the UAV from taking off if such conditions are present; or, if the condition is detected during flight, the system will trigger a Fatal Conditioned Response. **Fault Tolerance** - The key feature of the UAV fault tolerance is its mechanical simplicity. It uses four fixed pitched rotors, each mounted on a separate motor. No control surfaces or other actuators are required for the UAS to fly. Any component failure detectable by the system will be reported to the control station and will cause the UAV to perform a Fatal Condition Response (FCR) or Non-Fatal Conditioned Response (NFCR), depending on the type of failure. **Command and Control Systems** The XWORKS X-81 Ground Control station allows the operator simultaneous control over aircraft and payloads. The touch screen control allows for quick navigation and data entry while the display screen provides all essential flight data to the operator. Telemetry data is transmitted to the command station at least once per second. **Displayed on GCS:**
- UAS Position
- Navigation Route
- UAS Tail Number
- UAS Position
- UAS Altitude
- UAS Heading
- North Seeking Arrow
- Range to Target
- Calculated target position

- Date/time

- Sensor heading and orientation relative to UAS **On-board Flight Instruments** – The UAV is equipped with an Inertial Navigation System (3-axis gyroscope, 3-axis magnetometer, GPS receiver, and static pressure sensor).

**On–board computer systems** – The UAS is equipped on-board computer systems to monitor (sensors, battery, etc.), control (speeds, altitude, position, etc.), and communicate (control, telemetry, etc.).

**On-board guidance and navigation equipment** – The UAS can operate autonomously; it does not require any input from ground-based equipment, or from the pilot to hover in place.

**Takeoff and Landing** – The XWORKS X-81 has vertical lift autonomous launch and recovery. A Landing Zone "LZ" is designated by the operators and identified in the GCS software. For launch procedures the aircraft will takeoff and hover 3 meters directly above the LZ and hold until further operator instruction is given. The aircraft will automatically adjust for wind during this period.

**Navigation System** – Specific maps can be downloaded to the display screen (such as air sectional and geographic maps), which are overlaid with GPS positional data. Waypoints can be created before and during flight operation creating specific locations and sequences for the aircraft.

**Redundant Systems** – The UAS combines the input from a multitude of sensors. Even though the data from all sensors is required for optimal system performance, a single sensor malfunction is likely to result in degraded performance rather than leading to a catastrophic failure.

**Emergency Procedures and System Failures Failure Handling** – The UAS has extensive failure detection and handling capabilities. All failures are deeded to be either fatal or non-fatal. Failures classified as fatal result in a Fatal Condition Response (FCR); and failures classified as non-fatal result in a Non-Fatal Condition Response (NFCR).

**Sensor Failure** – Failure of on-board flight instruments/sensors will degrade the UAS performance and will result in either a FCR or a NFCR, depending on their severity. If the UAS becomes unstable due to sensor failure, it will stop all four motors and free fall to avoid a fly away condition.

**Motor Failure** – The UAS flight performance will degrade significantly if one or more motors fails. **Airframe Failure** – If airframe is damaged in ways that impacts flight characteristics, the UAS will behave similar to if an on-board flight instrument failed.

**Navigation System Failure** – In a navigation system failure, degraded GPS will result in FCR or NFCR 's depending on failures.

**Power Failure** – A complete battery failure which results in power loss to the UAS will

result in degraded flight performance.

**Low Battery Condition** – Operator will be alerted of a low battery condition and will land the aircraft as soon as able.

**Low Battery Condition** – Operator will be alerted of a low battery condition and will land the aircraft as soon as able.

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

**APPENDIX C**

**SUMMARY OF XWORKS SECTION 333 EXEMPTION REQUEST**

XWorks hereby provides pursuant to Part 11 a summary of its exemption application to allow commercial operation of the XWORKS X-81 small-unmanned system in market research, precision aerial survey work, mapping and inspections. An exemption is requested from the following regulations:

14 C.F.R. Part 21; 14 C.F.R. 45.23(b); 14 C.F.R. 91.7(a); 14 C.F.R. 91.9(b)(2) & (c); 14 C.F.R. 91.103; 14 C.F.R. 91.109(a); 14 C.F.R. 91.319; 14 C.F.R. 91.119; 14 C.F.R. 91.151(a); 14 C.F.R. 91.203(a) & (b); 14 C.F.R. 91.405(a); 14 C.F.R. 91.407(a)(1); 14 C.F.R. 91.409(a)(2); 14 C.F.R. 91.417(a).