

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CERTIFICATE OF WAIVER OR AUTHORIZATION

ISSUED TO

Cornell University, College of Agriculture and Life Sciences

ADDRESS:

Department of Entomology
Comstock Hall
Ithaca, New York 14853

This certificate is issued for the operations specifically described hereinafter. No person shall conduct any operation pursuant to the authority of this certificate except in accordance with the standard and special provisions contained in this certificate, and such other requirements of the Federal Aviation Regulations not specifically waived by this certificate.

OPERATIONS AUTHORIZED

Operation of the University Built (One-Third Scale Piper Cub) UAS in Class G and E airspace under the jurisdiction of Elmyra ATCT in the vicinity of Aurora, NY at 42-43-55.00N 76-39-21.00W (see Attachment 1) at or below 1,000 feet Above Ground Level (AGL). See special provisions.

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE

STANDARD PROVISIONS

1. A copy of the application made for this certificate shall be attached and become a part hereof.
2. This certificate shall be presented for inspection upon the request of any authorized representative of the Federal Aviation Administration, or of any State or municipal official charged with the duty of enforcing local laws or regulations.
3. The holder of this certificate shall be responsible for the strict observance of the terms and provisions contained herein.
4. This certificate is nontransferable.

Note-This certificate constitutes a waiver of those Federal rules or regulations specifically referred to above. It does not constitute a waiver of any State law or local ordinance.

SPECIAL PROVISIONS

Special Provisions are set forth and attached.

This certificate (2009-ESA-30) is effective from March 1, 2010 through February 28, 2011 and is subject to cancellation at any time upon notice by the Administrator or his/her authorized representative.

BY DIRECTION OF THE ADMINISTRATOR



FAA Headquarters, AJR-36
(Region)

Ardyth Williams
(Signature)

February 28, 2010
(Date)

Air Traffic Manager, Unmanned Aircraft Systems
(Title)

ATTACHMENT to FAA FORM 7711-1

Issued To: Cornell University, College of Agriculture and Life Sciences

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Comstock Hall
Ithaca, New York 14853

Activity: Operation of the University Built (One-Third Scale Piper Cub) UAS in Class G and E airspace under the jurisdiction of Elmyra ATCT in the vicinity of Aurora, NY at 42-43-55.00N 76-39-21.00W (see Attachment 1) at or below 1,000 feet Above Ground Level (AGL).

Purpose: To prescribe operating requirements in the NAS (outside of restricted and/or warning area airspace) for the purpose of training and/or operational flights.

Dates of Use: This COA (2009-ESA-30) is valid from March 1, 2010, through February 28, 2011. Should a renewal become necessary, the proponent shall advise the FAA, in writing, no later than 60 days prior to the requested effective date.

General Provisions:

- The review of this activity is based on our current understanding of UAS operations, and the impact of such operations in the NAS, and therefore should not be considered a precedent for future operations. As changes occur in the UAS industry, or in our understanding of it, there may be changes to the limitations and conditions for similar operations.
- All personnel connected with the UAS operation must comply with the contents of this authorization and its provisions.
- This COA will be reviewed and amended as necessary to conform to changing UAS policy and guidance.

Safety Provisions:

Unmanned Aircraft (UA) have no on-board pilot to perform see-and-avoid responsibilities, and therefore, when operating outside of restricted areas, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. In accordance with 14 CFR Part 91, General Operating and Flight Rules, Subpart J-Waivers, 91.903, Policy and Procedures, the following provisions provide acceptable mitigation of 14 CFR Part 91.113 and must be complied with:

- For the purpose of see-and-avoid, visual observers must be utilized at all times except in Class A airspace, restricted areas, and warning areas. The observers may either be ground based or in a chase plane. The UA must remain within a lateral

distance of no more than three-quarters (3/4) of a mile and 1,000 feet vertically from the visual observer. The distances listed are the maximum distance; at no time will the UA be operated at a distance beyond the visual line of sight for the visual observer.

- UAS pilots will ensure there is a safe operating distance between manned and unmanned aircraft at all times in accordance with 14 CFR 91.111, *Operating Near Other Aircraft*, and 14 CFR 91.113, *Right-of-Way Rules*. Cloud clearances and VFR visibilities for Class E airspace will be used regardless of class of airspace. Additionally, UAS operations are advised to operate well clear of all known manned aircraft operations.
- The dropping or spraying of aircraft stores, or carrying of hazardous materials (included ordnance) outside of active Restricted, Prohibited, or Warning Areas is prohibited unless specifically authorized in the Special Provisions of this COA.

Airworthiness Certification Provisions:

- UA must be shown to be airworthy to conduct flight operations in the NAS.
- Public Use Aircraft must contain one of the following:
 - A civil airworthiness certification from the FAA, or
 - A statement specifying that the Department of Defense Handbook "Airworthiness Certification Criteria" (MIL-HDBK-516), as amended, was used to certify the aircraft or
 - Equivalent method of certification.

Pilot / Observer Provisions:

- **Pilot Qualifications:** UA pilots interacting with Air Traffic Control (ATC) shall have sufficient expertise to perform that task readily. Pilots must have an understanding of and comply with Federal Aviation Regulations and Military Regulations applicable to the airspace where the UA will operate. Pilots must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA pilots.
- Aircraft and Operations Requirements:
 - Flight Below 18,000 Feet Mean Sea Level (MSL).
 - UA operations below 18,000 feet MSL in any airspace generally accessible to aircraft flying in accordance with visual flight rules (VFR) require visual observers, either airborne or ground-based. Use of ATC radar alone does not constitute sufficient collision risk mitigation in airspace where uncooperative airborne operations may be conducted.
 - Flights At or Above 18,000 Feet Mean Sea Level (MSL)
 - When operating on an instrument ATC clearance, the UA pilot-in-command must ensure the following:
 1. An ATC clearance has been filed, obtained and followed.

2. Positional information shall be provided in reference to established NAS fixes, NAVAIDS, and waypoints. Use of Latitude/Longitude is not authorized.
- **Observer Qualifications:** Observers must have been provided with sufficient training to communicate clearly to the pilot any turning instructions required to stay clear of conflicting traffic. Observers will receive training on rules and responsibilities described in 14 CFR 91.111, *Operating Near Other Aircraft*, 14 CFR 91.113, *Right-of-Way Rules*, cloud clearance, in-flight visibility, and the pilot controller glossary including standard ATC phraseology and communication. Observers must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA observers.
 - **Pilot-in-Command (PIC) –**
 - **Visual Flight Rules (VFR) as applicable:**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC operating a UA in line of sight must pass at a minimum the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105, and must keep their aeronautical knowledge up to date.
 - There is no intent to suggest that there is any requirement for the UAS PIC to be qualified as a crewmember of a manned aircraft.
 - Pilots flying a UA on other than instrument flight plans beyond line of sight of the PIC must possess a minimum of a current private pilot certificate, or military equivalent in the category and class, as stated in 14 CFR 61.105.
 - **Instrument Flight Rules (IFR) as applicable:**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC must be a certified pilot (minimum of private pilot) of manned aircraft (FAA or military equivalent) in category and class of aircraft flown.
 - The PIC must also have a current/appropriate instrument rating (manned aircraft, FAA or military equivalent) for the category and class of aircraft flown.
 - **Pilot Proficiency – VFR/IFR as applicable:**
 - Pilots will not act as a VFR/ IFR PIC unless they have had three qualified proficiency events within the preceding 90 days.
 - The term “qualified proficiency event” is a UAS-specific term necessary due to the diversity of UAS types and control systems.
 - A qualified proficiency event is an event requiring the pilot to exercise the training and skills unique to the UAS in which proficiency is maintained.

- Pilots will not act as an IFR PIC unless they have had six instrument qualifying events in the preceding six calendar months (an event that requires the PIC to exercise instrument flight skills unique to the UAS).
- **PIC Responsibilities:**
 - Pilots are responsible for a thorough preflight inspection of the UAS. Flight operations will not be undertaken unless the UAS is airworthy. The airworthiness provisions of 14 CFR 91.7, Civil Aircraft Airworthiness, or the military equivalent, apply.
 - One PIC must be designated at all times and is responsible for the safety of the UA and persons and property along the UA flight path.
 - The UAS pilot will be held accountable for controlling their aircraft to the same standards as the pilot of a manned aircraft. The provisions of 14 CFR 91.13, *Careless and Reckless Operation*, apply to UAS pilots.
- **Pilot/Observer Task Limitations:**
 - Pilots and observers must not perform crew duties for more than one UA at a time.
 - Chase aircraft pilots must not concurrently perform either observer or UA pilot duties along with chase pilot duties.
 - Pilots are not allowed to perform concurrent duties both as pilot and observer.
 - Observers are not allowed to perform concurrent duties both as pilot and observer.

Standard Provisions: These provisions are applicable to all operations unless indicated otherwise in the Special Provisions section.

- The UA PIC will maintain direct two-way communications with ATC and have the ability to maneuver the UA per their instructions, unless specified otherwise in the Special Provisions section. The PIC shall comply with all ATC instructions and/or clearances.
- If equipped, the UA shall operate with an operational mode 3/A transponder, with altitude encoding, or mode S transponder (preferred) set to an ATC assigned squawk.
- If equipped, the UA shall operate with position/navigation lights on at all times during flight.
- The UA PIC shall not accept any ATC clearance requiring the use of visual separation or sequencing.
- VFR cloud clearances and visibilities for Class E airspace will be used regardless of class of airspace the UAS is operating in, except when operating in Class A airspace where 14 CFR Part 91.155 will apply.
- Special VFR is not authorized.
- Operations (including lost link procedures) shall not be conducted over populated areas, occupied buildings, homes, heavily trafficked roads, an open-air assembly of people, or any other area which puts humans at risk.

- Operations outside of restricted areas, warning areas, prohibited areas (designated for aviation use) and/or Class A airspace may only be conducted during daylight hours, unless authorized in the Special Provisions section.
- Operations shall not loiter on Victor airways, Jet Routes, Q Routes, IR Routes, or VR Routes. When necessary, transit of airways and routes shall be conducted as expeditiously as possible.
- Operations conducted under VFR rules shall operate at appropriate VFR altitudes for direction of flight (14 CFR 91.159).
- The UA PIC or chase plane PIC (whichever is applicable) will notify ATC of any in flight emergency or aircraft accident as soon as practical.
- All operators that use GPS as a sole source, must check all NOTAM's and Receiver Autonomous Integrity Monitoring (RAIM). Flight into GPS test area or degraded RAIM is prohibited without specific approval in the special provisions.
- At no time will TCAS be used in any mode while operating an unmanned aircraft.
- Only one UA will be flown in the operating area unless indicated otherwise in the Special Provisions.
- A copy of this COA will be maintained on site by the PIC or designated representative.
- Cornell University, College of Agriculture and Life Sciences, and/or its representatives, is responsible at all times for collision avoidance with non-participating aircraft and the safety of persons or property on the surface with respect to the UAS.

Special Provisions:

1. In the event of a lost link, the UAS pilot will immediately notify Elmyra ATCT at 607-739-1971, state pilot intentions, and comply with the following provisions:
 - Aircraft will comply with the lost link procedure provisions listed in Attachment 2 and will report UAS landing time to Elmyra ATCT, 607-739-1971.
 - If lost link occurs within a restricted or warning area, or the lost link procedure above takes the UA into the restricted or warning area – the aircraft will not exit the restricted or warning areas until the link is re-established.
 - The UA lost link mission will not transit or orbit over populated areas.
 - When outside of restricted/warning area airspace, lost link programmed procedures will avoid unexpected turn-around and/or altitude changes and will provide sufficient time to communicate and coordinate with ATC.
 - Lost link orbit points shall not coincide with the centerline of Victor airways.
2. The ATC facility, Elmyra ATCT may terminate or delay the provisions of this COA at any time it deems a sufficient level of safety for operations is not met.
3. Daisy chaining of visual observers is not authorized.
4. A maximum of one UA will be controlled at a time for each ground control station.

5. Special provisions 1 will be used in lieu of maintaining direct two-way communications with ATC (Standard Provisions, bullet one).

NOTAM: A distance (D) Notice to Airmen shall be issued when UA operations are being conducted. This requirement may be accomplished through your local base operations or NOTAM issuing authority. You may also complete this requirement by contacting Flight Service Station at 1-877-4-US-NTMS (1-877-487-6867) not more than 72 hours in advance, but not less than 48 hours prior to the operation and provide:

- Name and Address of pilot filing NOTAM request
- Location, Altitude or the operating Area
- Time and nature of the activity

NOTE FOR PROPONENTS FILING THEIR NOTAM WITH DoD ONLY: This requirement to file with the AFSS is in addition to any local procedures/requirements for filing through DINS. The FAA Unmanned Aircraft Systems Office is working with the AFSS, and to eliminate the requirement to file a NOTAM with both the AFSS and DINS in the near future.

Incident / Accident and Normal Reporting Provisions: The following information is required to document routine and unusual occurrences associated with UAS activities in the NAS.

- The proponent for the COA shall provide the following information to Donald.E.Grampp@faa.gov on a monthly basis:
 - Number of flights conducted under this COA.
 - Pilot duty time per flight.
 - Unusual equipment malfunctions (hardware/software).
 - Deviations from ATC instructions.
 - Operational/coordination issues.
 - All periods of loss of link (telemetry, command and/or control)
- The following shall be submitted via email or phone (202-385-4542, cell 443-569-1732) to Donald.E.Grampp@faa.gov **within 24 hours and prior to any additional flight under this COA:**
 - All accidents or incidents involving UAS activities, including lost link.
 - Deviations from any provision contained in the COA.

This COA does not, in itself, waive any Federal Aviation Regulation (FAR) nor any state law or local ordinance. Should the proposed operation conflict with any state law or local ordinance, or require permission of local authorities or property owners, it is the responsibility of Cornell University, College of Agriculture and Life Sciences, to resolve the matter. This COA does not authorize flight within Special Use Airspace without approval from the Using Agency. Cornell University, College of Agriculture and Life Sciences, is hereby authorized to operate the University Built (One-Third Scale Piper

Cub) Unmanned Aircraft System UAS in the operations area depicted in “Activity” above and attachment 1 below.

Lost Link Procedures

Loss of link between the pilot and the UAS can have three causes; RF interference, failure of the onboard RF receiving and control system, and failure of the transmitter. The following procedures are utilized in the event of lost link.

A-1. RF interference.

A-1.1. Before each flight, a ground-based RF check with engine running at full throttle is conducted as part of the preflight safety check. This procedure checks for interference from nearby RF sources including leaking ignition sources and receiver sensitivity in the operating environment of the UAS operating at full throttle (tx with collapsed antenna). Detection of any RF interference problems grounds the aircraft until the source of the interference can be identified and corrected. A replacement aircraft will be flown in the questionable aircraft's place.

A-1.2. In the case of RF interference during flight, the receivers onboard the UAS are programmed to deflect the flight surfaces and reduce the throttle which places the UAS into a large circle with the UAS maintaining altitude. The UAS will maintain the altitude until the fuel supply is exhausted. After the fuel supply is exhausted, the UAS will slowly spiral into the ground. With the usual intermittent nature of the RF interference and the design of the receivers utilized, the control link should be reestablished within a very short period of time. At the point of control reestablishment, the UAS will be immediately landed and grounded until the source of the RF interference is identified and corrected.

A-2. **Failure of Onboard RF Receiving and Control System.** Each UAS is set up with two completely independent receiver and battery systems, similar and common to many large hobby RC aircraft. Each receiver system controls one side of the aircraft and has its own battery, switch and receiver. For example, rx-1 controls the right aileron and left elevator half while rx-2 controls the left aileron and the right elevator half. Rudder and flaps are assigned to one of the receivers and the throttle is assigned to the other receiver. This setup, while not truly redundant, plans for all system failures except frequency interference and the lost control link. For example, if the switch, battery, receiver or mechanical connections fail on one receiver system causing it to fail, the UAS can be flown and landed safely with active controls on 50% of the aircraft. This is a tried and true system and failure of both systems is highly improbable.

A-3. **Failure of the Transmitter.** There will always be a second backup transmitter on hand for each UAS currently flying. This backup transmitter is set on the appropriate control frequency and is programmed to control the UAS in flight. The backup transmitter will be kept within a few feet of the pilot and in the case of transmitter failure, the backup transmitter will be turned on and control of the UAS be reestablished within a very short period of time.

A-4. In the event of total loss of command/control of the aircraft through the procedures outlined above, a kill switch is present on the aircraft engine ignition to kill the engine. The control of the engine kill switch is located in the Flight Control Center. The engine kill switch is remotely operated through a second receiver which operates only the engine kill switch on the UAS and is controlled from a transmitter located in the Flight Control Center. The reason for this choice of engine kill switch control is the following:

A-4.1. If this option has to be used, the pilot has lost control of the aircraft and something has malfunctioned within the flight control systems. The second receiver system is completely independent of the flight control systems and it is highly unlikely that both the flight control systems and the receiver system will fail under the same circumstances and at the same time. Both systems operate on different radio frequencies and in most cases, the flight control systems are operated in the 50 mhz range and the airborne sampler control system is operated in the 72 mhz range.

A-4.2. The transmitter antennas for the second receiver system are located on the top of the Flight Control Center trailer. The location of the antennas provides a wider zone of control (both omidirectional and distance) than an antenna held by a ground based pilot. The transmitters controlling the second receiver system are also directly connected to the trailer power supply which eliminates any power issues with batteries and the transmitters are always operating at maximum power output.