

CERTIFICATE OF WAIVER OR AUTHORIZATION

ISSUED TO

Virginia Polytechnic Institute and State University

403 Latham Hall, Quad Lane
Blacksburg, VA 24061

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 Penguin B Unmanned Aircraft System (UAS) in Class G airspace at or below 400' Above Ground Level (AGL) at Virginia Tech's Kentland Farm under the jurisdiction of the Roanoke Approach Control.

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE

N/A

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 2011-ESA-54 is effective from August 29, 2011 to August 28, 2012, and is subject to cancellation at any time upon notice by the Administrator or his/her authorized representative.

BY DIRECTION OF THE ADMINISTRATOR



for

FAA Headquarters, AJV-13

(Region)

Dean E. Fulmer

(Signature)

August 29, 2011

(Date)

Acting Manager, Unmanned Aircraft Systems

(Title)

ATTACHMENT to FAA FORM 7711-1

Issued To: Virginia Polytechnic Institute and State University

Address: 403 Latham Hall, Quad Lane
Blacksburg, VA 24061

Activity: Operation of the Penguin B Unmanned Aircraft System (UAS) in Class G airspace at or below 400' Above Ground Level (AGL) at Virginia Tech's Kentland Farm under the jurisdiction of the Roanoke Approach Control.

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

Dates of Use: This Certificate of Authorization (COA) 2011-ESA-54 is valid from August 29, 2011 through August 28, 2012. Should a renewal become necessary, the proponent shall advise the Federal Aviation Administration (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 91.111/113 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. If the chase aircraft is operating more

than 100ft above/below and or 1/2 nm laterally, of the UA, the chase aircraft PIC will advise the controlling ATC facility.

- In order to comply with the see and avoid requirements of Title 14 of the Code of Federal Regulations sections 91.111 and 91.113, the pilot-in-command and visual observers must be able to see the aircraft and the surrounding airspace throughout the entire flight; and be able to determine the aircraft's altitude, flight path and proximity to traffic and other hazards (terrain, weather, structures) sufficiently to exercise effective control of the aircraft to give right-of-way to other aircraft, and to prevent the aircraft from creating a collision hazard.
- 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, heavily trafficked roads, or an open-air assembly of people.
- 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 NOTAMs 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.
- The Virginia Polytechnic Institute and State University, 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 Roanoke Approach Control at 540-563-5985, state pilot intentions, and comply with the following provisions:
 - The aircraft will comply with the Lost Link procedures depicted in Attachment 2 of this document.
 - 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. A maximum of one UA can be flown at this operating location at any given time.
3. UAS operators shall contact Roanoke Approach at 540-563-5985 prior to flight on days of operation to coordinate UAS activity.

4. Pilots will monitor KPSK Common Traffic Advisory Frequencies (CTAF) during all flight operations. The UAS pilot shall make radio transmissions as appropriate when manned aircraft transmissions are heard on the aforementioned frequency to include at a minimum: call sign, size and type (i.e. fixed wing) of UAS, location in reference to the airport, altitude, airspeed, and intentions.
5. By accepting this COA, The Virginia Polytechnic Institute and State University has authorized the FAA to conduct site evaluations at the operating location of this COA.
6. Any visual observer, sensor operator, or other person charged with providing collision avoidance for the Penguin B UAS must have immediate communication with the pilot-in-command (PIC) and must not simultaneously accomplish PIC/Vehicle Operator, nor Mission Operator duties for the flight.
7. The Virginia Polytechnic Institute and State University has certified this operation is a public aircraft under Section 40102 (a) (37), Title 49 United States Code, and COA 2011-ESA-54 is inherently a governmental function so intimately related to the interest of the public, and must comply with all provisions of the public aircraft law.
8. The Penguin B is prohibited from being used for commercial purposes. Any use other than a public aircraft voids this COA.
9. There will not be simultaneous occupancy of manned and unmanned aircraft in the Kentland Farm area of operation. When a manned aircraft approaches the Kentland Farms operating area, UAS pilots will ensure there is a safe operating distance between manned and unmanned aircraft at all times by immediately ceasing UAS operating and landing or delaying takeoff of the UA, as appropriate.
10. The Virginia Polytechnic Institute and State University has made its own determination on the Airworthiness and safety of the Penguin B UAS. The UAS must be operated in strict compliance with all provisions and conditions contained in the Airworthiness Statement.
11. Daisy chaining of visual observers is not authorized.
12. A Pilot-in-Command (PIC) means the person who has final authority and responsibility for the operation and safety of the flight and has been designated as PIC before or during the flight and holds the appropriate category, class and type rating, if appropriate, for the conduct of flight. The PIC must control the aircraft (or override authority to assume control) during all UAS operations.
13. All crewmembers including the PIC and visual observers must receive training under the direct supervision of a qualified instructor who has operational control of the UA at all times.

14. A copy of the COA must be at the site whenever UA operations are being conducted. All crewmembers including the PIC and visual observers must read and adhere to the contents and special provision in the COA.
15. The PIC must conduct a pre-takeoff briefing which includes a briefing on the contents of the COA, the maximum altitudes to be flown, initial heading, frequencies to be used, lost link procedures, the parameters for the use of a ditch point, hazards unique to the flight being flown, emergency procedures on takeoff and landing, a briefing on the amount of fuel/flight time remaining including a reserve of the UA, and any other briefing requirements.
16. A frequency integrity check must be conducted prior to the launch of the UA.
17. Sterile cockpit procedures must be observed during all critical phases of flight.
18. The use of cell phones or other telephonic communication is restricted to the operational control of the UAS, and any required communications with ATC.
19. The holder of this COA, or delegated representative, is responsible for halting or canceling activity in the operating area if, at any time, the safety of persons or property on the ground or in the air is in jeopardy, or if there is a failure to comply with the terms or conditions of this authorization.
20. The Federal Aviation Administration has the authority to cancel this COA or delay any activities if the safety of persons or property on the ground or in the air is in jeopardy, or if there is a violation of the terms specified.
21. The Virginia Polytechnic Institute and State University is responsible to ensure the safety of flight and adequate visual range coverage to mitigate any potential collisions with manned and unmanned aircraft and hazards to persons on the ground.
22. Special provisions 1, 3 and 4 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

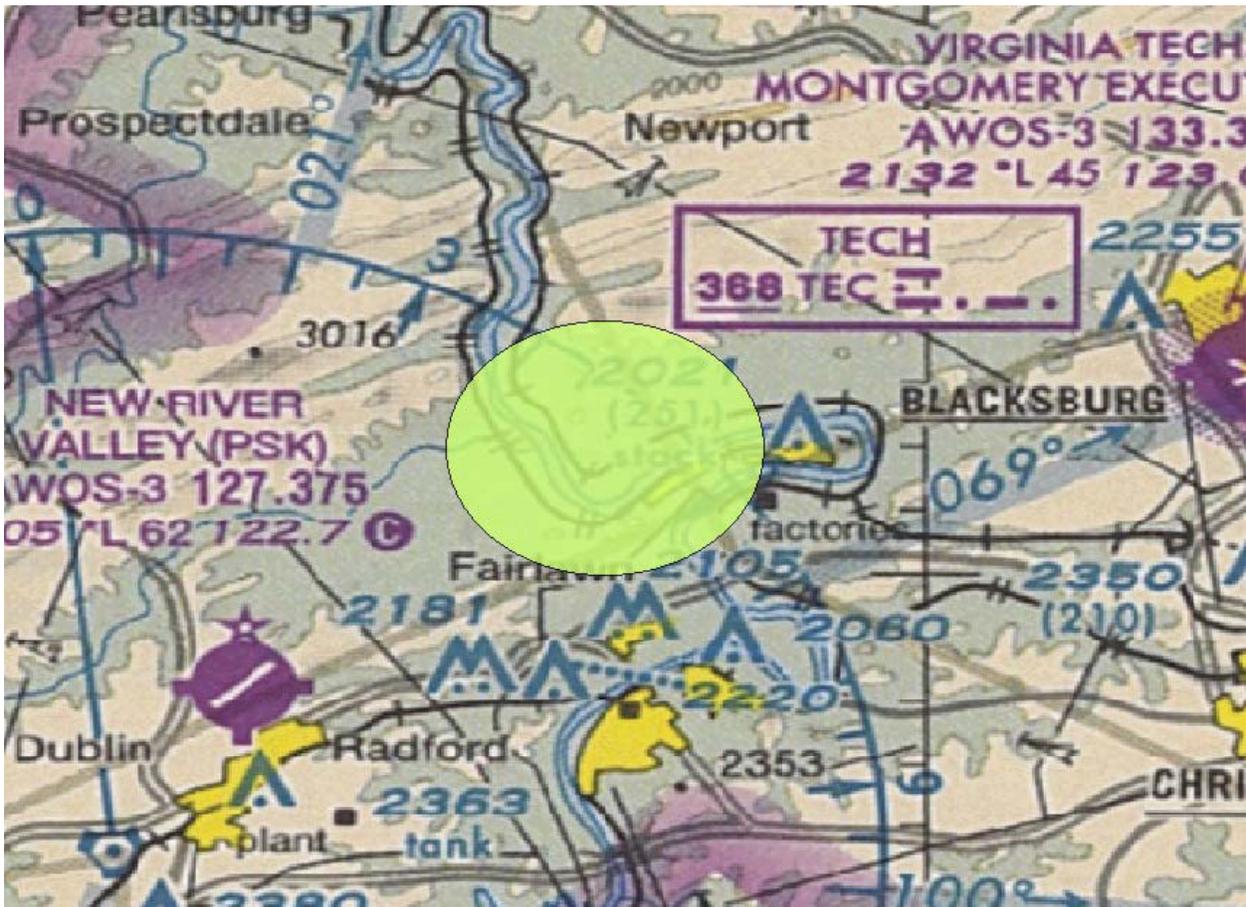
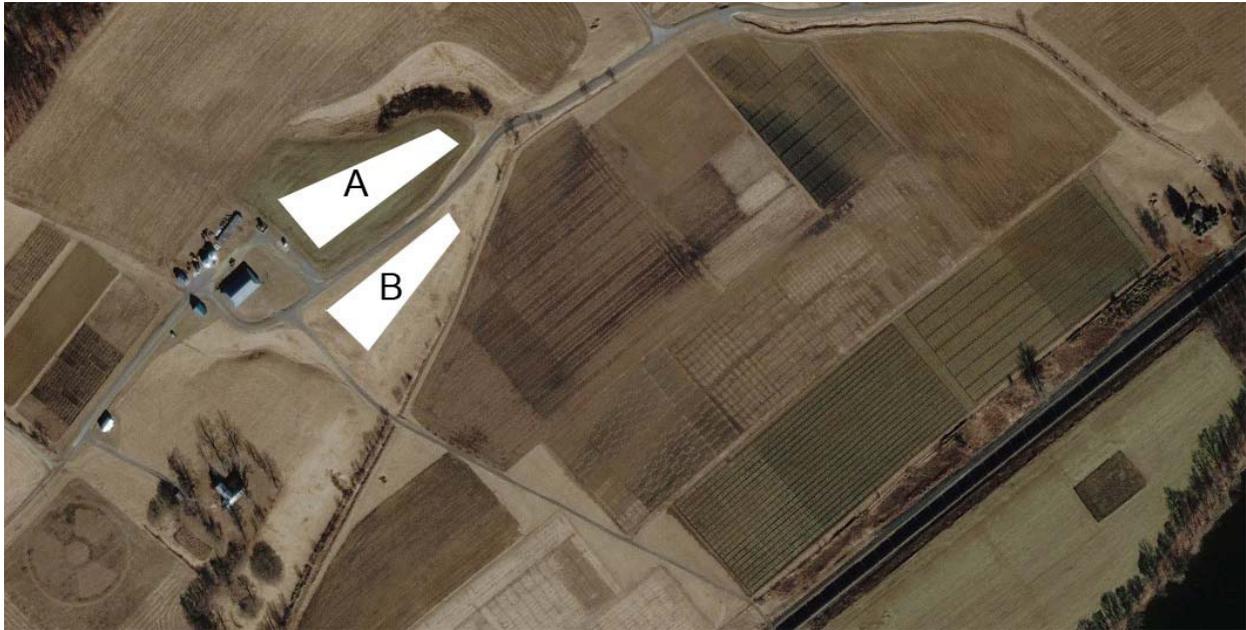
NOTE FOR PROPONENTS FILING THEIR NOTAM WITH DoD ONLY: This requirement to file with the AFSS is in addition to any local procedures/requirements for filing through DINS. The FAA Unmanned Aircraft Systems Office is working with the AFSS, and to eliminate the requirement to file a NOTAM with both the AFSS 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 COA Online, 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 the Virginia Polytechnic Institute and State University to resolve the matter. This COA does not authorize flight within Special Use Airspace without approval from the Using Agency. The Virginia Polytechnic Institute and State University is hereby authorized to operate the Penguin B Unmanned Aircraft System in the operations area depicted in "Activity" above and attachment 1 below.

Kentland Farms Operating Area



Lost Link Procedures

1. Lost link between ground station computer and UAV.

In the event that the UAV loses 900MHz communication with the ground control computer when the flight controller has control of the UAV, one of the pilots will regain control of the UAV with a 72MHz RC transmitter and the UAV will be brought in for a landing immediately. Either transmitter operated by either pilot can kill the throttle on the UAV. Since two pilots have control of the UAV at all times, and the UAV is always in the line-of-sight, it should be noted that the sampling missions do not rely on a link to the ground control computer.

2. Lost link between UAV and one transmitter.

If the primary pilot is unable to control the UAV on one channel with one transmitter, the secondary pilot will take control of the UAV with the other 72MHz RC transmitter operating on a different channel and the UAV will be brought in for a landing immediately. Either transmitter operated by either pilot can kill the throttle on the UAV. Back-up transmitters are always available on-site should one transmitter fail to operate. The back-up transmitter is kept near the main pilot. In the case of transmitter failure, the backup transmitter can be turned on and control of the UAV be reestablished within a period of seconds.

3. Lost link between UAV and both transmitters.

Should both transmitters fail to communicate with the UAV, the autopilot will maintain a steady orbital pattern with a 150 meter diameter path operating at 1/4 throttle and a constant speed of 45 km/h. This will enable the ground-based-pilots sufficient time to regain control of the UAV with another transmitter. Should the ground-based-pilots be unable to regain control, the autopilot will continue to circle until it is out of fuel and will slowly pilot the aircraft toward the ground in a mild orbital pattern. This pattern is always in an uninhabited area near the airstrips at the Kentland Farm.