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UNMANNED AERIAL SYSTEMS (UAS)

FLIGHT OPERATIONS MANUAL

[AGENCY NAME]

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# 1. Preface

The following procedures are intended to promote safe, efficient and lawful operation of The Program’s unmanned aerial systems (UAS). Safety, above all else, is the primary concern in each and every operation, regardless of the nature of the mission. Many procedures are adopted from the Oak Ridge National Laboratory “Best Practices for Unmanned Aerial Systems” (February 2017), American Civil Liberties Union (ACLU) “Protecting Privacy from Aerial Surveillance (recommendations for Government Use of Drone Aircraft) December 2011”, National Telecommunications and Information Administration (NTIA) “Voluntary Best Practices for UAS Privacy, Transparency and Accountability”, Federal Aviation Administration (FAA) Small Unmanned Aircraft Systems Part 107, as well as other sources.

# 2. Philosophy & Mission Statement

It shall be the mission of those personnel of the program who are trained in the use of unmanned aircraft systems (UAS), to use this manual to perform aerial applications safely and effectively while also respecting private property and privacy of the citizens.

It shall be the intent of every UAS operator to make safe, effective applications and while taking every reasonable effort to not invade a person's reasonable expectation of privacy when operating the UAS. When operating the UAS, operators shall abide by all Federal Aviation Administration (FAA) Regulations for flight and receive the proper authorization for flight.

# 3. Protection of Rights and Privacy

## 3.1 Privacy

UAS operators and observers ensure the protection of private individuals’ Fourth Amendment Rights, civil rights and reasonable expectations of privacy before deploying the UAS. UAS operators and observers ensure and are held accountable for ensuring that operations of the UAS intrude to a minimal extent upon the private property, persons and businesses. To accomplish this primary goal, UAS Operators must observe the following:

1. The UAS will not record video or still pictures of features on the ground that relate to public property and private-owned assets. Any data captured outside the focus of flight operations is unintentional or only as necessary due to document needed mission parameters or the proximity to public property or private-owned assets.
2. When the UAS is flown, the onboard cameras are turned so as to be the intended application target area and to minimize inadvertent video or still images of uninvolved persons or property.
3. The program does not conduct random surveillance activities. The use of the UAS is tightly controlled and regulated and not in any way intended to document the activity of private citizens.
4. Hovering over private property shall be kept to a minimum or only as necessary to accomplish the goal of an individual flight operation.
5. Flight over private property shall be conducted a minimum of 30 feet away in any direction from any structures or people, and wherever practical well above the roofline of any privately owned structures.
6. All authorized missions for UAS are for:
7. Liquid and granular application services
8. Site assessment/mapping.
9. Program emergency operations.
10. The UAS operate strictly within the Federal, State, and City laws and regulations. If in doubt, prior to operating the UAS we ensure that the proper forms and applications are applied for and obtained.

## 3.2 Protection/Annoyance

It is essential that the UAS Program build a reputation for well-managed, minimally intrusive UAS use. A reputation of professionalism will support future, more complex applications. Any adverse incidents such as unprofessional and unsafe use have the potential to jeopardize the public trust, thus hindering future expansion of the far-reaching UAS capabilities. The following list of privacy and UAS etiquette best practices should be considered when operating UAS.

1. Aircraft Noise Abatement. UAS noise could create a public relations problem. Operators should review their operating practices on a continuing basis with a view toward minimizing this nuisance to the public.
2. Prohibited Operation Over Persons. FAA Part 107 prohibits a person from flying a UAS directly over a person who is not under a safe cover such as a protective structure or a stationary vehicle that would protect the person from harm from the UAS.

Protecting the public from harm if the UAS were to crash into a person, structure or vehicle is the primary concern of the UAS flight crew. However, a UAS may be flown over a person who is directly participating in the operation of the UAS, such as the remote PIC (Pilot In Charge), other persons manipulating the controls, a VO (Visual Observer), or crew members necessary for the safety of the UAS operation, as assigned and briefed by the remote PIC. There are several ways that the UAS remote PIC can comply with these requirements, including the following:

1. If possible, selecting an operational area (site) that is clearly unpopulated/uninhabited. If selecting a site that is populated/inhabited, the PIC should have a plan of action that ensures persons remain clear of the operating area, remain indoors, or remain under safe cover that would protect them from harm until such time as the UAS flight has ended.
2. Established an operational area that the remote PIC has taken reasonable precautions to keep free of persons not directly participating in the operation of the UAS.
3. Choosing an operating area that is sparsely populated or, ideally, clear of persons and never operate a UAS from a moving vehicle.
4. Having a plan of action that ensures the UAS remains clear of persons who may enter the operating area.
5. Adopting an appropriate operating distance from persons not directly participating in the operation of the UAS.

Prohibited Maneuvers. The following maneuvers shall be prohibited when flying in any UAS or drone:

1. Maneuvers solely for “thrill” purposes or in an adverse nature.
2. Flying directly over an electrical substation
3. Flying within 30 ft. of energized power lines

In Summary, all UAS operators and assigned crew members should make every reasonable effort not to invade the safeguard the use of the UAS and ensure the public’s privacy in the execution of UAS work. All federal, state, and local regulations should be adhered to, and as required, the public should be notified before UAS operations.

## 3.3 Public Notification

No flights shall be conducted over a city or town unless a mission has been agreed upon and approved by the appropriate local and program officials.

Notice of flights over a congested area will be given prior to flight as required by:

1. Newspaper advertisements
2. Television reports
3. Radio reports
4. Internet postings

When applicable the following agencies will be notified prior to takeoff:

1. Air traffic control
2. Local law enforcement agencies
3. Emergency Personnel

# 4. Acronyms

1. AP autopilot

2. AGL above ground level

3. ATC air traffic control

4. BOE Bureau of Engineering

5. BVLOS beyond visual line of sight

6. C2 Command and Control

7. CICA Convention on International Civil Aviation

8. COA certificate of authorization

9. CFR Code of Federal Regulations

10. COW certificate of waiver

11. CS control station

12. CTAF Common Traffic Advisory Frequency

13. DoD US Department of Defense

14. DROTAM Drone Notice to Airmen

15. EM electromagnetic

16. EMI electromagnetic interference

17. EPRI Electric Power Research Institute

18. FAA Federal Aviation Administration (US Department of Transportation)

19. FPV first-person view

20. FSDO Flight Standards District Office (FAA)

21. GPS Global Positioning System

22. HD high definition

23. ICAO International Civil Aviation Organization

24. IFR instrument flight rule

25. IoT Internet of Things

26. lidar light detection and ranging

27. MAD minimum approach distance

28. MOA military operations area

29. mph miles per hour

30. MPO mission payload operator

31. MSL mean sea level

32. NAS National Airspace System

33. NM nautical mile

34. NOTAM Notice to Airmen

35. NSA National Security Area

36. NTIA National Telecommunications and Information Administration

37. NUASCP National Unmanned Aircraft Systems Credentialing Program

38. NWS National Weather Service

39. ORM operational risk management

40. ORNL Oak Ridge National Laboratory

41. PIC pilot in command , remote pilot in command

42. RPAS remotely piloted aircraft system

43. RTB return to base

44. RTF ready-to-fly

45. SA situational awareness

46. SAR Synthetic Aperture Radar

47. SOSC Systems Operations Support Center (FAA)

48. SUA special use airspace

49. sUAS small unmanned aerial system

50. TFR temporary flight restriction

51. TIR thermal infrared

52. TSA Transportation Security Administration (US Dept. of Homeland Security)

53. UA unmanned aircraft

54. UAS Unmanned Aerial System; Unmanned Aircraft System

55. UASRC Unmanned Aerial Systems Research Center

56. UAV unmanned aerial vehicle

57. VFR visual flight rule

58. VHF very high frequency

59. VLOS visual line of sight

60. VMC visual meteorological condition

61. VO visual observer

# 5. Administration

## 5.1 Operations Manual

1. The policies and procedures contained in this manual are issued by the District. As such it is an official policy document.
2. This manual is not intended to be all-inclusive, but as a supplement to other programmatic guidelines, Federal Aviation Administration regulations, pre-flight safety checklists, and the UAS manufacturers' approved flight manual.
3. This manual is been written to address UAS operations, as they existed when it was drafted. Equipment, personnel, certifications, environment (internal and external), etc., change over time. The management of change involves a systematic approach to monitoring organizational change and is a critical part of the risk management process. Given this, it is essential that this manual be continually updated as necessary. The entire manual must be reviewed, at a minimum, annually or any time the FAA issues new advisories or new regulations to assure it is up to date.
4. All pilots will be given a Flight Operations Manual (FOM) at the beginning of each year, and thereafter, if changes are applied during the year.
5. All changes made will be reviewed with UAS pilots. If changes are made during the year, each change will be sent to pilots via email for him or her to print and apply a copy to their FOM. Each pilot will confirm that their FOM has been updated by emailing the Chief Pilot or Drone Coordinator within 7 days. Pilots can forward any questions or concerns to the Chief Pilot or Drone Coordinator.
6. Pilots can request a change by emailing the Chief Pilot or Drone Coordinator. If it is determined that a change is necessary, then changes will be submitted to the local Flight Standards District Office (FSDO) at least 15 days before it is implemented. Each FOM will be updated and the revision page will be noted.
7. If a change needs to be made immediately due to a safety issue, the change will be made by the Chief Pilot and Drone Coordinator in coordination with the local FAA FSDO.
8. All pilots will acknowledge receipt of Flight Operations Manual as indicated on the signature page with his or her signature.

## 5.2 Organization

The organizational structure of the UAS Operation is;

Management:

UAS (Drone) Coordinator

Flight Crew (Field):

UAS Operator, Pilot in command (PIC) - FAA 14 CFR Part 107 certificate holder

Visual Observer (VO)

Mission Payload Operator (MPO)

The Mission Payload Operator, Visual Observer and Pilot can change positions as long as a Part 107 Certificate Holder is present on the Flight Crew.

1. The UAS Flight crew is comprised of those personnel approved by the program and includes a FAA Part 107 Certified Remote Pilot (PIC), Payload operators (MPO), Visual Observers (VO) and others as deemed necessary to be assigned as part of the UAS Flight crew.
2. Assignment to the UAS crew is by careful selection and by the appropriate Chief Pilot from specially trained employees with knowledge of the airspace within which the UAS operation will take place and how that airspace fits into the National Airspace System (NAS).
3. There will always be a minimum of two flight crew members (PIC and at least one MPO/VO) required for any mission to be flown. This is a mandatory requirement.

## 5.3 Personnel

1. The UAS Coordinator is responsible for the overall direction and performance of the UAS unit and exercises command and control over it.
2. UAS Coordinator Responsibilities:
3. Maintaining all training, flight and maintenance records for each operator and observer as well as individual airframes;
4. Maintain contact with the FAA and regulations as they change
5. Evaluate airframes based on mission needs
6. The UAS Coordinator is not required to be a FAA Part 107 Certified Remote Pilot. However, if the UAS Coordinator is not so certified, duties and responsibilities that require such certification MUST be delegated to or overseen by the most qualified staff that is so certified, usually the senior remote pilot in command (PIC).
7. The senior PIC would be required to be the point of contact between the FAA and the District. The senior PIC should also be required to stay up to date on FAA regulations as they change, evaluate airframes based on present and future mission needs, stay current on UAS technology, assist with training, etc.
8. UAS Operators (PIC):
9. To be considered for selection as an operator, applicants must meet the requirements for and successfully pass an administered UAS Flight Check in order to be accepted into the UAS crew.
10. At least one onsite operator must hold a current FAA Part 107 Remote Pilot Certificate during any flight operations.
11. Operators interacting with Air Traffic Control (ATC) or Terminal Radar Approach
12. Operators shall have sufficient expertise to perform that task readily. Operators must have an understanding of, and comply with FAA Regulations applicable to the airspace where the UAS operates, including rules and responsibilities described in 14 CFR 91.111, Operating Near Other Aircraft, 14 CFR 91.13, Right-of-Way Rules, cloud clearance, in-flight visibility, and the pilot controller glossary including standard ATC phraseology and communication. FAA PAR 14 CFR 91.17, Alcohol or Drugs, applies to the PIC.
13. An operator's primary duty is the safe and effective operation of the UAS in accordance with the manufacturers' approved flight manual, FAA regulations and program policy and procedures. Operators must remain knowledgeable of all FAA regulations; UAS manufacturer's flight manual and bulletins and District policy and procedures and exhibit situational awareness at all times.
14. Operators may be temporarily removed from flight status at any time by the UAS coordinator, for reasons including performance, proficiency, physical condition, etc. Should this become necessary, the operator will be notified verbally and in writing of the reason, further action to be taken and expected duration of such removal.
15. The UAS Coordinator shall maintain a file for each operator that shall include copies of training records, flight incidents, etc. This file is reviewed in accordance with current District policy and procedures.
16. Visual Observers (VO)
17. Visual Observers must have been provided with sufficient training to communicate clearly to the operator any turning instructions required to stay clear of conflicting traffic and obstacles. Observers receive training on rules and responsibilities described in 14 CFR 91.111, Operating Near Other Aircraft, 14 CFR 91.13, Right-of-Way Rules, cloud clearance, in-flight visibility, and the pilot controller glossary including standard ATC phraseology and communication. FAA PAR 14 CFR 91.17, Alcohol or Drugs, applies to UAS observers.
18. An observer's primary duty is communication with other crew members and property owners as well as be an observer for anything that may affect the operator's primary duty (see and avoid). Secondarily they may be asked to operate the UAS's equipment including flight controls and cameras while another crew member takes on the task of observer.
19. The UAS Coordinator maintains a file for each observer, which includes copies of training records, UAS incidents, etc.
20. Mission Payload Operators (MPO)
21. Mission Payload Operators include individuals responsible for mixing and loading all products to be applied.
22. The MPO will communicate directly with the pilot as needed to facilitate the flight mission and ensure that the mission’s task has been completed.
23. When not loading the UAS, the MPO will have the same duties as a VO.

## 5.4 Scheduling (Training and Proficiency)

1. To facilitate the broad use of the UAS, it shall be made available to all UAS flight crew members.
2. To maintain a level of proficiency with the UAS, operators are required, as part of their acceptance into the UAS flight crew, to attend training every six months. Training is coordinated through the UAS coordinator and announced in advance for scheduling purposes. At a minimum, training shall consist of a review of preflight checks, take-off and landing procedures, emergency procedures, UAS crew communication protocols, and 4 hours of actual UAS flight time for every UAS PIC.
3. All pilots must maintain the appropriate state and local permits or licenses for the application of pesticides and operation of the UAS.

## 5.5 Area of Operation

1. Due to the complexity of our operations throughout the 48 contiguous states, there is no way to pin point the exact area of operation until the mission is ordered. Mosquito biology and other factors dictates that missions can rarely be planned more than two days in advance.
2. All mission maps, operating areas, routes, special areas, no spray areas and any hazards will be included on any approved congested area plan (CAP). A CAP may be required to be approved by each controlling Flight Standards District Office (FSDO) before beginning any mission in a new area.
3. All Maps used by the pilots and submitted for CAP approval are received from the FAA in the form of "Digital Sectionals". Updates are received every 56 days from the FAA. Any map submitted to the local FSDOs will be 56 days old or less.

# 6. Safety

## 6.1 Safety Policy

1. The Program is committed to having a safe and healthy workplace, including:
2. The ongoing pursuit of an accident free workplace, including no harm to people, no damage to equipment, the environment and property.
3. A culture of open reporting of all safety hazards in which management will not initiate disciplinary action against any personnel who, in good faith, disclose a hazard or safety occurrence due to unintentional conduct.
4. Support for safety training and awareness programs.
5. Conducting regular audits of safety policies, procedures and practices.
6. It is the duty of every member within the UAS flight crew to contribute to the goal of continued safe operations. This contribution comes in many forms and includes always operating in the safest manner practicable and never taking unnecessary risks. Any safety hazard, whether procedural, operational, or maintenance related must be identified as soon as possible after, if not before, an incident occurs. Any suggestions in the interest of safety should be made to the UAS Coordinator.
7. If any member observes, or has knowledge of an unsafe or dangerous act committed by another member, the UAS coordinator is to be notified immediately so that corrective action may be taken.
8. The person manipulating the flight controls cannot operate a UAS and drive a moving vehicle in a safe manner and remain in compliance with FAA Part 107.
9. All members of the UAS flight crew are responsible for the following:
10. Ensuring all flight operations personnel understand applicable regulatory requirements, standards and organizational safety policies and procedures.
11. Observe and control safety systems by monitoring all operations.
12. Review standards and the practices of UAS personnel as they impact operational safety.
13. Communicate all reported safety related problems and the corrective action taken. If there were any in-flight problems (or learned experiences), the proper procedures for handling that problem should be discussed.
14. Copy and circulate pertinent safety information.
15. Copy and circulate emergency safety bulletins.
16. Place any electronic copies of safety information or bulletins in a conspicuous location for all employees to access.
17. It is emphasized again that safety is the responsibility of ALL members of the

UAS unit.

## 6.2 Flight Crew Rest and Medical Factors

1. PIC and Observers shall only deploy the UAS when rested and emotionally prepared for the tasks at hand.
2. Physical illness, exhaustion, emotional problems, etc., seriously impair judgment, memory and alertness. The safest rule is not to act as an operator or observer when suffering from any of the above. Members are expected to "stand down" when these problems could reasonably be expected to affect their ability to perform flight duties.
3. All members shall make a self-assessment of their physical condition during pre-flight activities.
4. Prescription and over-the-counter drugs can seriously hamper performance. The UAS Coordinator must be advised anytime such drugs are being taken. If it is determined that the medication being taken could hamper an operator or observer, that member shall be prohibited from the deployment or exercise.
5. No member shall act as an operator or observer within eight hours after consumption of any alcoholic beverage, while under the influence of alcohol.

## 6.3 Safety Equipment

1. UAS flight crew personnel are required to wear minimal Personal Protective Equipment during flight operations. This equipment should include class II safety vests, hard hats, and eye protection at a minimum. Certain missions will require the use of work/hiking boots, N95 respirators and chemical resistant gloves.
2. Other safety equipment for the flight crews: two-way radios/cell phones (required), First Aid kit (required), fire extinguisher (desired).

## 6.4 Airframe and Control Station Safety

Among the top hazards involving flight are inadequate pre-flight preparation and/or planning and improper operation of flight controls. Even if the UAS manufacturer has a written pre-flight inspection procedure, it is recommended that the remote PIC ensure that the following inspection items are incorporated into the pre-flight inspection procedure required by FAA Part 107 to help determine that the UAS is in a condition for safe operation overall airworthiness. The pre-flight inspection should include a visual or functional check as per the manufacturer’s instructions and at a minimum include the following items:

1. UAS components
2. Airframe structure (including undercarriage), all flight control surfaces, and linkages
3. Registration markings (for proper display and legibility)
4. Servomotors, including attachment points
5. Propulsion system, including power plants, propellers, rotors, ducted fans, etc.
6. Battery condition
7. Avionics, including control link transceiver, communication/navigation equipment, and antennas
8. Compass (calibrate UAS compass before any flight)
9. Control link transceiver, communication/navigation data link transceiver, and antennas
10. Display panel, if used (confirm functioning properly)
11. Ground support equipment, including takeoff and landing systems
12. Control link functionality established between the aircraft and the flight control surfaces
13. Onboard navigation and communication data links
14. Secure attachment of all equipment, including application booms and sensors
15. Communications with the UAS, including that the UAS has acquired GPS location from at least four satellites
16. UAS propellers; inspect for any imbalance or irregular operation
17. Controller operation
18. If required by the flight path, walk through and verify any noted obstructions that may interfere with the UAS. At a controlled low altitude, fly within range of any interference and recheck all controls and stability. If available, whenever a UAS is started, personnel should be on hand with adequate fire extinguishing equipment. Note: These operating limitations are intended, among other things, to support the PIC’s ability to identify hazardous conditions relating to encroaching aircraft or persons on the ground and to take the appropriate actions to maintain safety.
19. The person manipulating the flight controls cannot operate a UAS and drive a moving vehicle in a safe manner and remain in compliance with FAA Part 107.

## 6.5 Battery Charging Safety

1. Always charge LiPo batteries in a safe, well-ventilated area away from flammable materials.
2. Always inspect the batteries, charger and power supply before charging.
3. If at any time the LiPo battery begins to balloon or swell, discontinue charging or discharging immediately. Quickly and safely disconnect the battery and then place it in a safe, open area away from flammable materials to observe it for at least 15 minutes. Continuing to charge or discharge a battery that has begun to balloon or swell can result in a fire or explosion. A battery that has ballooned or swollen even a small amount must be removed from service completely.
4. Only use batteries as supplied by the UAS Manufacturer. Never substitute any battery for use in the UAS.
5. If a battery is dropped it cannot be used. The batteries are very fragile and could cause a fire if dropped and then charged.
6. Charge only two batteries per charger at a time. Place the charger on a flat, stable surface. Do not block the ventilating fans when using the charger.
7. Do not attempt to touch or expose the metal terminals under the main panel of the charger.
8. Air cool each battery after flight if the temperature of the battery exceeds 98 degrees F (36.7 degrees C). This can be accomplished by placing the battery in a cooler location or in an air-conditioned location such as the vehicle while in the field or even using a cooler with dry ice packs.
9. LiPo batteries can be transported in stainless steel or plastic battery boxes capable of containing any free liquid.
10. The battery holder should be securely fastened and the battery protected in such a manner as to prevent damage and short circuits. If possible, tape over the battery terminals and cables before transport.

## 6.6 Safety Risk Assessment

When conducting a risk assessment, identify the present risks and look for ways to mitigate the hazards they create. Pre-flight familiarizations, inspections, and actions can be accomplished as part of an overall safety risk assessment. FAA encourages the remote PIC to complete the overall safety risk assessment as a method of compliance with the prohibition on operations over certain persons and the requirements to remain clear of other aircraft. Flight operations should be conducted at least 30 ft. from all nonparticipating persons, structures, vehicles, and vessels unless:

1. The owner/controller of any structures, vehicles, and/or vessels has granted permission for operating closer to 30 ft. of those objects, and the operator has made a safety assessment of the risk of operating closer to those objects and determined that is does not present an undue hazard.

## 6.7 Risk Mitigation

1. Knowing the risk factors that can affect a successful operation is important. These risks range from the people involved to issues with the aircraft or the environment. Higher risk situations include taking off with a known problem, unstable approach when landing the aircraft, and deviating from standard operating procedures. Similar to manned-aircraft pilots, UAS pilots see an increased workload during critical phases of flight, notable during takeoff, approach, and landing. Understanding the risks of flight is the first step to mitigating mishaps associated with these risks.
2. All of these risks are inherent but can be mitigated by proper planning, communication, and situational awareness. If applicable, file a NOTAM and/or DROTAM to inform other pilots about any UAS activity that is conducted within the airspace. Check for current NOTAMs in the mission area.
3. Crews should also review the causal factors, results, and lessons learned from other aircraft mishaps. Knowing the recommended corrective actions and preventive measures from other mishaps assists with contingency and safety planning and the ultimate mitigation of risk of accidents. Crews should not hesitate to recommend and promulgate recommended risk reduction procedures to enhance overall safe operations.
4. Wind impacts and other data found in weather forecasts should be considered for proper flight planning. The aircraft operating manual should provide the wind limitation for safe flights. As part of the weather brief, checking the wind helps mitigate risks of the aircraft operating beyond the recommended condition. Do not hesitate to postpone operations until the winds are suitable, making the right decision helps prevent unnecessary harm to people and property.
5. Risk mitigation is crucial for the well-being of the crew members. Be aware of potential health issues and ensure that crew members are physically equipped for the environment in which you are operating. Heat exhaustion can be prevented by drinking fluids and staying out of direct sunlight as much as possible. When a crew member is suffering from heat exhaustion, the individual in question may not be aware of his/her condition. The PIC and crew members should look for early signs of danger such as heavy sweating or breathing, noticeable fatigue, and/or far off gaze from fellow crew members should take steps to prevent hypothermia by wearing proper clothing and staying as dry as possible. Onset signs of hypothermia include fatigue, slower breathing, loss of coordination, and confusion. Again, the PIC and crew members should look for signs in distress in other team members.
6. In the event that an emergency does occur, follow the proper emergency procedures that have been established. For immediate, severe emergencies where every second is critical, call 911 immediately and provide first aid, as applicable. Consider all possible emergency scenarios, and plan for each situation accordingly. All crew members should have a compact emergency card containing phone numbers of all authorities to contact during an emergency. Examples include local law enforcement, emergency services, and ATC authorities. Operations in rural areas may not have the same emergency procedures as an urban area due to variance in communication and emergency response times at different locations. Always plan for any situation, and contact FAA for incidents and accidents that involve major damage, injury, or loss of property and life.

## 6.8 Accident Reporting

1. What needs to be reported:
2. Any time an emergency is declared. Even if no accident or incident occurred.
3. Any time an accident occurs. Example: Damage to the UAS in flight or on the ground. Unintended chemical discharge.
4. Any complaint levied by any person.
5. Any mechanical malfunction of the airplane or spray equipment.
6. Who to Report Incidents to:
7. Director of Aerial Operations: Name and Phone

The Director of Operations will notify any government agency that is necessary such as NTSB, FAA, EPA, local and state officials, and the Chief Pilot. The Chief Pilot will also notify any program personnel that need to be notified.

1. Chief Pilot: Name and Phone

Secondary Contact (UAS Coordinator), if the Director of Aerial Operations cannot be contacted.

# 7. Training

## 7.1 Objective

The key to continued safe operations is by maintaining a professional level of competency. The first step in this process is establishing minimum qualifications for selecting members and the second step involves training those personnel.

## 7.2 Instructors

1. FAA certified remote pilots may be given instructor duties. Such duties can include developing training courses; provide training, and staff evaluation and documentation.
2. Instructors are designated by those within the unit and approved by the UAS Coordinator.

## 7.3 Training Plans

1. All crew members have a training plan on file that outlines training objectives for the upcoming year. This training plan will be held in conjunction with the member's normal training. UAS training sessions should be conducted in a dedicated training area free from non-participants and hazards. Training scenarios should simulate real world scenarios that UAS crew members are likely to encounter or consist of scenarios the UAS crew isn’t likely to encounter but which should elicit a predictable, trained response (e.g. emergencies, mishap drills, etc.). Training scenarios should be briefed and debriefed as closely as possible to real world operations or events to include crew member roles, checklists, emergency procedures, etc.
2. The approved training plan is developed by the UAS coordinator.
3. All deployments or exercises are documented and count toward a member's training.
4. It is the member's responsibility to verify their training file contains all pertinent information.

## 7.4 Initial Training

1. UAS Pilot (PIC) and Operators

The pilot in command should complete UAS operator training before operating a UAS in the National Airspace System (NAS). The UAS Operator training must include, but is not limited to, the following topics:

1. Aircraft Components
2. Aircraft Systems
3. Airspace
4. Aerodynamics
5. FAA Regulations
6. FAR 91.3, Responsibility and authority of the Pilot In Command (PIC)
7. FAR 91.13, Careless or reckless operation
8. FAR 91.17, Alcohol and drugs
9. FAR 91.25, Aviation safety reporting program
10. FAR 91.103, Preflight actions
11. FAR 91.111, Operating Near Other Aircraft;
12. FAR 91.113, Right-of-Way Rules: Except Water Operations; and
13. FAR 91.155, Basic VFR Weather Minimums
14. Flight Operations
15. Flight Basics
16. Emergency Procedures
17. Mission Scenarios
18. VO Responsibilities
19. MPO Responsibilities
20. Privacy
21. Safety
22. Visual Observers (VO) and Mission Payload Operators (MPO)

VOs and MPOs must have completed sufficient training to communicate to the pilot any instructions required to remain clear of conflicting traffic. This training, at a minimum, shall include knowledge of the rules and responsibilities described (in 14 CFR)/Federal Aviation Regulations (FAR) and shall include knowledge of air traffic and radio communications, including the use of approved ATC/pilot phraseology.

1. In conjunction with fulfilling all training requirements for operator/observer duties, each crew member must also become familiar with UAS operations, the aircraft and its application equipment.
2. Any person who fails to successfully complete the initial training may be denied as a member of the UAS flight crew.
3. Before a person can fly as an operator, they must complete at least 25 hours of flight training with UAS instructors to show proficiency of the flight training exercises and the airframe. This must be accomplished to show their ability and knowledge of the UAS.

## 7.5 Recurrent Training

1. All persons within the unit shall maintain proficiency in their operator/observer abilities. Members who do not have any documented training or flight time will have to show proficiency before being an operator/observer during a deployment or exercise.
2. Recurrent training is not limited to actual operating/observer skills but includes knowledge of all pertinent UAS/aviation matters.
3. Failure to prove proficiency can result in removal from UAS responsibilities.
4. PICs may be required to attend, and forward information on FAA sponsored safety seminars, industry conferences, UAS online training etc...
5. Training shall only be conducted at approved locations and follow the provisions within the approved FAA regulations.

# 8.0 General Flight Operations

1. All flights will be conducted in accordance with FAR Part 107
2. All flights over a congested area will be conducted in accordance with FAR 137.4l(a)
3. Flight patterns will be planned to avoid excessive maneuvering-approach and departure to the target area. When possible all flight paths to the target area will be conducted in straight and level flight.
4. All flights shall be conducted at altitudes no lower than 50 feet AGL within congested areas and no lower than minimum required by the label within non­congested areas. All congested area turnarounds will be made no lower than 50 feet AGL.
5. All spray patterns should be planned to maintain an obstacle clearance of a minimum 30 feet. In certain instances, obstacle clearances may be less than 30 feet in order to complete the mission successfully. The PIC will have sole discretion in determining the safest possible spray pattern to avoid obstructions.
6. Flights will be made during daylight hours. Flight times will take into consideration the target pest activity and service and at all times will seek to minimize nontarget exposure and avoidance of people. If a nighttime application is requested, the drone must be equipped with proper lights and strobes prior to approval of the mission. Also, a flight of all intended treatment areas will be conducted during the daylight hours prior to each spray mission. This is done to confirm all towers and other obstacles and hazards are noted in the flight plan. If no over flight is made during the daylight hours prior to the mission, then the mission will not take place until an over flight can be successfully accomplished.
7. All chemicals dispensed will be registered and regulated pesticides, approved by the Environmental Protection Agency (EPA). All chemicals will be applied in accordance with the limitations set forth by the product label.
8. All UASs will operate only in VFR weather conditions and never inconsistent with the label or weather restrictions.
9. When operating within controlled airspace the PIC will maintain two-way radio communications with controllers. The controlling agency will be notified in advance of any operations. The pilot, aircraft, time and day of operation and mission map will be given to the controlling agency.
10. All aircraft will operate under FAR part 91 and part 107 regulations during ferrying to and from the spray mission area. Pilots must remain at least 30 feet from any person or obstacle except during the actual application. During the pre-mission fly over, pilots will determine the best route to and from the spray area to avoid people and obstacles during an emergency. This information will be communicated to the controlling FSDO, if required.
11. All Pilots in Command will ensure that FAR 137; FAR 107 is met in all aircraft and operations.

## 8.1 Pre-Flight Inspections

1. Prior to beginning any aerial mission, the PIC will conduct a full preflight inspection of the aircraft, application system, and battery charging station. The PIC may delegate the inspection to the VO. The VO will verbalize to the PIC that the inspection has been completed. Specific items to be inspected will be based upon the requirements of the UAS Manufacturer and FAA guidance for UAS operations; however, will include the following general items:
2. Aircraft:
3. The manufacturer's approved preflight checklist must be followed
4. General condition
5. Confirm the remote controller antennas are extended and in the optimal position
6. Confirm all GPS antenna (red arrows) are oriented to the front of the UAS
7. Confirm the battery warning threshold is set to 25%, Flight Path Mode is set to NORMAL, Action When Finished is set to NoAction. Confirm Go-Home Height is set to an altitude that will clear ANY obstruction of the maximum obstruction height ANYWHERE in or around the treatment area
8. Extend and check all props, aligning each prop as straight as possible to reduce vibration on take off
9. Application Equipment:
10. All filters are clear, clean and unobstructed
11. All fittings are secure
12. All hoses visually inspected for leaks
13. All electrical connections inspected for corrosion and continuity
14. Spray-tank has been properly loaded with correct gallons/pounds assigned by pilot only
15. All nozzles are clean, clear and turning freely
16. Nozzles are properly set for flow rates desired and proper settings for the product to be applied
17. Spray booms are secure
18. Inspect structures for cracks, etc.
19. Application equipment has been calibrated and set for the desired application rate based on ground speed and lane separation
20. No fluid leaks
21. Ground handling equipment removed
22. The PIC is responsible for operating the aircraft within the weight and balance requirements the aircrafts approved flight manual and current weight and balance data.
23. All PICs are responsible for safe flight and are required to perform these duties.

## 8.2 Personnel Responsibilities for Deployments

Operator (PIC)

1. The Operator or PIC is directly responsible for, and is the final authority over the actual operation of the UAS.
2. Operators have absolute authority to reject a flight based on personnel safety or violation of FAA regulations. No member of the program, regardless of status, shall order an operator to make a flight when, in the opinion of the operator, it poses a risk to personnel or is in violation of FAA regulations.
3. Operators are responsible for compliance with this manual, program policy and procedure and FAA regulations.
4. The operator's main duty during the deployment of the UAS is to operate the UAS safely while accomplishing the goals of the deployment.
5. Operators shall see-and-avoid any obstacle that will lessen safety during the mission and maintain situational awareness at all times.
6. Operators shall be responsive to the requests of the observer in order to accomplish the deployment.
7. Operators shall be responsible for documentation for mission training and updating of flight books.

Visual Observer (VO) and Mission Payload Operator (MPO)

1. The VO and/or MPO are responsible for the operational aspect of the deployment.
2. In the event that an Observer is not used, the Operator (PIC) will serve all functions of the VO.
3. VO and MPO shall see-and-avoid and communicate to the operator any obstacle that will lessen safety during the mission.
4. MPO shall operate any attachments (e.g. application equipment) on the UAS, allowing the PIC to maintain complete focus on the operation of the UAS.
5. Observers shall remain alert for suspicious persons or activities on the ground and coordinate response by other UAS flight crewmembers.
6. Observers shall assist the operator in the main objective of safe operations of the UAS.
7. A VO shall not perform VO duties for more than one PIC at a time.
8. The VO cannot act as the PIC during the flight.
9. If an operation begins with the use of a VO, then that operation must be completed with the use of the same VO. All operations will immediately cease, if the VO is unable to continue observing for the Operator during a mission.

## 8.3 Weather Planning

## Before each flight the PIC and VO should ensure that they gather enough information about the existing and anticipated near-term weather conditions for the duration of the entire mission environment. The PIC should utilize FAA approved weather resources such as; Meteorological Terminal Aviation Weather Reports (METARS), Terminal Area Forecasts (TAF), etc. to obtain the most accurate weather information. The PIC must always consult most current weather conditions, Notices to Airmen (NOTAMs), and Temporary Flight Restrictions (TFRs) with a valid source, such as: www.1800wxbrief.com

## Wind direction plays a major factor in flight operations. Operators should take precautions to ensure that wind conditions do not exceed the aircraft limits stated in the aircraft operations manual/specifications. An anemometer (e.g. pocket anemometers) should be utilized at the mission site to better estimate the local wind speed and determine if it is within the necessary limits of the UAS being flown.

## The PIC should ensure that the flight will occur within the weather requirements specified in Part 107.51 (c-d), 3 statute miles, the UA must be kept at least 500 ft. below a cloud and at least 2,000 ft. horizontally from a cloud. If, at any time, weather conditions become hazardous and deviate from the prescribed pre-mission plan, all operations should immediately cease.

## 8.4 Mission Planning

1. The PIC/observer shall familiarize themselves with all available information concerning the deployment including, but not limited to, the weather conditions, hazards, description of the incident, deployment goals, etc.
2. The PIC should check for recent Notice to Airmen (NOTAM) listings within the 15nm of the mission area (notams.aim.faa.gov/notamSearch). Additionally, the publication of a Temporary Flight Restrictions (TFR) should be noted (tfr.faa.gov)
3. Operators will ensure that the location for take-off and emergency landing is adequate for a safe deployment.
4. The take-off/landing area should be clearly marked and identifiable with short cones or similar marking system if necessary.
5. At least one emergency landing area should be identified per deployment.
6. Operators & Visual Observers will ensure that they are aware of their surroundings in the event that an emergency landing is necessary. This includes the ability to recover the UAS.

## 8.5 Preflight UAS Briefings

PIC and Observer preflight review:

1. Crews will be emailed maps of their spray areas, obstructions, swath-lines, gallons required, total spray acres, obstruction heights, etc.
2. Each aircrew will conduct a review of charted aerial hazards in areas to be flown
3. The review will include all current FAA sectional charts and other local aerial hazard charts as available from local and state agencies.
4. Pilots will review VFR sectional charts for comprehension of all airports, airspace, TFR's, MOA's, restricted airspace and if any other applicators are scheduled in the vicinity of their operations.
5. All available NOTAM's will be reviewed during the pre-flight briefings.
6. All aircrew members will complete and review their time charts to ensure their maximum workable hours will not be exceeded.
7. Pilots will obtain a weather/ air space briefing from flight service prior to operations. All operations will only be conducted in Visual Flight Rules (VFR) conditions.

## 8.6 Maintenance

1. Although there are few parts on the UAS that need servicing, it is necessary that the manufacturer's maintenance schedule is followed and properly documented.
2. Any issues that arise during maintenance that cannot be resolved by routine methods shall be forwarded to the manufacturer for further technical support.

## 8.7 Multi-UAS Operation

1. Each UAS and Controller used for Multi-UAS Operations must be capable of autonomous flight.
2. The PIC should have the ability to maintain control of each UAS individually, except in case of a lost command and control (C2) link.
3. The operations of multiple UAS should be preprogrammed and take place in an automated way.
4. All UAS operating in the area of operation should be within visual range from the PIC and/or VO.
5. Visibility should be sufficient to ensure that the each individual UAS remains in visual range for the entire duration of the flight. At any given time, each UAS position should be visible by at least one crew member.
6. Visibility should be sufficient to ensure that no people are in danger on the ground within the controlled ground area
7. The PIC and other crew members should be able to visualize the boundaries of the operational area and the relative position of each UAS in order to be able to trigger emergency procedures including the termination of the flight, especially in case of incoming traffic outside the operational area.
8. Visibility should be sufficient to ensure that incoming traffic can be detected and avoided by the PIC.
9. The pilot should apply emergency landing procedures to all UAS immediately if any single UAS shows a behavior that may lead to the initiation of emergency procedures.
10. The VO should monitor for any malfunction or unexpected behavior of each UAS, as well as monitor for incoming nonoperational traffic.

## 8.8 Other

1. All Operations will adhere to the Program’s Health and Safety Plan for handling and storing hazardous materials.
2. All application equipment on the UAS will be checked for proper operation prior to loading.
3. The PIC will ensure the spray system is set for the proper chemical and rate of application and ensure the application parameters are loaded into the controller.
4. Operators/Observers will ensure that no items are attached to the UAS prior to flight that is not required for safe operation and to complete the mission goal.
5. The following hand signals will be used to relay mission critical operations from the Observers to the PIC:



# 9.0 Operations at Night

1. The PIC of the UAS must have completed an initial knowledge test or training, as applicable.
2. Any UAS used for night operations must be operated with lighted anti-collision lighting visible for at least 3 statute miles that has a flash rate sufficient to avoid a collision.
3. The PIC may reduce the intensity of, but may not extinguish, the anti-collision lighting if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.
4. FAR 107.29, operation at night, defines civil twilight as the 30 minutes after official sunset and 30 minutes before official sunrise, with the caveat in Alaska as civil twilight is as defined in the Air Almanac.
5. The PIC or Visual Observer (VO) must adhere to all requirements for meteorological visibility and maintain Visual Line of Sight (VLOS) with the UAS at all times.
6. Part 91 operators, civil and PAO, should refer to any specific COAs for any further instructions or limitations on night flight

## 9.1 UAS Lighting

1. If the UAS lighting does not provide adequate lighting to monitor and maintain positional awareness of the aircraft at night, the UAS must be retrofitted with high visibility position and anti-collision lighting system.
2. LED position lights must be seen by all the operation crew for at least 1 mile.
3. Anti-collision lighting must be rated as visible for a minimum of 3 miles.
4. Position lights should be configured in the same manner as manned aircraft with one red light on the left and one green light on the right with a white anti-collision light located on the top of the UAS.
5. In the event of a partial or complete lighting system failure, the PIC will immediately notify the flight crew to terminate the mission and then land the aircraft in nearest designated landing area.
6. Primary and alternate landing areas should be selected during pre-mission surveys to allow a clear flight path in the event of an emergency.
7. The VO will verify that the designated landing area is clear and then notify the PIC.
8. If the area is not clear, the alternate landing area will be used. If the PIC loses sight of the aircraft, they will immediately notify the VO. The aircraft's forward motion will be halted and the aircraft placed in a hover.

## 9.2 Loss of Visual Line of Sight (VLOS)

PIC Loss of VLOS:

1. The VO will assist the Remote PIC in visually reacquiring the aircraft by providing the location of the aircraft relative to the PIC's location.
2. If the PIC re-establishes visual line of sight, the operation will continue; otherwise, the PIC will initiate a Return to Home procedure.

VO Loss of VLOS:

1. If the VO loses sight of the aircraft, he/she will immediately notify the remote PIC.
2. The aircraft's forward progress will be halted and the aircraft placed in a hover.
3. The PIC will then assist the VO in visually reacquiring the aircraft by first providing the VO with the location of the aircraft relative to the VO's location and then, if needed, maneuvering the aircraft to a location that will allow the VO to visually reacquire the aircraft.
4. If the VO reestablishes visual line of sight, the operation will continue; otherwise, the PIC will initiate a Return to Home procedure.

## 9.3 Night Operation Mission Planning

1. The PIC shall ensure a clear flight path that is free from obstructions by conducting a preflight mission survey of the area of operation during daylight hours that is conducted within 24 hours of the night mission.
2. All obstructions and structures within the turn radius of the area of operations will be identified and documented.
3. Flight paths and landing areas (primary and alternative) that maintain a safe distance from any obstacles and structures will be created during the preflight survey.
4. When determining the minimum safe distances from obstacles, the PIC shall anticipate maximum wind, airspeed and altitude must be taken into account.
5. Flight paths should be practiced during daylight hours.
6. Landing areas should be selected in locations away from non- participants, with a clear flight path to the operation area, and a 20 foot perimeter should be established using high visibility caution tape.
7. All available NOTAM's will be reviewed during the pre-flight briefings

## 9.4 Night Crew Assignments

1. Ideally, a VO should be used to assist the PIC in locating and maintaining awareness of other aircraft and non-participants in the area of operation.
2. All crew members not co-located with the PIC should equipped with two-way, full duplex, VHF radios to facilitate communications.
3. The VO or PIC is responsible for locating and tracking aircraft in the area using nighttime visual scanning techniques and by monitoring the Common Traffic Advisory Frequency (CTAF).
4. The VO should continually monitor the area of operations for other aircraft and obstructions and verify the landing area is always clear prior to mission termination.
5. The VO's location is chosen to maximize the view of the sky and the landing area. If required, a second VO is used to ensure that both areas are monitored.
6. The VO should always maintain the location of the UAS in proximity to structures. If operations need to be conducted close to a structure, a dedicated VO is placed near the structure, providing the PIC with a second perspective on the aircraft's position relative to the structure.
7. The PIC should establish a nighttime operations lighting procedure that allows for the flight crew's vision to adjust to the low light conditions and maintain dark adaptation. All crew members start this procedure a minimum of 30 minutes before flight operations begin.
8. The PIC should set all video displays to minimal brightness.
9. The PIC or VO should mark the primary landing area perimeter with four low intensity blue LED marker lights

## 9.5 Manned Aircraft Avoidance

1. If the PIC or VO observes an aircraft (manned or unmanned) approaching the area of operation, he/she will determine if corrective action is needed.
2. The required action determination will be based on the observable position lights of the aircraft (red = left wing, green = right wing, white = rear of aircraft) and anti-collision lights (generally rotating or flashing red on top and bottom of aircraft), whether it is moving across their field of vision or seems stationary, and altitude of the aircraft.
3. The PIC will yield the right of way to the manned aircraft by immediately reducing altitude if the manned aircraft is transient or by landing if the manned aircraft remains in the area.
4. If another unmanned aircraft enters the operational area, the PIC will cease the operation and move away from the other sUAS until the area is cleared.
5. If the area cannot be cleared of other aircraft, the operation will be terminated.

# 10.0 Certified UAS Pilots

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Job | Ratings | License | Date of Issue | Hours |
| John Doe | Drone Coordinator | UAS Remote Pilot |  | 9/2000 | 50 |
|  | Pilot |  |  |  |  |
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# 11.0 Registered UAS Aircraft

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Manufacturer | Model | Registration Number | Date of Expire | Engine |
|  |  |  |  | Multi-rotor |
|  |  |  |  | Multi-rotor |
|  |  |  |  | Multi-rotor |

UAS Specific Performance Information: For example - The PrecisionVision 35 and 35X propulsion systems are engineered for industrial applications. The propulsion system is designed to carry payloads of up to 35 pounds and total gross weight of 74 pounds. The average propulsion motor is operating at 60% capacity when the PV35 or PV35X is at a gross weight of 74lbs during flight.

# 12.0 Summary / Signature Page

The Chief Pilot or UAS Coordinator must authorize in advance any deviation to the UAS Flight Operations Manual or any Addendum. Approved deviations will be documented at the earliest opportunity and presented to the following personnel for review and possible policy change:

1. Drone Coordinator or Chief Pilot
2. Officer of the District
3. Federal Aviation Agency (FAA)

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*By signing this page, I state that I have read and understand this Flight Operation Manual.*