Alaskan Aviation Safety Foundation
REMOTELY PILOTED AIRCRAFT SYSTEMS
GUIDELINES

Adapted from Helicopter Safety Advisory Conference UAS RP 15-1

Purpose

This document is made available by the Alaskan Aviation Safety Foundation to provide operators of Remotely Piloted Aircraft Systems (RPAS) and organizations contracting RPAS operators with guidance for conducting operations with a high degree of safety and professionalism.

Background

An upsurge in commercial RPAS activity and an ever increasing number of manufacturers and operators has led to the establishment of these guidelines by some of those involved in establishing commercial RPAS operations on Alaska's North Slope during 2013 and 2014[1]. The Helicopter Safety Advisory Conference (HSAC), adopted the guidelines and made them public in February 2015 as HSAC UAS RP 15-1.

Members of Alaska UAS Interest Group, in meetings led by the State of Alaska Division of Economic Development during the winter of 2015/2016 recognized the need for RPAS safety guidelines to be made available for the purpose expressed above, so the HSAC document was adapted to meet that need.

Introduction

Since the terms Unmanned Aerial Vehicle (UAV), Unmanned Aircraft System (UAS) and Remotely Piloted Aircraft Systems (RPAS) are often used synonymously, this document will use the term RPAS to standardize and describe all unmanned aircraft systems. These guidelines consider the entire system, not just the vehicle being operated. The RPAS has four subsystems: aircraft, data links (command & control, telemetry), ground control equipment, and the pilot/operator. In general, RPAS operations can occur within visual line of sight (VLOS), extended visual line of sight (EVLOS) (within electronic line of sight of the ground control station and still using visual observers), or beyond visual line of sight (BVLOS).

RPAS may be controlled either manually or semi-autonomously through use of programing and autopilot, and they can vary in size from those weighing less than a pound to some the size of a commercial jet. Regardless of the size, the basic guidelines outlined below should be considered. They are not an exhaustive list nor should they be considered the only source to reference. These basic guidelines are intended for to apply primarily to RPAS under 55 lbs. (maximum takeoff weight).

RPAS operations should be incorporated into a Safety Management System (SMS). Although many of the elements in these RPAS guidelines can be incorporated directly into a Safety Management System, they do not constitute a complete SMS. The RPAS operator should maintain a comprehensive SMS that seamlessly integrates RPAS operations. Operators without an SMS are encouraged to develop one, and may be considered to be in compliance with these guidelines while their SMS is being actively developed.

[1] HSAC RPASRP 15-1 development led by Todd Chase (tchase@oceaneering.com) with assistance from Steve Poirot (Steven.Poirot@WorleyParsons.com), Terry Bennett (retired) and others

Regulatory Compliance

RPAS operators should ensure that their operations meet all legal requirements and industry guidance, which is constantly evolving. Some of these guidelines cover types of operations that are currently allowed by the FAA in only very limited circumstances (e.g. EVLOS operations). The guidance provided here is for cases where the FAA does allow such operations. **Nothing in this document should be construed as condoning any violation of FAA or other federal, state, or local regulations.**

ASTM International

ASTM International (astm.org) Committee F38 on Unmanned Aircraft Systems is producing a number of standards related to manufacture and operation of unmanned aircraft. Several ASTM standards are mentioned in this document (but not required). ASTM standards are copyrighted, and can be purchased from ASTM.

Document Questions, Corrections & Comments

This is a living document maintained by AASF. Contact Steve Poirot (Steven.Poirot@WorleyParsons.com) for questions or comments.

General

Note: More detail on some of the general guidelines is provided in later sections.

1. RPAS should be operated in accordance with all applicable local, state and federal regulatory requirements, including all limitations on aircraft type certificates where applicable, provisions of Certificates of Waiver or Authorization (COAs), and provisions of exemptions granted under Section 333 of the FAA Modernization and Reform Act of 2012 "Special Rules for Certain Unmanned Systems".
    a. Offshore RPAS operations should be in compliance with the above regulatory statues and must comply with applicable USCG, EPA and BSEE requirements as well.
    b. A Notice to Airman (NOTAM) should be issued for the affected airspace of RPAS operations. NOTAMs should be filed by the pilot in command (PIC).
    c. Operators should maintain documentation of system operating certification, flight operations manual and FAA pilot certifications (as required) for each operation at the point of control of the RPAS operation.
    d. RPAS operations should avoid overflight of personnel not involved in the operation.
    e. **In situations where manned aircraft pose a potential conflict with RPAS operations, the manned aircraft have the right-of way and RPAS operations should be terminated until the potential conflict has passed**.

2. Where RPAS may be operated in the vicinity of facilities where explosive vapors may be present, the owner/operator of the facilities must determine if the RPAS will be required to be intrinsically safe (see Glossary of Terms). This issue should be included in the risk assessment.

3. The contracting company should determine the level of insurance specified by the RPAS contractor is in line with company risk management guidelines.

4. All RPAS should use "detect and avoid" technology on the aircraft and a mode "S" or ADS-B capable transponder whenever practical and allowed by the FAA. Light UAVs (less than 15 pounds without fuel) operating within visual line of sight below 400 feet are exempted from this policy, but are encouraged to comply where practical, and should have a designated visual observer to provide a similar level of safety to detect and avoid hazards.

5. All RPAS must be in an airworthy condition and should have a continuing airworthiness program to conduct flight operations in the National Airspace System (NAS). All RPAS should be accepted as airworthy by the FAA (such as through certification or a Section 333 exemption). In cases where there are no applicable regulatory standards available to determine airworthiness, the operator must assert that an equivalent level of safety will be provided through adherence to maintenance and safety checklist usage standards prescribed in this document in addition to compliance with manufacturer guidance.

6. Essential elements of a continuing airworthiness program include a maintenance training program, unique skills or maintenance practices relating to their aircraft and a process to report applicable data relating to the maintenance of an operation. Continuing airworthiness programs compliant with *ASTM International F2909, Standard Practice for Maintenance and Continued Airworthiness of Small Unmanned Aircraft Systems (sUAS)* are acceptable.

Operations

1. All RPAS operations should be controlled by a Pilot in Command (PIC). Completely autonomous RPAS operations should not be conducted.

2. Where RPAS operations are conducted in civil airspace utilized by manned aircraft, the PIC should be a certificated private or commercial pilot in manned aircraft, hold a valid FAA second-class medical issued under FAR Part 67, and be current in manned aircraft as specified in FAR 61.56.
    a. If the PIC does not meet the above qualification, a safety case may be submitted by the operator to the contracting company's responsible authority addressing the ratings and currency of the PIC as they relate to the RPAS operation being considered.
    b. The potential to interact with manned aircraft, applicable FAA requirements, the size and capability of the RPAS platform and the risk of the overall operation should be primary considerations in the type of certificate the PIC should hold.

3. Supplemental pilots are those pilots assigned RPAS flight duty to augment the PIC. It is common for operators to have both an internal and an external RPAS pilot. The supplemental pilot can assume either of these positions.
    a. Supplemental pilots must have, at a minimum, successfully completed private pilot ground school and passed the written test or FAA-recognized equivalents within the previous two years.
    b. Supplemental pilots must hold a valid FAA second-class medical certificate issued under part 67 or the FAA-recognized equivalent.

4. The RPAS operators must provide documentation showing the pilots maintain an appropriate level of recent pilot experience in the RPAS being operated or in a flight simulation training device (FSTD). At a minimum, the remote pilot must have conducted three takeoffs (launch) and three landings (recovery) in the specific RPAS within the previous 90 days, or as prescribed by the operator/applicant's recurrent training and currency program. All RPAS pilots must have the following additional training:
    a. Normal, abnormal, and emergency procedures in all specific details of the RPAS being operated;
    b. Manufacturer-specific training (or an FAA accepted equivalent);
    c. Demonstrated proficiency;
    d. Defined interval testing on the RPAS being operated (i.e. semi-annual, quarterly, etc.).

5. Visual Line of Sight (VLOS).
    a. Operating within Visual Line of Sight means that the PIC or visual observer is able to maintain direct, unaided (other than corrective lenses) visual contact with the unmanned aircraft, which is sufficient to monitor its flight path in relation to other aircraft, persons, vessels, vehicles and structures for the purpose of avoiding collisions. VLOS operations are normally accepted out to a maximum distance of 500-700m horizontally (depending on the size of the aircraft) and 400 ft. vertically from the RPAS pilot.

6. Extended Visual Line of Sight (EVLOS).
    Note: EVLOS operations are currently not allowed by the FAA except under special circumstances, and then only with specific authorization under a COA.
    a. EVLOS operations are operations where the PIC is still able to comply with his collision

avoidance responsibilities, but the need for the remote pilot to maintain direct visual contact with the unmanned aircraft is addressed via other methods or procedures. It is important to note, however, that collision avoidance is still achieved through 'visual observation' (by the PIC and/or RPAS Observers.) All RPAS operations should occur within VLOS, or EVLOS range. Operations beyond visual line of sight are not recommended unless an approved method of aerial separation and collision avoidance exists and the operations are in accordance with the FAA's requirements.

b. EVLOS operations are normally beyond a distance of 500-700m horizontally and 400 ft. vertically from the Remote Pilot.
c. The operator should submit a safety case including a risk assessment for the EVLOS operation. Factors taken into consideration should include:
    i. The procedures for avoiding collisions
    ii. Aircraft size and configuration
    iii. Aircraft color and markings
    iv. Aircraft aids to observation
    v. Meteorological conditions and visibility, including background conditions (cloud/blue sky)
    vi. The use of deployed observers
    vii. Operating range limits - suitable radio equipment should be fitted in order to be able to effect positive control over the unmanned aircraft at all times
    viii. Contingency plans for loss of link event

7. RPAS operations (including night operations) should utilize one or more trained visual observers to assist the PIC with see-and-avoid responsibilities by scanning the area around the aircraft for intruder traffic and assisting the PIC with navigational awareness. The visual observer(s) should have a reliable method of instantaneous communications with the PIC such as two-way radios. Cellular phones are not considered reliable for this purpose. The PIC and visual observer(s) together should have a view of the area that is sufficient to allow enough time for the PIC to de-conflict as required.

8. Spacing multiple visual observers and/or antennas in a linear manner ("daisy chaining") to increase operational distance are only allowed by the FAA by specific authorization in a COA, and should generally be avoided; however, operations involving "daisy-chaining" observers/antennas may be permitted if the operator's FAA COA allows it, and an acceptable safety case is presented by the operator to the contracting company's responsible authority demonstrating the risks are sufficiently managed.
    a. When multiple visual observers are being used, it is important for the PIC to know which visual observer(s) have direct visual contact on the aircraft.

9. Visual observers should:
    a. Be designated as such and not share in any other duties associated with the flight;
    b. Be in communication with PIC either within speaking distance or with a portable radio.
    c. Be trained in areas such as aviation terminology, Visual Flight Rules (VFR), airspace requirements and applicable aviation regulatory requirements;
    d. Establish an observation position having a clear view of the RPAS operating area;
    e. Keep the pilot informed of possible hazards (power lines, crane/venting booms, birds, other aircraft, approaching workboats (when working underneath facility), and weather conditions;
    f. Meet any medical or physical requirements mandated by the appropriate civilian regulatory authority (i.e. FAA second-class medical exam);

g. Be briefed on lost communications procedures prior to the flight.

10. Weather Observation.
    a. A reliable method of determining wind speed, ceiling and visibility should be used.
    b. Weather observations should be taken near enough to the operation that it is certain that they are valid; for example, an airport's observations can be used if the airport is within several miles and the conditions appear to be uniform.
    c. Ceiling may be estimated by the temperature/dew point spread.

11. Night Operations.
    a. Night operations may be considered if the operator provides a safety case and sufficient mitigation to avoid collision hazards at night. External pilots and observers should be in place 30 minutes prior to night operations to ensure dark adaptation.

12. Only the PIC should conduct radio communications. The PIC should follow the radio communications protocol appropriate to the airspace. Where communications are not specifically required by FAA regulations, such as in uncontrolled airspace (Class G), the PIC should announce on appropriate CTAF frequency prior to launch, just after launch, periodically during operations, and after landing. Announcements should include at least:
    a. "Unmanned" followed by the aircraft type and registration number; e.g. "Unmanned Endeavor 235F".
    b. Location of the aircraft with reference to a NAVAID, airport, or VFR reporting point.
    c. Trajectory and speed or, if remaining in a localized area, the radius of that area.
    d. Range of altitudes.

13. All operators should have a flight operations manual approved by a competent authority. At a minimum, the manual should include procedures and checklist information for pre-flight, in flight, post flight, emergency procedures, and limitations. The operations manual should also include information on aircraft systems and performance. Manuals compliant with *ASTM International F2908, Standard Specification for Aircraft Flight Manual for a Small Unmanned Aircraft (sUAS)* are acceptable.

14. Notification to other potential users authorities of the airspace and appropriate regulatory authorities should be issued with ample time for those operators/regulators to plan appropriately. Ensure no simultaneous operations between RPAS and manned aircraft are planned in same area at similar altitudes. The following should take place prior to operations.
    a. File NOTAMs
    b. Notify ATC if in the vicinity of an airport, and notify local airspace users where practical, e.g. by contacting commercial operators and flight schools in the area or putting up notices at local general aviation airports.
    c. Include at least:
        i. Date and time range
        ii. Precise location
        iii. Altitude range
        iv. Aircraft type and description (what to look for)
        v. Frequencies monitored and call sign
        vi. Contact information to coordinate, de-conflict and exchange other information

15. All RPAS operations should include a pre-flight brief. The briefing should include at a minimum:
    a. Mission overview
    b. Hazards unique to the mission (including potential sources of interference)
    c. Check and brief applicable NOTAMs
    d. FSS/ATC notifications.
    e. Identify any special airspace and restrictions (i.e. VFR corridors, TFRs, MOAs etc.).
    f. De-confliction plans for intruding aircraft.
    g. Weather (current and forecast ceiling, visibility and winds).
    h. Mission altitude.
    i. Lost Link, divert and flight termination procedures.
    j. Identification of any public or residential areas near flight path and privacy concerns.
    k. Flight time and fuel/battery requirements.
    l. Fuel reserves/minimum voltage requirements.
    m. Frequencies to be used.

16. Immediately prior to each launch, the PIC should:
    a. Perform a pre-flight inspection/checklist;
    b. Perform visual inspection of airframe condition;
    c. Run system diagnostics;
    d. Conduct engine run test;
    e. Check battery, sensors, etc.;
    f. Verify communications with the visual observer(s) and confirm that there is no conflicting air traffic.
    g. The use of cell phones and other electronic devices during flight operations should be restricted to communications pertinent to the operational control of the RPAS and any required communications with Air Traffic Control. Cell phones should not be used as the primary means of communications between visual observers and pilots.

17. All RPAS operations should be conducted with sterile cockpit procedures during critical phases of flight. These include: taxi and ground operations involving aircraft movement, take-off and landing, as well as all other flight operations in which safety or mission accomplishment might be compromised by distractions.

18. Lost Link Procedures.
    a. There are many acceptable approaches to satisfy lost link requirements. The intent of any lost link procedure is to ensure airborne operations remain predictable.
    b. Lost link procedures should comply with any regulatory requirements and the lost link solution will need to comply with the last Air Traffic Control (ATC) clearance if applicable.
    c. The appropriate ATC facility should be notified immediately.
    d. Lost link procedures should avoid flight over any populated areas and hazards, as well as any frequently travelled flight paths.
    e. The time and duration of each lost link event should be recorded by the operator and reported through the incident reporting process.
    f. The designated return site should be clear of any personnel and hazards in the event of an immediate lost link return to base and landing.

Maintenance

1. A maintenance program should be in place to ensure the airworthiness of any RPAS being utilized. Maintenance should be performed in accordance with manufacturer recommendations and only by properly trained and certified personnel. This program should comply with all governing regulations and policy. The program should, at a minimum:
    a. Have a maintenance policy and a procedures manual approved by a relevant authority.
    b. Be certified by the aircraft manufacturer.
    c. Include a pre-flight and post flight inspection of the vehicle and have an associated logbook to track inspections
    d. Include a pre-flight and post flight inspection of the ground control station.
    e. Incorporate a logbook to track flight hours and any inspection replacement times and life limited items. (i.e. batteries, rotors)
    f. Document software and hardware changes as a part of the maintenance procedures.
    g. Maintain a record of malfunctions (i.e. loss of link), anomalies and damaged parts.
    h. Maintenance training and evaluation program for each operated system.
    i. A quality assurance (QA) program should be utilized as a part of the overall safety management system (SMS).
    j. Include both field and depot level maintenance intervals.

2. It is highly recommended that all RPAS operators provide the following information:
    a. A continuing airworthiness program, such as that defined by *ASTM International F2909, Standard Practice for Maintenance and Continued Airworthiness of Small Unmanned Aircraft Systems (sUAS).*
    b. A maintenance training program.
    c. Any unique skill sets or maintenance practices relating to their aircraft and/or aircraft operations that may be outside the current scope and practices of manned aviation.
    d. A process to report any applicable data relating to the operation and maintenance of the RPAS.

3. A minimum essential subsystem list (MESL) or similar list should be established for the entire system. The MESLs lay the ground work for reporting the status of aircraft, ground control station and communications link availability. They list the minimum essential systems and subsystems that must work on an aircraft, ground control station and communications. The MESL should include required equipment necessary for the specific mission and can include items such as ground control stations, sensors, back-up power supplies, aircraft lighting systems, transponder, back –up antennas, etc.

Training

1. In addition what is specified in guidelines 1-3 above under Operations, RPAS pilots should meet any other applicable FAA licensing, training and testing requirements for each class or type of RPAS they will operate. The licensing should be appropriate and as required by aircraft type certification or determination of airworthiness. RPAS type or class ratings may be determined on the basis of individual type in the case of larger aircraft, or by class for smaller ones under 55 pounds.

2. All operators should have a training program to verify the aircrew and observers meet the

applicable requirements. The training program should be appropriate for each aircrew role, the environment and mission the operator is expected to perform.

3. The training program at a minimum should cover currency, evaluation, emergency procedure proficiency, systems knowledge and specialized tasks, and the training required by guideline 4 above under Operations.

4. Type-specific training requirements should exist for most RPAS, however training programs on very small RPAS can be designed for similar types of systems (i.e. quad copters under five pounds).

5. All training programs should comply, or be consistent with manufacturer's recommended training programs.

Communications

1. The communications control links are essential with all RPAS operations. RPAS should be operated in a reliable radio frequency environment that minimizes the probability of lost link and Radio Frequency (RF) interference with nearby systems. RPAS operators should have a valid communications plan that considers:
    a. Every effort is made to ensure positive control of the RPAS at all times.
    b. A spectrum and/or RAIM analysis to determine frequency strength, integrity, and areas of possible interference prior to RPAS operations. The RPAS should be operated in strict compliance with all provisions and conditions contained within the spectrum analysis assigned and authorized.
    c. At a minimum, sources of possible radio frequency (RF) interference such as microwave antennas and high voltage lines should be identified and assessed prior to commencing operations.
    d. All command and return links should be encrypted, especially when sensitive information is being collected.
    e. All frequencies used to support safety-critical RPAS functionality must be coordinated and licensed in accordance with the appropriate licensing regime (i.e. FCC).
    f. Quick access to back-up ground control systems must be ensured.
    g. Secondary power supplies must be immediately available for the GCS and all antennas.
    h. Safe recovery of the vehicle in the event of loss of link must be planned for.

Hazard Identification and Safety

1. The RPAS operator should have in place a Safety Management System (SMS) or be actively developing one.

2. The RPAS operators should have an incident reporting system that tracks and reports all mishaps, potential mishaps, control link events, and near misses. This system should provide for analysis and improvements made as a part of the operator's Safety Management System (SMS) if one exists. All mishaps, incidents and anomalies should be tracked and reported to the contracting entity's aviation authority and civilian aviation authorities as applicable.

3. Appropriate air traffic control should be immediately notified in the event of any emergency, loss of command link, loss of visual contact, or any other malfunction that would impact safety or operations.

4. All RPAS operators should be equipped with any specialized equipment that may be required in the event of a mishap. For example, specific types of fire extinguishers are required for suppressing some battery fires, some composite material may require specific handling and equipment when the integrity of the composite is compromised, etc.

5. Consideration should be given towards using RPAS with redundant controls, automatic flight termination and/or flight recovery systems when operating near populated areas or sensitive infrastructure.

6. The RPAS operator should have an established hazard register and hazard identification process. A hazard analysis should be completed prior to beginning flight operations in a new location, or when a new RPAS is employed at an existing location. All risks should be evaluated according to a Risk Assessment Matrix (RAM), and the results of any risk controls should be evaluated through a Gap Analysis process.

7. Crew rest and crew mission day requirements, including consecutive days worked should be consistent with regulatory requirements.
    a. No PIC or reserve pilot should be at the controls of an RPAS for more than eight (8) hours in one day to include no longer than three (3) hours in succession. RPAS crews should have the opportunity of no less than twelve (12) hours of uninterrupted rest prior to flight operations.
    b. RPAS service providers should have a comprehensive aircrew fatigue management program as a part of their Safety Management Systems.

Emergency Response Planning

1. A formal emergency response plan should be in place for all flight operations. An incident response checklist, approved as part of the flight operations manual, should be followed in the event of an incident or accident.

Battery Handling

1. All RPAS operators should have a battery safety program that includes:
    a. Documentation with appropriate Safety Data Sheets included in the aircraft flight manual, battery tracking systems and battery log books.
    b. Battery storage plans that include storage and charging in fire proof containers.
    c. Battery inspection procedures and requirements.
    d. Procedures for thermal runaway, determination of battery pack capacity
    e. Recommended procedures for safe and transportation of the batteries that are compliant with applicable regulations and work site requirements.

DEFINITIONS

The FAA's Unmanned Aircraft Systems (UAS) Integration Office (AFS-80) and other organizations use the following definitions to describe relevant differences between RPAS operations and those of manned aircraft. Other organizations, such as the International Civil Aviation Organization (ICAO) and RTCA, Inc., have also developed acronyms and definitions which may differ from those used by the Federal Aviation Administration (FAA). Aviation Safety Inspectors (ASI) may wish to refer to the current version of ICAO Circular 328, Unmanned Aircraft Systems (RPAS) and RTCA Guidance DO-304, Guidance Material and Considerations for Unmanned Aircraft Systems, until harmonization of terminology is achieved.

1. **Aircraft.** A device used or intended to be used for flight in the air, including unmanned aircraft (UA).
2. **Airworthiness.** A condition in which the RPAS (including the aircraft, airframe, engine, propeller, accessories, appliances, and control station (CS)) conforms to its type certificate (TC), if applicable, and is in condition for safe operation.
3. **Airworthiness Certification.** A repeatable process that results in a documented decision that an aircraft system has been judged to be Airworthy. It is intended to verify that the aircraft system can be safely maintained and safely operated by fleet pilots within its described and documented operational envelope.
4. **Airworthiness Statement.** Document required from public RPAS applicants during a Certificate of Waiver or Authorization (COA) application process which confirms aircraft airworthiness.
5. **Certificate of Waiver or Authorization (COA).** An FAA grant of approval for a specific operation. COAs may be used as an authorization, issued by the Air Traffic Organization (ATO), to a public operator for a specific UA activity. COAs for civil and commercial operations are only for aircraft that have received an airworthiness certificate from Aircraft Certification Service (AIR). Provisions or limitations may be imposed as part of the approval process to ensure the UA can operate safely with other airspace users.
6. **Chase Aircraft.** A manned aircraft flying in close proximity to a UA that carries a qualified observer and/or UA pilot for the purpose of seeing and avoiding other aircraft and obstacles.
7. **Civil Aircraft.** Aircraft other than public aircraft.
8. **Congested Area.** A congested area is determined on a case-by-case basis. The determination should take into consideration all circumstances, not only the size of an area and the number of homes or structures (e.g., whether the buildings are occupied or people are otherwise present, such as on roads).
9. **Cooperative Aircraft.** Aircraft that have an electronic means of identification (i.e., a transponder or Automatic Dependent Surveillance—Broadcast (ADS-B) transceiver) aboard in operation.
10. **Crewmember (RPAS).** In addition to the crewmembers identified in Title 14 of the Code of Federal Regulations (14 CFR) part 1, a RPAS flight crew member includes pilots, sensor/payload operators, and visual observers (VO), but may include other persons as appropriate or required to ensure safe operation of the aircraft.
11. **Crew Resource Management (CRM).** The effective use of all available resources including human, hardware, and information resources.
12. **Daisy-Chaining.** The use of multiple, successive observers to extend the flight of a UA beyond the direct visual line-of-sight of any other pilot in command (PIC) or VO.
13. **Due Regard.** A phase of flight wherein an aircraft commander of a State-operated aircraft assumes responsibility to separate his or her aircraft from all other aircraft.
14. **Experimental Certificate.** A type of Special Airworthiness Certificate issued for the purposes of research and development (R&D), crew training, exhibition, and market survey as defined in 14 CFR part 21, § 21.191(a), (c), and (f). (NOTE: According to 14 CFR part 91, § 91.319(a)(2), experimental

aircraft may not be used for carrying persons or property for compensation or hire.) Commercial RPAS operations cannot be conducted with an experimental certificate.

15. **External Pilot.** A RPAS pilot who flies from outside a control station with direct visual contact with the aircraft.
16. **FAA-Recognized Equivalent.** An FAA recognition that a public agency may exercise its own internal processes regarding airworthiness and pilot, aircrew, and maintenance personnel certification and training; furthermore, the agency has determined that its RPAS is capable of safe operation in the National Airspace System (NAS) when conducting public aircraft operations under Title 49 of the United States Code (49 U.S.C.) §§ 40102(a)(41) and 40125.
17. **Flight Termination.** The intentional and deliberate process of performing controlled flight into terrain (CFIT). Flight termination should be executed in the event that all other contingencies have been exhausted, and further flight of the aircraft cannot be safely achieved, or other potential hazards exist that require immediate discontinuation of flight.
18. **Flyaway.** An interruption or loss of the control link, or when the pilot is unable to effect control of the aircraft and, as a result, the UA is not operating in a predicable or planned manner.
19. **Internal Pilot.** A RPAS pilot who flies from inside a control station without direct visual contact with the aircraft.
20. **Intrinsically Safe**. Conforms with UL 913 Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, II, Division 1 Hazardous Locations, or similar as appropriate. Such standards ensure that an electrical device, (RPAS in this case) will not be the ignition source for an explosion if in the presence of explosive gases, dusts, etc.
21. **Lost Link.** The loss of command-and-control link contact with the remotely piloted aircraft such that the remote pilot can no longer manage the aircraft's flight.
22. **Non-Cooperative Aircraft.** Aircraft that do not have an electronic means of identification (e.g., a transponder) aboard or that have inoperative equipment because of malfunction or deliberate action.
23. **Observer.** A trained person who assists a RPAS pilot in the duties associated with collision avoidance and navigational awareness through electronic or visual means. Collision avoidance includes, but is not limited to, avoidance of other traffic, clouds, obstructions, terrain and navigational awareness. A visual observer (VO) is a trained person who assists the RPAS pilot by visual means in the duties associated with collision avoidance. A VO includes the OPA pilot when the OPA is being operated as a RPAS.
24. **Off-Airport.** Any location used to launch or recover aircraft that is not considered an airport (e.g., an open field).
25. **Optionally Piloted Aircraft (OPA).** An aircraft that is integrated with RPAS technology and still retains the capability of being flown by an onboard pilot using conventional control methods (see OPA Safety Pilot, below).
26. **OPA Safety Pilot.** The PIC that is responsible for ensuring the safe operation of an Optionally Piloted Aircraft (OPA), whether under remote control or onboard control, for the purposes of overriding the automated control system in the case of malfunction or any other hazardous situation.
27. **Pilot Duty Period.** The period beginning when a flight crew member is required to report for duty with the intention of conducting a flight and ending when the aircraft is parked after the last flight. It includes the period of time before a flight or between flights that a pilot is working without an intervening rest period.
28. **Pilot in Command (PIC).** The person who has final authority and responsibility for the operation and safety of flight, has been designated as PIC before or during the flight, and holds the appropriate category, class, and type rating, if applicable, for the conduct of the flight. The responsibility and authority of the PIC as described by § 91.3 apply to the UA PIC. The PIC position may rotate duties as necessary with equally qualified pilots. The individual designated as PIC may change during flight.

(NOTE: The PIC can only be the PIC for one aircraft at a time. For an OPA, the PIC should meet RPAS guidance requirements for training, pilot licensing, and medical requirements when operating an OPA as a RPAS.)

29. **Safety Risk Management (SRM).** A formalized, proactive approach to system safety. SRM is a methodology that ensures hazards are identified; risks are analyzed, assessed, and prioritized; and results are documented for decision-makers to transfer, eliminate, accept, or mitigate risk.
30. **Scheduled Maintenance (Routine).** The performance of maintenance tasks at prescribed intervals.
31. **Supplemental Pilot.** Pilots assigned RPAS flight duties to augment the PIC. It is common for operators to have both an internal and an external RPAS pilot. The supplemental pilot can assume either of these positions. The supplemental pilot may also assume duties of the PIC if the specified qualifications are met.
32. **Unmanned Aircraft (UA).** A device used or intended to be used for flight in the air that has no onboard pilot. This device excludes missiles, weapons, or exploding warheads, but includes all classes of airplanes, helicopters, airships, and powered-lift aircraft without an onboard pilot. RPAS do not include traditional balloons (refer to 14 CFR part 101), rockets, and unpowered gliders.
33. **Unmanned Aircraft System (RPAS).** A UA and its associated elements related to safe operations, which may include control stations (ground-, ship-, or air-based), control links, support equipment, payloads, Flight Termination Systems (FTS), and launch/recovery equipment.
34. **Unscheduled Maintenance (Nonroutine).** The performance of maintenance tasks when mechanical irregularities occur.
35. **Visual Line of Sight (VLOS).** Unaided (corrective lenses and/or sunglasses exempted) visual contact between a PIC or a VO and a UA sufficient to maintain safe operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to see and avoid other air traffic or objects aloft or on the ground