Environmental Review Form for Argonne National Laboratory

Form:	ANL-985
Version:	5
Your Form ID:	ANL-985-1053
Form Status:	Approved
Date:	2/12/2018 2:11:12 PM
Created By:	Brocker, William A.

Creator

Badge:	**49659**	Name:	**Brocker, William A.**
Cost Center:	**331**	Division:	**HSE**
Job Title:	**Safety Manager**	Employee Type:	**Regular Full-Time Exempt**
Building:	**202**	Lab Extension:	**2-1186**

General Information

Project/Activity Title: Off-site Use of UASs for Research Applications

ASO NEPA Tracking No.: Type of Funding:

B & R Code: Identifying Number: N/A

SPP Proposal Number: CRADA Proposal Number:

Work Project Number: ANL Accounting Number: (Item 3a in Field Work Proposal)

Other (explain):

List appropriate NEPA Owners:

Division: GSS NEPA Owner:

Financial Plans

To select a Financial Plan, click the magnifying glass icon to open a search window.

Cost Center: Project: Phase: Task:

Description of Proposed Action

Argonne National Laboratory (Argonne) wishes to use small unmanned aircraft systems (sUAS) for a variety of experimental and inspection applications. These will include both fixed-wing unmanned aircraft as well as multi-copter UAS that are each less than or equal to 55 pounds in weight. All UASs will either be commercially available equipment or constructed from commercially available light weight airframes. UAS will typically be equipped to carry sensing/data collection technologies (i.e. optical cameras, sensors, hyperspectral cameras, etc.). Flights will be consistent with DOE's blanket FAA Certificate of Authorization, which specifies conditions on flights (e.g., maximum altitude, acceptable weather conditions, time of day considerations, and acceptable locations/airspace for flights).

Description of Affected Environment

Operations of the UASs will be from the surface) to 1200 feet Above Ground Level (AGL). Flights will occur in Class G air space, with FAA notification requirements implemented as required. Flights over property other than Argonne will have written authorization from property owners. All aircraft flown will be registered with the FAA, and will have an accompanying airworthiness assessment. All work will be carried out within the requirements of LMS-POL-8 Aviation Management and Safety and LMS-PROC-261 Aviation Safety. Flights will conducted under the conditions specified in the Department of Energy's blanket FAA Certificate of Authorization and will be subject to DOE HQ Office of Aviation Management and Argonne Site Office approval. Every flight will include a certified airman as pilot in command (PIC) and at least one Visual Observer (VO) with the appropriate certification. Flights will be terminated if there are conditions where collisions with birds are to be expected. Flights will not conducted that would, in any way, result in observable impacts to terrestrial wildlife health or behavior.

Potential Environmental Effects

- Attach explanation for each "yes" response near bottom of form.
- **See Instructions for Completing Environmental Review Form.**

Section A (Complete For All Projects)	Yes	No	Explanation

1.		Project evaluated for Pollution Prevention and Waste Minimization opportunities and details provided under items 2, 4, 6, 7, 8, 16, and 20 below, as applicable	◉	○	Explanation below under hazardous waste section.
2.		Air Pollutant Emissions	○	◉	
3.		Noise	◉	○	Although all UASs emit nuisance noise within a short radius of the unit, this impacts only equipment operators. Mission traffic patterns are located over low population areas during working hours to minimize impact to workers.
4.		Chemical/Oil Storage/Use	○	◉	
5.		Pesticide Use	○	◉	
6.		**Toxic Substances Control Act (TSCA) Substances**			
	6a.	Polychlorinated Biphenyls (PCBs)	○	◉	
	6b.	Asbestos or Asbestos Containing Materials	○	◉	
	6c.	Other TSCA Regulated Substances	○	◉	
	6d.	Import or Export of Chemical Substances	○	◉	
7.		Biohazards	○	◉	
8.		Effluent/Wastewater (If yes, see question #12 and contact Peter Lynch (HSE) at 2-4582 or lynch@anl.gov)	○	◉	
9.		**Waste Management**			
	9a.	Construction or Demolition Waste	◉	○	UASs run on rechargeable batteries, mostly of the Li variety. All spent batteries owned by Argonne will be sent out for recycling when an option; sent out as hazardous waste if not.
	9b.	Hazardous Waste	○	◉	
	9c.	Radioactive Mixed Waste	○	◉	
	9d.	Radioactive Waste	○	◉	
	9e.	Asbestos Waste	○	◉	
	9f.	Biological Waste	○	◉	
	9g.	No Path to Disposal Waste	○	◉	
	9h.	Nano-material Waste	○	◉	
10.		Radiation	○	◉	
11.		Threatened Violation of ES&H Regulations or Permit Requirement	◉	○	The Argonne aviation safety SME has flagged this project as requiring a COA (certificate of operation) from the FAA, which has been obtained.
12.		New or Modified Federal or State Permits	◉	○	The Argonne aviation safety SME has flagged this project as requiring a COA (certificate of operation) from the FAA, which has been obtained.
13.		Siting, Construction, or Major Modification of Facility to Recover, Treat, Store, or Dispose of Waste	○	◉	
14.		Public Controversy	◉	○	There has been significant media attention recently regarding the extent to which UASs may interfere with homeowner Fourth Amendment rights. The FAA-approved operational area for this project is laid out in the attached COA on page 15 and will not interfere in any private property rights.
15.		Historic Structures and Objects	○	◉	
16.		Disturbance of Pre-existing Contamination	○	◉	
17.		Energy Efficiency, Resource Conserving, and Sustainable Design Features	○	◉	
Section B (For Projects that Occur Outdoors)			**Yes**	**No**	

18.	Threatened or Endangered Species, Critical Habitats, and/or other Protected Species	○	◉	
19.	Wetlands	○	◉	
20.	Floodplain	○	◉	
21.	Landscaping	○	◉	
22.	Navigable Air Space	◉	○	All unmanned aviation systems (UASs) will be operated below 1200 feet AGL (above ground level) in Class G airspace. Distances from public airports will be maintained per the limitations documented in DOE¿s Blanket COA. Risk mitigation strategies are outlined in the attached UAS Operations and Procedures Manual.
23.	Clearing or Excavation	○	◉	
24.	Archaeological Resources	○	◉	
25.	Underground Injection	○	◉	
26.	Underground Storage Tanks	○	◉	
27.	Public Utilities or Services	○	◉	
28.	Depletion of a Non-Renewable Resource	○	◉	
Section C (For Projects Outside of ANL)		**Yes**	**No**	
29.	Prime, Unique, or Locally Important Farmland	◉	○	The research needs may necessitate UAS operation above, prime, unique, or locally important farmland, in such cases appropriate permissions will be obtained. It is not anticipated nor likely that farmland will be adversely impacted.
30.	Special Sources of Groundwater (such as sole source aquifer)	◉	○	The research needs may necessitate UAS operation above special sources of groundwater, in such cases appropriate permissions will be obtained. It is not anticipated nor likely that groundwater will be adversely impacted.
31.	Coastal Zones	◉	○	The research needs may necessitate UAS operation above coastal zones, in such cases appropriate permissions will be obtained. It is not anticipated nor likely that coastal zones will be adversely impacted.
32.	Areas with Special National Designations (such as National Forests, Parks, or Trails)	◉	○	The research needs may necessitate UAS operation above special sources national designations, in such cases appropriate permissions will be obtained. It is not anticipated nor likely that special sources of national designations will be adversely impacted.
33.	Action of a State Agency in a State with NEPA-type Law	○	◉	
34.	Class I Air Quality Control Region	◉	○	The research needs may necessitate UAS operation in a Class I Air Quality Control Region, in such cases appropriate permissions will be obtained. It is not anticipated nor likely that Air Quality will be adversely impacted.

Categorical Exclusion

ANL NEPA Reviewer Use Only

○ My approval is the final approval necessary

◉ This form requires additional approval from DOE

To be Completed by DOE/ASO

Section D	Yes	No
Are there any extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal?	○	◉
Is the project connected to other actions with potentially significant impacts or related to other proposed action with cumulatively significant impacts?	○	◉
If yes, is a categorical exclusion determination precluded by 40 CFR 1506.1 or 10 CFR 1021.211?	○	○
Can the project or activity be categorically excluded from preparation of an Environment Assessment or Environmental Impact Statement under Subpart D of the DOE NEPA Regulations?	◉	○

If yes, indicate the class or classes of action from Appendix A or B of Subpart D under which the project may be excluded:

Categorical exclusion approved by DOE under 10 CFR Part 1021, Appendix B of Subpart D, Class of action B3.2 Aviation activities.

If no, indicate the NEPA recommendation and class(es) of action from Appendix C or D to Subpart D to Part 1021 of 10 CFR.

Attachments

File Description:	Non-Aircraft Specific Operations Guide for Flights Conducted Under Blanket COA FAA	View Attachment
File Description:	Onsite Aviation Safety Plan Feb 2018 Small UAS	View Attachment
File Description:	FAA Form 7711-1 UAS COA Attachment	View Attachment
File Description:	Offsite Aviation Safety Plan Feb 2018 Small UAS	View Attachment

Comments

This request is for a new ASO-CX to raise the UAS ceiling on flights from 400 feet to 1,200 feet. Recently a new Blanket COA from DOE was obtained that allows us additional latitude in our on-site and off-site flights, i.e., raise the ceiling on flights from 400 feet to 1200 feet.

Add Approver

Approver Name	Approver Badge	Reason	Delete
Johnson, Robert L.	42078	Manager of Program	

Notifications

The approval notification email will be copied to the people listed below.

Badge	Name	Division	Delete
276734	Swanson, Eric C.	GSS	

ASO-CX Number

ASO-CX- 351

Comments:

This categorical exclusion is tracked by DOE as ASO-CX-351. This new ASO-CX is approved by DOE to raise the maximum UAS altitude from 400 feet (previously approved) to 1200 feet.

Approval

Approver	Action	Date Routed	Action Date	Approval Reason / Comments	Approval Type
Brocker, William A.	APPROVED	2018-02-19	2018-02-19 15:35:12.0	Creator :	PRIMARY
Brocker, William A.	APPROVED	2018-02-19	2018-02-19 15:35:12.0	Allows access to the form :	PRIMARY
Brocker, William A.	APPROVED	2018-02-19	2018-02-19 15:35:12.0	Project Manager :	PRIMARY
Johnson, Robert L.	APPROVED	2018-02-19	2018-02-19 15:43:35.0	Manager of Program :	PRIMARY
Brocker, William A.	APPROVED	2018-02-19	2018-02-19 15:35:12.0	NEPA Owner Approval for Argonne Environmental Review :	PRIMARY
Ptak, Jill S.	APPROVED	2018-02-19	2018-02-20 10:57:39.0	ANL NEPA Reviewer :	PRIMARY
Hellman, Karen B.	APPROVED	2018-02-20	2018-02-21 14:43:28.0	ANL-985 Review and Approval :	PRIMARY

Stine, Gail Y.	APPROVED	2018-02-21	2018-02-22 08:44:00.0	ANL-985 Review and Approval :	PRIMARY
Lee, Alice J. for Kearns, Paul K.	APPROVED	2018-02-22	2018-02-22 09:11:48.0	ANL-985 ANL COO Review and Approval :	DELEGATE
Joshi, Kaushik N.	APPROVED	2018-02-22	2018-02-22 10:11:24.0	ANL-985 DOE-ASO Review and Approval : **Tracked by DOE as ASO-CX-351**	PRIMARY
Siebach, Peter R.	APPROVED	2018-02-22	2018-02-22 16:36:35.0	ANL-985 DOE NEPA Compliance Officer Review and Approval :	PRIMARY

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CERTIFICATE OF WAIVER OR AUTHORIZATION

ISSUED TO
Department of Energy (DOE) Part 91

ADDRESS
HQ, US DOE
1000 Independence Ave, SW
Washington, DC 20585

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

OPERATIONS AUTHORIZED
Operation of small Unmanned Aircraft Systems (UASs) weighing less than 55 pounds in Class G airspace for the purpose of public aircraft operations.

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE
N/A

STANDARD PROVISIONS

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

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

SPECIAL PROVISIONS

Special Provisions are set forth on the reverse side hereof.

The certificate is effective from November 3, 2017, through November 2, 2019, and is subject to cancellation at any time upon notice by the Administrator or his/her authorized representative.

BY DIRECTION OF THE ADMINISTRATOR

FAA Headquarters (Region)	Scott J. Gardner (Signature)
November 2, 2017 (Date)	Acting Manager, UAS Tactical Operations Section (Title)

FAA Form 7711-1 (7-74)

Purpose: To prescribe UAS operating requirements in the National Airspace System (NAS) for the purpose of public aircraft operations. The holder of this COA will be referred herein as the "Proponent".

Public Aircraft:

1. A public aircraft operation is determined by statutes, 49 USC §40102(a)(41) and §40125.
2. All public aircraft flights conducted under a COA must comply with the terms of the statutes.
3. All flights must be conducted per the declarations submitted in the application, and as specified in the following Standard/Special Provisions.
4. This COA provides an alternate means of complying with 14 CFR §91.113(b) for unmanned aircraft operations.
5. All operations will be conducted in compliance with Title 14 CFR §91 and the conditions of the authorization issued herein. If the operator cannot adhere to any of these requirements a separate FAA Form 7711-2 Waiver application may be required.

STANDARD PROVISIONS

A. **General.**

1. The review of this activity is based upon current understanding of UAS operations and their impact in the NAS. This COA will not be considered a precedent for future operations. As changes occur to policy, procedures, and regulatory requirements, limitation and conditions for UAS operations will be adjusted.
2. All personnel connected with the UAS operation must read and comply with the contents of this authorization and its provisions.
3. A copy of the COA, including the special limitations, must be immediately available to all operational personnel at each operating location whenever UAS operations are conducted.
4. This authorization may be cancelled at any time by the Administrator, the person authorized to grant the authorization, or the representative designated to monitor a specific operation. As a general rule, this authorization may be cancelled when it is no longer required, there is an abuse of its provisions, or when unforeseen safety factors develop. Failure to comply with the authorization is cause for cancellation. The proponent will receive a written notice of cancellation.
5. During the time this COA is approved and active, a site safety evaluation/visit may be accomplished to ensure COA compliance, assess any adverse impact on ATC or airspace, and ensure this COA is not burdensome or ineffective. Deviations, accidents/incidents/mishaps, complaints, etc., will prompt a COA review or site visit to address the issue. Refusal to allow a site safety evaluation/visit may result in cancellation of the COA. **Note**: This section does not pertain to agencies that have other existing agreements in place with the FAA.
6. Radiofrequency spectrum authorization is independent of the COA process and requires the proponent to obtain equipment certification and frequency assignments (licenses) in the Aeronautical Radionavigation, Aeronautical Mobile (Route), or Aeronautical Mobile Services, as appropriate, from the National Telecommunications and Information Administration (NTIA) for all radiofrequency devices, including the control link, ATC radios, transponders, detect and avoid systems, and navigation systems, used to support this COA (47 CFR Part 300).

B. **Airworthiness Certification.**

The Unmanned Aircraft System will be maintained in a condition for safe operation while conducting operations in the NAS. The proponent has made their own determination that the unmanned aircraft is airworthy. The unmanned aircraft system must be operated in strict compliance with all provisions and conditions contained in the Airworthiness Safety Release, including all documents and provisions referenced in the COA application.

C. **Operations.**

1. The UA must be operated within visual line of sight (VLOS) of the Pilot in Command (PIC) and the person manipulating the flight controls at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses. Although the remote PIC and person manipulating the controls must maintain the capability to see the UA, using one or more visual observers (VO)'s allows the remote PIC and person manipulating the

controls to conduct other mission-critical duties (such as checking displays) while still ensuring situational awareness of the UA.

2. Must yield right of way to other aircraft, manned or unmanned.
3. First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways.
4. Maximum altitude of 1200' above ground level (AGL). In all cases, the UAS must remain within Class G airspace.
5. Minimum visibility of 3 statute miles from control station.
6. No person may act as a remote pilot in command or VO for more than one unmanned aircraft at one time.
7. No operations from a moving vehicle or watercraft unless the operation is over a sparsely populated area and the PIC and VO are co-located.
8. Lost link must remain within visual line of sight of the PIC and VO.
9. The remote pilot in command must:
   a. Make available to the FAA, upon request, the small UAS for inspection, and any associated documents/records required to be kept under the rule.
   b. Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation.
10. The remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency.
11. Tethered operations must adhere to the Obstruction Marking and Lighting Requirements of AC No: 70/7460-1L. Standards for marking and lighting obstructions that have been deemed to be a hazard to navigable airspace.

D. **Notice to Airmen (NOTAM).**

1. A Distant (D) NOTAM must be issued prior to conducting UAS operations not more than 72 hours in advance, but not less than 24 hours for UAS operations prior to the operation for routine operations. This requirement may be accomplished:
   a. Through the proponent's local base operations or (D) NOTAM issuing authority, or
   b. By contacting the NOTAM Flight Service Station at 1-877-4-US-NTMS (1-877-487-6867). The issuing agency will require:
      (1) Name and contact information of the pilot filing the (D) NOTAM request
      (2) Location, altitude and operating area
      (3) Time and nature of the activity.
2. The area of operation defined in the (D) NOTAM must only be for the actual area to be flown for each day defined by a point and the minimum radius required to conduct the operation.
3. Operator must cancel (D) NOTAMs when UAS operations are completed or will not be conducted.
4. <u>For first responders only.</u> Due to the immediacy of some emergency management operations, the (D) NOTAM notification requirement may be issued as soon as practical before flight

and if the issuance of a (D) NOTAM may endanger the safety of persons on the ground, it may be excluded. If the (D) NOTAM is not issued, the proponent must be prepared to provide justification to the FAA upon request.

E. **Reporting Requirements.**

1. Documentation of all operations associated with UAS activities is required regardless of the airspace in which the UAS operates. NOTE: Negative (zero flights) reports are required.
2. The Proponent must submit the following information on a monthly basis through CAPS:
   a. Name of Proponent, and aircraft registration number,
   b. UAS type and model,
   c. All operating locations, to include city name and latitude/longitude,
   d. Number of flights (per location, per aircraft),
   e. Total aircraft operation hours,
   f. Takeoff or landing damage, and
   g. Equipment malfunction. Required reports include, but are not limited to, failures or malfunctions to the:
      (1) Control station
      (2) Electrical system
      (3) Fuel system
      (4) Navigation system
      (5) On-board flight control system
      (6) Powerplant
   h. The number and duration of lost link events (control, performance and health monitoring, or communications) per UAS, per flight.
3. Incident/Accident/Mishap Reporting
   a. The proponent must provide initial notification to the FAA via email at mail at 9-AJV-115-UASOrganization@faa.gov and via the COA Application Processing System forms (Incident/Accident) within 24 hours of an incident or accident that meets the following criteria:
      (1) All accidents/mishaps involving UAS operations where any of the following occurs:
         (a) Fatal injury, where the operation of a UAS results in a death occurring within 30 days of the accident/mishap
         (b) Serious injury, where the operation of a UAS results in:
            - Hospitalization for more than 48 hours, commencing within 7 days from the date of the injury was received;
            - A fracture of any bone (except simple fractures of fingers, toes, or nose);
            - Severe hemorrhages, nerve, muscle, or tendon damage;
            - Involving any internal organ; or

- Involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.

(c) Total unmanned aircraft loss

(d) Substantial damage to the unmanned aircraft system where there is damage to the airframe, power plant, or onboard systems that must be repaired prior to further flight

(e) Damage to property, other than the unmanned aircraft.

(2) Any incident/mishap that results in an unsafe/abnormal operation including but not limited to

(a) A malfunction or failure of the unmanned aircraft's on-board flight control system (including navigation)

(b) A malfunction or failure of ground control station flight control hardware or software (other than loss of control link)

(c) A power plant failure or malfunction

(d) An in-flight fire

(e) An aircraft collision involving another aircraft.

(f) Any in-flight failure of the unmanned aircraft's electrical system requiring use of alternate or emergency power to complete the flight

(g) A deviation from any provision contained in the COA

(h) A deviation from an ATC clearance and/or Letter(s) of Agreement/Procedures

(i) A lost control link event resulting in

- Fly-away, or
- Execution of a pre-planned/unplanned lost link procedure.

b. Initial reports must contain the information identified in the COA On-Line Accident/Incident Report.

c. Follow-on reports describing the accident/incident/mishap(s) must be submitted by providing copies of proponent aviation accident/incident reports upon completion of safety investigations.

d. The above procedures are not a substitute for separate accident/incident reporting required by the National Transportation Safety Board under 49 CFR Part 830 §830.5.

e. For other than Department of Defense operations, this COA is issued with the provision that the FAA be permitted involvement in the proponent's incident/accident/mishap investigation as prescribed by FAA Order 8020.11, Aircraft Accident and Incident Notification, Investigation, and Reporting

F. **Registration.**

The proponent must comply with the aircraft registration and marking requirements set forth in 14 CFR Parts 47 and 45, or Part 48, prior to conducting flight operations authorized by this COA. Title 49 United States Code (49 USC) sections 44101 through 44104 contain the laws requiring aircraft registration in the United States.

G. **Night small UAS Operations.**

Small UAS operations may be conducted at night, as defined in 14 CFR § 1.1, provided:

1. All operations under the approved COA must use one or more VO;
2. Prior to conducting operations that are the subject of the COA, the remote PIC and VO must be trained to recognize and overcome visual illusions caused by darkness, and understand physiological conditions which may degrade night vision. This training must be documented and must be presented for inspection upon request from the Administrator or an authorized representative;
3. The sUA must be equipped with lighted anti-collision lighting visible from a distance of no less than 3 statute miles. The intensity of the anti-collision lighting may be reduced if, because of operating conditions, it would be in the interest of safety to do so.

H. **Minimum Safe Altitude Operations.**

A waiver from the requirements of 14 CFR 91.119(b) and (c) is approved as follows:

1. The groundspeed of the small UAS must not exceed 100 mph/87 knots.
2. Except for those operations where it is necessary to safeguard human life, no person may operate a small unmanned aircraft over a human being unless that human being is:
   a. Directly participating in the operation of the small unmanned aircraft; or
   b. Located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft.

   Note: People "directly participating in the operation of the small unmanned aircraft" may include qualified non-crewmembers, as defined in 49 USC 40125.
3. For those operations where it is necessary to operate over a human being in order to safeguard human life, the remote pilot in command must not operate any lower or in proximity to human beings necessary to accomplish the operation.

I. **Special Use Airspace.**

1. Coordination and de-confliction between Military Training Routes (MTR) and Special Use Airspace (SUA) is the operator's responsibility. When identifying an operational area the operator must evaluate whether an MTR or SUA will be affected. In the event the UAS operational area overlaps an MTR or SUA, the operator will contact the scheduling agency as soon as practicable in advance to coordinate and de-conflict. Approval from the scheduling agency is required for regulatory SUA, but not for MTR's and non-regulatory SUA. If no response to coordination efforts, the operator must exercise extreme caution and remain vigilant of all MTRs and/ or non-regulatory SUAs.
2. Scheduling agencies for MTRs are listed in the Area Planning AP/1B Military Planning Routes North and South America. If unable to gain access to AP/1B contact the FAA at email address mailto:9-AJV-115-UASOrganization@faa.gov with the IR/VR routes affected and the FAA will provide the scheduling agency information. Scheduling agencies for SUAs are listed in the FAA JO 7400.8.

AIR TRAFFIC CONTROL SPECIAL PROVISIONS

A. **Flight Planning Requirements.**

Operations must only be conducted beyond the following distances from the airport reference point (ARP) of a public use airport, heliport, gliderport, or water landing port listed in the Airport/Facility Directory, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Publications:

1. 5 nautical miles (NM) from an airport having an operational control tower, or
2. 3 NM from an airport having a published instrument flight procedure, but not having an operational control tower, or
3. 2 NM from an airport not having a published instrument flight procedure or an operational control tower, or
4. 2 NM from a heliport.

B. **Emergency/Contingency Procedures.**

1. Lost Link Procedures:

   In the event of a lost link, the UAS pilot will comply with the following provisions:

   a. The UA lost link will be programmed to ensure that lost link flight does not fly over persons and the landing location is within the view of the PIC.

   b. Rally and home locations will be programmed to remain within the area defined in the NOTAM where flight operations are being conducted.

   c. Lost link procedures will not transit or orbit over populated areas, Victor airways, or busy roadways/interstate highways.

   d. Lost link procedures will be programmed to remain within the operations area and altitude, avoid unexpected turn-around and/or altitude changes, and will provide sufficient time to communicate with ATC if necessary.

2. Emergency/Fly-Away Procedures:

   a. In the event of an emergency, the PIC will immediately contact the ATC facility having jurisdiction for the airspace, state the nature of emergency and pilot intentions.

   b. In the event of a UA fly-away, advise ATC of the following:

      (1) Direction of flight.

      (2) Last know altitude.

      (3) Maximum remaining flight time.

AUTHORIZATION

This Certificate of Waiver or Authorization does not, in itself, waive any Title 14 Code of Federal Regulations not specifically stated, nor any state law or local ordinance. Should the proposed operation conflict with any state law or local ordinance, or require permission of local authorities or property owners, it is the responsibility of the proponent to resolve the matter. This COA does not authorize flight within Temporary Flight Restrictions, Special Flight Rule Areas, regulatory Special Use Airspace or the Washington DC Federal Restricted Zone (FRZ) without pre-approval. The proponent is hereby authorized to operate small Unmanned Aircraft System in the NAS within the areas defined in the Operations Authorized section of the cover page.

ONSITE AVIATION SAFETY PLAN, February 2018
SMALL UNMANNED AIRCRAFT SYSTEMS

2017-AHQ-901-COA
2016-WSA-191-COA

Argonne National Laboratory

Scope

This plan documents safety requirements for operating small Unmanned Aircraft Systems (sUAS) over the Argonne National Laboratory campus for the purposes of conducting the following operations: demonstration/currency flights, infrastructure inspections, sensor and airframe development, and emergency operations support.

Background Information

Executive Summary:

Argonne proposes to operate small Unmanned Aircraft Systems (sUAS) over the Argonne National Laboratory site. This Safety Plan documents the basis for how Argonne will provide an adequate separation of sUAS from commercial and general aviation traffic as well as furnish an adequate level of safety for the employees of Argonne, on-site contractors, and the general public. This Safety Plan embraces the concept of defense in depth that employs layers of engineered and administrative controls to create a working envelope that adequately reduces the probability of a sUAS having an accident (i.e. with unacceptable consequences) to extremely small levels. In other words, the overall risk associated with operating small sUAS over the Argonne National Laboratory site is acceptable.

This document is designed to identify and disclose known and specific hazards and procedures to mitigate such risks while operating a Small Unmanned Aircraft System (sUAS) for demo/currency flights, infrastructure inspections, sensor & airframe development, and/or emergency operation support at Argonne National Laboratory. Information was derived and constructed with respect to the requirements of *Blanket Area Public Agency COA 2016-WSA-191-COA issued to the Department of Energy (DOE), and Blanket Area sUAS Class G COA (DOE) 2017-AHQ-901-COA issued to the Department of Energy (DOE).*

This document is not designed to be a stand-alone document, but rather to be used in conjunction with each sUAS vendor's Aircraft Flight Manual/Pilot Operating Handbook (AFM/POH), the Argonne National Laboratory sUAS Airworthiness Statement, the FAA-approved Argonne COAs, and other documentation as required to operate legally, under developed authorizations, and accepted guidance. Operators must ensure that the risk mitigation methodology as defined below will not compete with established procedures by the aircraft manufacturer. Whenever possible, the more restrictive operating standard must be adopted to reduce potential operational risk.

Identified Hazards and Consequence:

The inherent hazard associated with operating a sUAS over the Argonne campus is two-fold. The sUAS conceivably could result in a midair collision with a general aviation or commercial aircraft resulting in a subsequent crash, and/or a sUAS could crash into a residential area outside the perimeter fence or populated area on the Argonne campus. Any failure of the primary power supply will in most cases cause an uncontrolled descent of the Unmanned Aircraft (UA) to occur. Due to the limited speed, weight, and size

of these systems, an uncontrolled and unpowered collision with terrain, structures, or persons will result in minimal risk to persons or property, other than the UA itself. Aircraft operated under the Blanket Certificate of Authorization will include many advanced safety features designed to make the operation as safe as possible for both urban and non-urban environments. This includes but is not limited to built-in fault handling which allows the sUAS to detect a system fault while in the air, and to automatically fly back to its take-off location and land without any input from the operator. Faults that can be detected can include, but are not limited to: loss of communication; pre-set wind thresholds exceeded; penetration of airspace by other manned aircraft; and low battery levels. For these reasons, the likelihood of a collision with structures/persons on the surface resulting in damage is believed to be very low.

Risk Mitigation:

The Argonne has an advantage of tightly controlled access to the compound, and a distribution of more heavily occupied buildings that are concentrated near the center of the compound and very sparse in the surrounding belt of woods and open grass fields. This physical arrangement and the ideal location of the UAS operating fields limits the proximity between airborne sUAs and human vehicle and pedestrian traffic.

Prior to the launch of an aircraft, appropriate on-site staff will be notified in the most expeditious method possible. This may include notification to the Argonne Protective Force, Argonne Today, Building/Area Managers, Facilities Management & Services, the Aviation Safety Officer, and others as appropriate for the particular mission.

The Argonne Unmanned aircraft Operating Area (UOA) has a disadvantage of having a regularly used Brookeridge private airstrip less than 3 SM away to the north, and at least the aircraft range potential for sUAs and manned aircraft to cross paths. To minimize incursions with inbound and outbound air traffic at Brookeridge Airpart, a Letter of Agreement (LOA) has been established between Argonne and Brookeridge that outlines communication and notification protocols prior to sUAS operation.

Rotor and fixed-wing aircraft have the ability to operate for extended duration and a certain range. It is likely that commercial unmanned platforms could reach the local Brookeridge airstrip and the populated neighborhoods just beyond Brookeridge, but neither could reach O'Hare, Midway, Lewis University airports, nor would they have the range to reach or interfere with any known or previously established radio-based NAVAIDs. It is possible that both of these types of aircraft could possibly reach over 400 ft. Above Ground Level (AGL) into the Class E airspace above Argonne, but it is very unlikely that either could penetrate that Class E 3600 ft. MSL into the Class B airspace above – this represents an [intentionally] very difficult effort for a remotely operated aircraft.

Argonne will provide adequate separation of its sUAS from commercial and general aviation traffic, provide sufficient margin from operating over residential areas, and avoid populated areas of the Argonne campus through a combination of both *engineered* and *administrative* controls. These controls will reduce the probability of an accident involving an Argonne sUAS from remote to extremely unlikely levels thereby resulting in a residual risk that is acceptably small.

The following *administrative* controls will be used to ensure safe operation of sUAS over the Argonne campus:

- sUAS flights will be limited to 400 ft. AGL for operations under the COA-WSA-191-COA, and no higher than 700 ft. AGL under the 2017-AHQ-901-COA and will remain within Class G airspace in both circumstances;
- All flight operations will be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures, unless it is necessary to safeguard human life;

- Whenever possible the operator will employ geofencing restrictions on the operation of the sUAS to ensure that the aircraft remains within a predefined area.
- sUAS flights will limited to the lateral boundaries of the Argonne campus and will not overfly residential or adjacent forest preserve areas;
- NOTAM will be filed with the FAA 24-48 hours in advance of sUAS operations over the Argonne campus*;
- sUAS flights will be limited to Visual Flight Rules (VFR) weather conditions during daylight hours for operations conducted under the 2016-WSA-191-COA. Operations at night will be limited to VFR weather conditions and must abide by the equipage and personnel requirements found within the 2017-AHQ-901-COA;
- Airworthiness has been established, tested, and certified by the manufacturer of each sUAS;
- sUAS flights will be conducted in accordance with a sUAS Aircraft Flight Manual/Pilot's Operating Handbook (AFM/POH), or other documentation as provided by the manufacturer of the sUAS;
- Pilot-In-Command (PIC) of the sUAS flights will be certificated as (at least) a Remote Pilot / Private Pilot certificate and maintain a current Third Class Medical Certificate;
- PIC will practice "see and avoid" practices in accordance with 14 CFR 91;
- PIC has been trained and qualified on the operation of the designated sUAS;
- Trained Visual Observers (VOs) that are in direct communication with PIC will be used on sUAS flights;
- Visual Observers will have Third Class medical certificates;
- Lost link procedures (described below) will address instances where communication links between the sUA portion of the sUAS and the PIC have been lost;
- sUAs will be operated within "visual-line-of-sight". This distance may vary based on the design and location of the operator, but this distance should not exceed ½ statute mile (SM);

*Pre-Flight Reporting and NOTAM Filing

The following *engineered* controls will be used to support safe operation of sUAS over the Argonne campus:

- sUAS designated for this COA are small tabletop aircraft that consist of lightweight materials (typically < 6 lbs, with the largest weighing potentially weighing 55 lbs);
- sUAS are typically powered by Lithium Polymer (LiPo) batteries that have an intentionally *limited capacity* to support powered flight that would by definition handicap errant flight outside of authorized COA airspace. LiPo batteries will be charged in a LiPo Guard or equivalent bag;
- sUAS are controlled remotely by the PIC who has the option of controlling flight manually or via preprogrammed flight paths along waypoints using a Ground Control System (GCS) that receives telemetry feeds from the GPS system and wireless links;
- A GPS receiver, magnetic compass, barometer, or a combination thereof is located on each sUAS that provides accurate location and altitude information to the PIC and to enhance the level of safety.
- Return to Launch (RTL) commands can be used by the PIC under certain unexpected conditions to interrupt preprogrammed flight to return to the launch location.

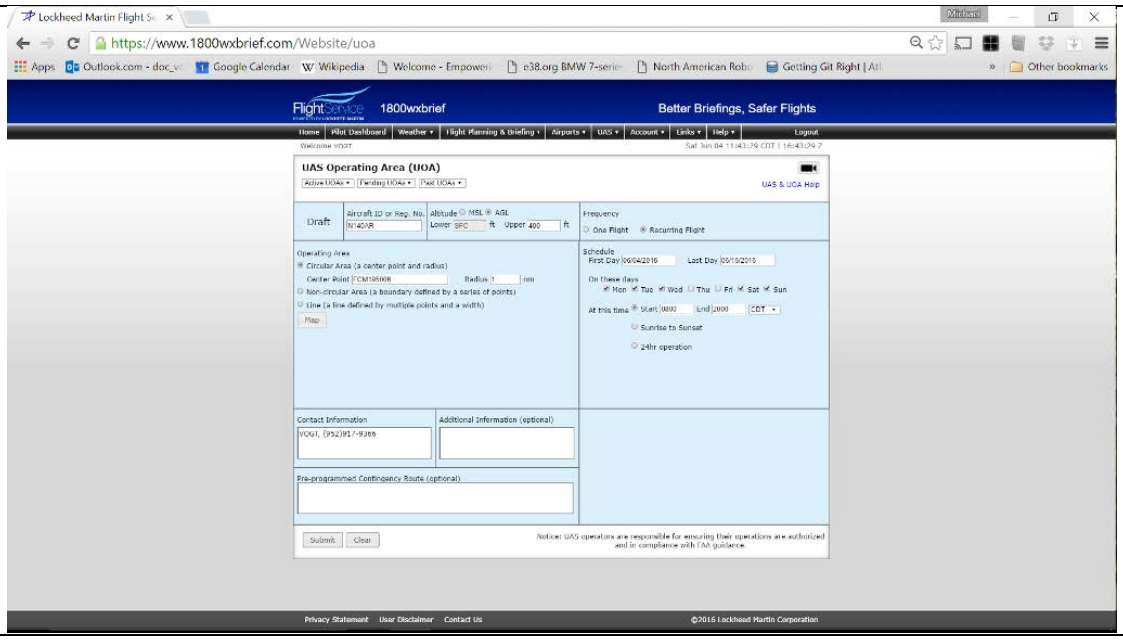
Airspace Environment:

Argonne National Laboratory is located in the southwest suburbs of Chicago underneath the overlying *Class B* airspace associated with O'Hare International Airport (ORD). Argonne is located about 1 - 2 SM (statute miles) south of Brookeridge Airpark (LL22) and is located in uncontrolled *Class G* airspace that extends up to but not including 700 ft. AGL. Other nearby airports that are located more than 5 SM away includes both Bolingbrook's Clow (1C5), Lewis University (KLOT), and Joliet (JOT). The nearest airport that has a control tower, Midway Airport (KMDW), is approximately 12 SM to the northeast of Argonne. A helicopter flyway is located to the north of the Argonne campus along Interstate Highway I-55. The Argonne campus consists of populated and non-populated (e.g. forested) areas. It is separated from residential areas by the surrounding Waterfall Glen Forest Preserve. The sUAs that will be used to conduct aerial missions are small, tabletop aircraft made of lightweight materials.

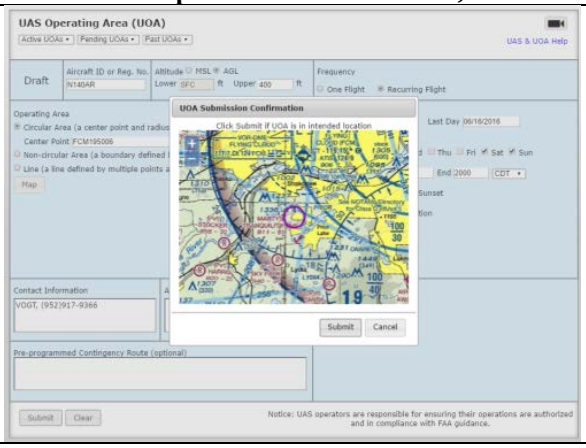
Argonne has a unique aircraft operating environment due to its proximity to local airports and overlying *Class B* airspace. Argonne has systematically analyzed both the consequence and probability of sUAS operations over the Argonne campus. Argonne concludes that through using the concept of "defense in depth" (i.e. layers of both administrative and engineered controls), brief, local, low-level sUAS aerial missions present a level of risk that is acceptable.

All operations over Argonne National Laboratory (Argonne) will be in uncontrolled Class G air space. Because of their proximity (just 1-2 SM [statute miles] north of Argonne), the local airstrip at Brookeridge Airpark (LL22) will by LOA be notified prior to each sUAS flight at Argonne. Because Bolingbrook's Clow (1C5) and Lewis University Airport (KLOT) are further away (> 5 SM), there will be no routine communication with 1C5 or KLOT prior to sUAS flights.

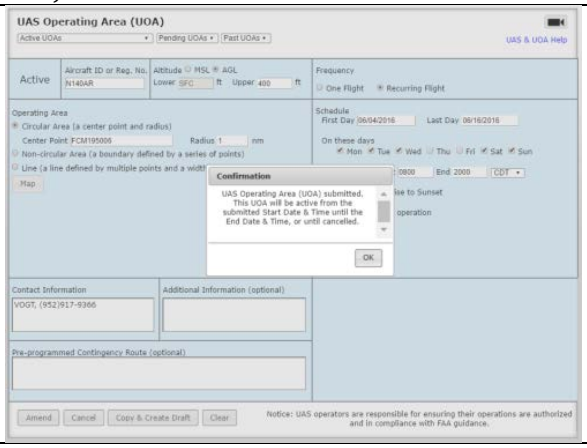
The center point for the Argonne Campus is defined as 18 nautical miles on the 055 radial of the Joliet VOR (JOT). This is area can be defined as either JOT055018, or 414219.3N0875854.8W. Prior to the operation of any sUAS, the Argonne sUAS Pilot In Command (PIC, or designated alternate) will file a formal Notice to Airmen (NOTAM) with the FAA (via Lockheed Martin 1-800/WX-BRIEF or NOTAM Flight Service Station at 1-877/4-US-NTMS) 24-48 hrs. prior to each planned day of operation. The submittal of a NOTAM through a Flight Service Station should be used as the preferred option.



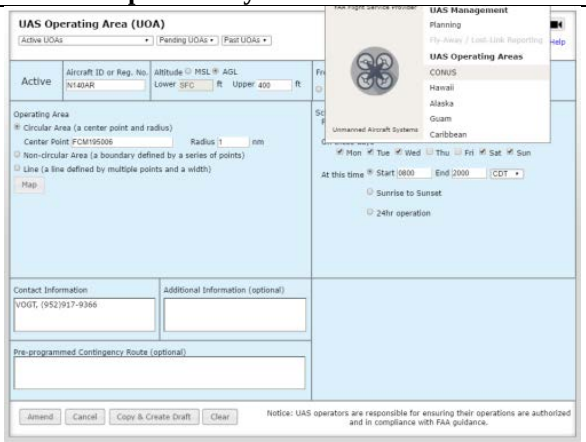
Step 1 – fill out aircraft info, date and duration, and aeronautical chart reference.



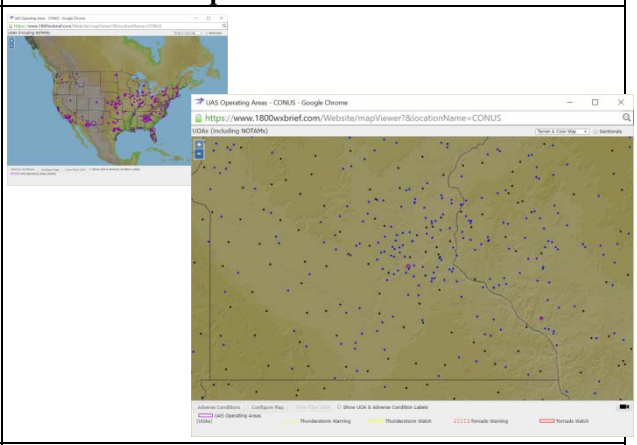
Step 2 – verify nav chart reference.



Step 3 – UOA is defined.



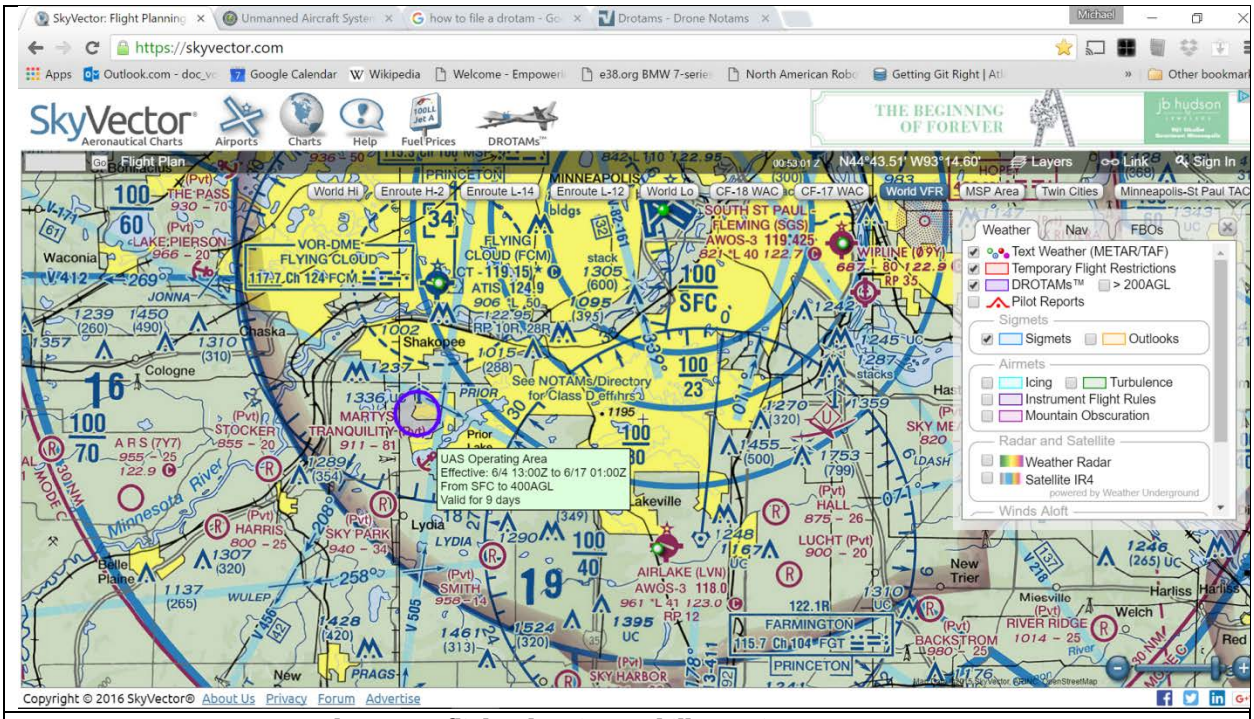
Step 4 – Inspect other UAS UOA's.



Step 5 – Verify UOA demarcation.

If used, Lockheed Martin has made inspecting the Flight Services and filing a NOTAM a simple procedure. Some hints are provided to use proper FAA phrase-ology in defining the location of the desired unmanned aircraft Operating Area (UOA), but a simple radio button interface is used to define the duration. The calendar settings automatically send out NOTAMs that satisfy the FAA requirements for preceding the event. For convenience, more than a week at a time and repeated events can be scheduled.

A separate flight planning service, SkyVector https://skyvector.com, inherits the data for UAS NOTAMs and displays it superimposed over standardized aeronautical navigation charts. This improves the interpretation of each DROTAM schedule and area coverage.



SkyVector flight planning tool illustrating DROTAMs

ATC Communications

During Argonne UAS operations, the PIC must possess a minimum of two methods of communication: (1) The PIC must have access to a portable/handheld radio and monitor and announce operations on the appropriate Unicom/CTAF frequencies to alert manned pilots of UAS operations with a radio equivalent to the ICOM radio mentioned below, and (2) The PIC must have access to a cell phone which has been preprogramed or contains a database of essential contacts in the event of an errant UAS. These phone numbers must include the local Approach/Departure facility, nearby airport control towers, and other uncontrolled airports as required.

Whenever possible, the PIC must use a radio which features a programmable memory to allow for the rapid toggle to certain frequencies the event of an emergency. For operations within the lateral boundaries of Argonne, the PIC must reference the latest aeronautical information as published by the Federal Aviation Administration. The PIC should expect to communicate intentions on Brookeridge/Clow CTAF (122.9).

- The PIC must have the contacts for the following *airports* at the minimum: Brookeridge Air Park, Bolingbrook Clow, Lewis University, Chicago Midway, and Naper Aero Club.
- The PIC must have the contacts for the following *heliports* at the minimum: Lemont Fire Department, Midwest Heliport, and Adventist Bolingbrook Hospital.
- The PIC must have the contacts for the following *ATC Services* at the minimum: Chicago Approach/Departure (C90).

***For easy reference, a list of airport frequencies and contact information has been provided in a separate chapter of this document (See Airport/Facility Contacts).

	• **VOR reception with CDI display** • **DVOR function shows the radial to or from the VOR** • **Duplex operation (listen on NAV, talk on COM)** • **200 memory channels** • **Dedicated 121.5 emergency key** • **NOAA weather stations** • **Receives and transmits 118.000-136.975 MHz** • **Receives 108.000-117.975 MHz and 161.650-163.274 MHz**
ICM IC-A24 Aviation Transceiver Specifications	

Contingency Planning

The fairly substantial area covered by Argonne's UOA [almost 7 km^2], and anticipated limited flight duration, mitigate any negative impacts of any possible UAS system failure that might result in an errant aircraft.

As engineering controls, all of the initial sUAs are of a small size and light weight, also minimizing any potential for ground property damage resulting from an uncontrolled landing.

All of the Argonne UAS employ GPS navigation as part of their avionics/autopilots. This gives them one more pre-determined stored waypoint - Home or the Launch Point that will be used in conjunction with the Return-to-Launch (RTL) command as a basic contingency maneuver.

These administrative and engineered controls do not require the Argonne UOA to define *specific* points at which to land the aircraft in the event of a problem. These aircraft, which are typically hand-launched and skid-landed aircraft pose little threat to landing on any open ground whether having vegetative ground cover or man-made ground cover.

Lost Link Procedures:

a. In the event of lost link, the UA must initiate a flight maneuver that ensures timely landing of the aircraft. Lost link airborne operations shall be predictable and the UA shall remain within the defined operating area filed in the NOTAM for that specific operation. In the event that the UA leaves the defined operating area, and the flight track of the UA could potentially enter controlled airspace, the PIC will immediately contact the appropriate ATC facility having jurisdiction over

the controlled airspace to advise them of the UASs last known altitude, speed, direction of flight and estimated flight time remaining and the Proponent's action to recover the UA.

b. The UA lost link will be programmed to ensure that lost link flight does not fly over persons and the landing location is within the view of the PIC.

c. Rally and home locations will be programmed to remain within the area defined in the NOTAM where flight operations are being conducted.

d. Lost link procedures will not transit or orbit over populated areas, Victor airways, or busy roadways/interstate highways.

e. Lost link procedures will be programmed to remain within the operations area and altitude, avoid unexpected turn-around and/or altitude changes, and will provide sufficient time to communicate with ATC if necessary.

Lost Visual Line of Sight:

If an observer loses sight of the UA, they must notify the PIC immediately. If the UA is visually reacquired promptly, the mission may continue. If not, the PIC will immediately execute the lost link procedures.

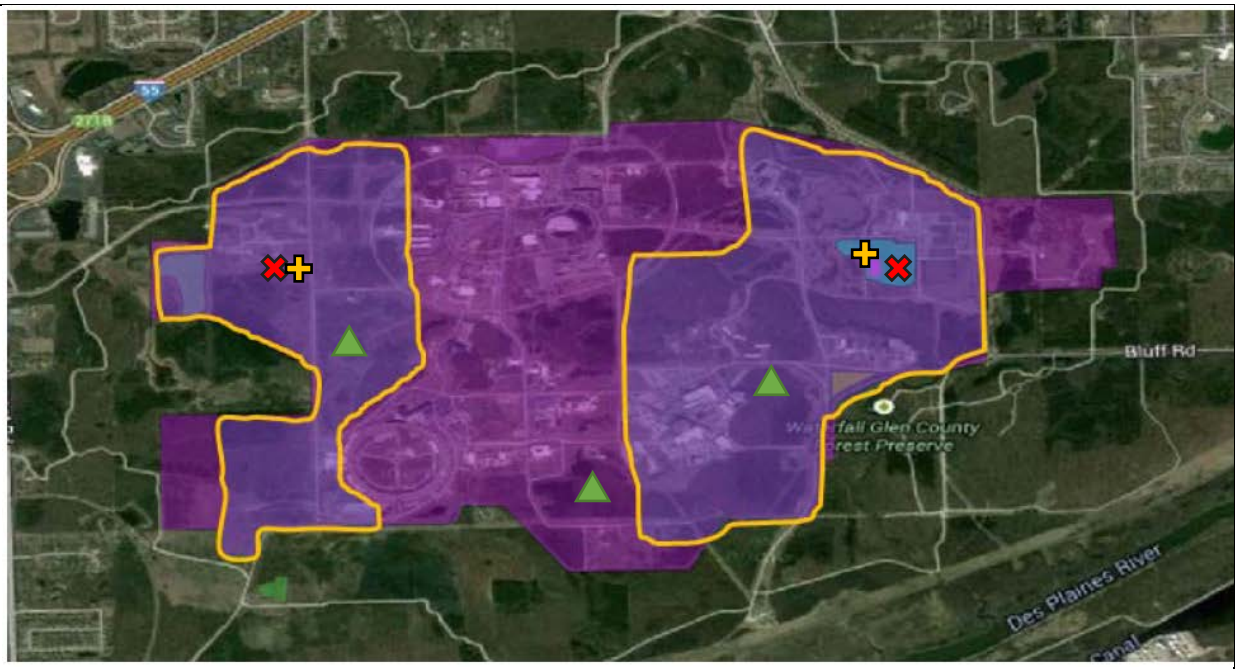
Lost Communications:

If communication is lost between the PIC and the observer(s), the PIC must immediately execute the lost link procedures.

Locations of Operations

UA operations at Argonne will require only tens of horizontal feet for launch or recovery of fixed-wing or rotary UAs, and will remain within the Argonne perimeter fence (area shown in purple) throughout the planned flights. Anticipated launch/recovery areas include grassy areas, restricted usage pavement areas, as well as the paved intersecting runways of an on-site R/C airstrip (blue). The larger gold bounded regions represent the very low population density areas of the site where little-to-no-notification may be required. Flights will be conducted within the Argonne perimeter fence to reduce operational risk to persons on the ground, aircraft, and others.

In the event that operations cannot commence in close proximity to the area of interest for safety or for other operational concerns (such as a building, or critical infrastructure), two key locations, one on the East region of campus at the historic Argonne R/C airstrip and one on the West region near the landfill will serve as alternating primary and contingency launching/recovery zones. If required for safety, these two operating areas can be cordoned off with high visibility tape to be easily seen from the air and to deter non-participants from approaching the flight crew during operations. These areas, as marked on the map below, will be labeled as Lost Link Points (LLPs), Divert/Contingency Points (DCPs) and Flight Termination Points (FTPs) during exercises and practice flights. The LLPs, DCPs, and FTPs are pre-determined GPS waypoints programmed into the UAS autopilot for retrieval to guide the sUA in the event that primary radio command is lost (Lost Link conditions). LLPs are points along a route to loiter at until radio communications can be re-established. DCPs are airborne sites where again, the sUA can loiter until communication is re-established, or, from where it can automatically return to a pre-designated landing site (the FTP). By introducing placeholders for these locations on a site that does not require them, the Argonne UAS crew can train for maneuvers they will be performing in the future at remote research sites.



Argonne UOA with designated LLPs ✚, DCPs ▲, and FTPs ✖

Summary of Site Specific Requirements

Unless authorized by a special provision, all UAS operations under the Blanket COA at the Argonne UOA will be conducted only if all of the following conditions are met:

1) Interactions with appropriate Argonne Health and Safety Officers/Aviation Officer/Cyber Security Officer have been completed to ensure any mission-specific safety/cyber concerns are identified and addressed accordingly.
2) Notification of appropriate on-site staff. This may include notification to the Argonne Protective Force, Argonne Today, Building/Area Managers, Facilities Management & Services, the Aviation Safety Officer, and others as appropriate for the particular mission. An onsite notification should be issued near the same time as the Notice to Airman (NOTAM) is submitted to the Federal Aviation Administration. For non-emergencies, this notification should occur approximately 48-72 hours before the proposed operation as required.
3) Unnecessary exposure to persons on the surface is limited. Operations must be conducted away from populated areas, heavily trafficked roads, or open-air assembly of people to the greatest extent possible as permitted under the Blanket Certificate of Authorization. Aircraft shall not be operated closer than 500 feet to nonparticipating vessels, vehicles, and structures unless lesser distances are necessary to safeguard human life. Specific procedures must be followed as defined in the Blanket Certificate of Authorization for flights in close proximity to participants and nonparticipants.
4) Ensuring that flights will be conducted in "visual-line-of-sight" in Visual Meteorological Conditions (VMC) pertaining to the designated class of airspace. VMC are conditions in which pilots or operators have sufficient visibility to fly the aircraft maintaining visual separation from terrain and from other aircraft.
5) The entire operation will remain within uncontrolled, Class G airspace at an altitude not exceeding 400 or 1200 ft. AGL (Depending on the COA). Operators will ensure that the aircraft will maintain cloud clearance requirements as defined as less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC. Horizontal boundaries of the operating area include the Argonne National Laboratory fence line.
6) Operations may only be conducted during daylight hours unless the aircraft is properly equipped with anti-collision lighting and the aircrew meets the requirements as necessary for safe operation. UAS daylight operations are those operations that occur between the beginning of morning civil twilight and the end of evening civil twilight, as published in the American Air Almanac, converted to local time. (Note: this is equal to approximately 30 minutes before sunrise until 30 minutes after sunset).
7) sUAS will be limited to 87 knots or less.
8) A preflight inspection will be conducted to ensure sUAS will be airworthy and in a condition for safe flight prior to each mission.
9) A configuration control program will be used to track replacement of sUAS hardware and software to ensure airworthiness of the sUAS.
10) Pilots will give way to manned aircraft at all times.

Airport/Facility Contacts

Bolingbrook's Clow International Airport (1C5) 122.90
JOSEPH DE PAULO
130 S CLOW INTL PARKWAY
BOLINGBROOK, IL 60490
Phone 630-378-0479

Brookeridge Air Park (LL22) 122.90
BOB SIEGFRIED
628 86TH ST.
DOWNERS GROVE, IL 60516
Phone 630-985-8502
NEAL RIDENOUR 630-985-3837. NOTE: CALL SIEGFRIED FIRST, THEN RIDENOUR.

Chicago Approach/Departure (C90) 128.20
1100 Bowes Rd.
ELGIN, IL 60123
Phone 847-608-5654

Chicago Midway International Airport (KMDW) 118.70
ERIN O'DONNELL
5700 S CICERO
CHICAGO, IL 60638
MANAGER 773-838-0608
ARPT OPNS 773-838-0677
ATCR 773-884-3662

Lemont Fire Dept Heliport (6IS2) 122.90 or 122.80
DEPUTY CHIEF JAY NICKLESKI
15900 NEW AVE
LEMONT, IL 60439
Phone 630-257-2376

Lewis University Airport (KLOT) 122.80
CHRIS LAWSON
#1 EXECUTVE TERMINAL, GEORGE MICHAS DRIVE
ROMEOVILLE, IL 60446-7175
Phone 815-838-9497
AMGR ADDNL PHONE NUMBER - 815-838-9512.

Midwest Memorial Heliport (05LL) 122.90
RICHARD J. SMITH
525 EXECUTIVE DR
WILLOWBROOK, IL 60527
Phone 630-325-7860

Document Change Log

Revision 1.0 4/13/2017	Draft document prepared.
Revision 1.1 4/24/2017	Document updated to include information about lost link, lost communication, and lost visual line of sight procedures, communication with local airports and air traffic, in addition to other requirements mentioned in the COA. Added signature lines for the document preparer, reviewer, and approver.
Revision 1.2 4/26/2017	Addressed commentary, and added the respective airport contact information.
Revision 1.3 9/20/2017	Revised to accompany for the recent minimum medical certificate change from a 2nd Class to a 3rd Class for PIC's and VO's.
Revision 1.4 1/26/2018	Revised the document to include references to 2017-AHQ-901-COA. Changed maximum permitted altitude from 400 ft. to 1,200 ft. AGL so long as the aircraft remains within Class G airspace. Added language that permits night-time operation with an aircraft that is properly equipped and aircrew that is properly trained. Updated Lost Link Procedures to ensure compliance with both the 2017-AHQ-901-COA, and 2016-WSA-191-COA. Changed minimum pilot requirements from Private Pilot to Remote Pilot.
Revision 1.4.1 2/6/2018	Reversed the preferred the procedure for submitting a NOTAM, removed Peter Washburn as an approver.

Signatures

By signing below, you certify that you have read this documentation and that you know and understand the meaning and intent within. You are entering this agreement knowingly and voluntarily. Note: Significant revisions beyond punctuation or formatting errors may require the collection of new signatures. A summary highlighting the date and content of these major changes will be provided at the end of this documentation for quick reference.

Documentation Control			
Printed Name	**Role/Description**	**Signature**	**Date**
David Gartman	Preparer (EVS)		
Robert Johnson	Preparer (GSS)		
Matthew Kwiatkowski	Reviewer		

Argonne UAS Flight and Ground Crew			
Printed Name	**Role/Description**	**Signature**	**Date**

Non-Aircraft Specific Operations Guide for Flights Conducted Under a Blanket Certificate of Authorization Issued by the Federal Aviation Administration

Purpose: This documentation was developed to supplement and assist with the pre-flight planning process in order to safely and legally operate under the specific authorization as defined in the FAA Blanket COA, current laboratory policy, and industry best practices. The intention is to standardize and sequentially order the required tasks for any type of small unmanned aircraft system to operate under this specific authorization.

Note: This documentation does not alleviate the requirement for each person to be familiar with individual policies, specific authorizations, or reporting requirements.

Contents

Document References

FAA Form 7711-1 UAS COA Attachment Blanket Area sUAS Class G COA (DOE) 2017-AHQ-901-COA. Shorthand Reference (2017-AHQ-901-COA)

FAA FORM 7711-1 UAS COA Attachment Blanket Area Public Agency COA 2016-WSA-191-COA. Shorthand Reference: (2016-WSA-191-COA)

Title 14 Code of Federal Regulations
Part 1: *Definitions,*
Part 47: *Aircraft Registration,*
Part 48: *Registration and Marking Requirements for Small Unmanned Aircraft*
Part 61: *Certification: Pilots, Flight Instructors*
Part 67: *Medical Certification*
Part 91: *General Operating and Flight Rules*
Part 107: *Small Unmanned Aircraft Systems*

Title 49 USC §§ Part 40125: *Qualifications for Public Aircraft Status*

Title 50 Code of Federal Regulations Part 27.34: *Aircraft (National Parks)*

AC 107-2 - Small Unmanned Aircraft Systems (sUAS)

LMS-PROC-261: *Aviation Safety*

LMS-PROC-86: *Injuries and Illnesses*

LMS-PROC-157: *Incident Reporting*

Definitions

AC: Advisory Circular.
AD: Airworthiness Directives
AIM: Aeronautical Information Manual
ACR: Airman Certification Representative.
AGL: Above Ground Level.
ATC: Air Traffic Control.
AWR: Airworthiness Safety Release
CFI: Certificated Flight Instructor.
CFR: Code of Federal Regulations.
COA: Certificate of Authorization
DPE: Designated Pilot Examiner.
FAA: Federal Aviation Administration.
FSDO: Flight Standards District Office.
GC: Ground Crew
GPS: Global Positioning System.

MSL: Mean Sea Level.
MT: Maintenance Technician
NOTAM: Notice to Airmen.
NAS: National Airspace System.
PIC: Pilot in Command.
PM: Project Manager
UA: Unmanned Aircraft.
UAS: Unmanned Aircraft System.
U.S.C.: United States Code.
VO: Visual Observer.
SB: Service Bulletin
SO: Sensor Operator
TFR: Temporary Flight Restriction
VFR: Visual Flight Rules
ADM: Aeronautical Decision-Making
CRM: Crew Resource Management

Background

Argonne National Laboratory (Argonne) has received authorization to utilize small unmanned aircraft systems (sUAS) for a variety of experimental and inspection applications. These will include both fixed-wing unmanned aircraft as well as multi-copter UAS that are each less than or equal to 55 pounds in weight. All UASs will either be commercially available equipment or constructed from commercially available light weight airframes. sUAS will typically be equipped to carry sensing/data collection technologies (i.e. optical cameras, sensors, hyperspectral cameras, etc.). Flights will be consistent with DOE's blanket FAA Certificate of Authorization, which specifies conditions on flights (e.g., maximum altitude, acceptable weather conditions, time of day considerations, and acceptable locations/airspace for flights).

Document Authority and Applicability

This document has been reviewed for accuracy, and is approved for all stages of operational usage. An approved operations document defines minimum standards, general flight rules, maintenance management policies, and aircrew requirements in order to safely and effectively govern the flight operations and maintenance of Unmanned Aircraft Systems (UAS) and respective equipment. It applies to all personnel who directly and indirectly support operations with such aircraft, including those who are designated with the tasks of airframe maintenance, reporting, and other essential tasks. Aircraft covered under a lease agreement or special warranties as issued by the distributer/manufacturer may require additional consideration not currently discussed in this document.

The Department of Energy Office of Aviation Management / Federal Aviation Administration issued Blanket Certificate of Authorization allows for the routine operation of small unmanned aircraft systems within the National Airspace System (NAS). If operations will be conducted entirely or partially within Special Use Airspace (SUA), such as Restricted or Prohibited areas, special considerations and reviews will be required to determine the COA's applicability.

Specific operational guidance is designated based on specific authorization and required crew positions. The terms operator and Pilot are equivalent in this document when referring to flight operations. In addition to this document, all other aircrew publications pertaining to normal flight operational requirements must be adhered to.

Utilization

This operations document was carefully constructed to accompany the restrictions contained within the Blanket Certificate of Authorization, as well as specific, and current, Department of Energy restrictions. This document is arranged in a chronological flow and should be reviewed from the start to finish during a typical operation. Certain tasks have been arranged to ensure regulatory compliance with defined time-based restrictions and to ensure the continued safety throughout the operation.

Compliance

The intent of this document is to be directive. It is the expectation that all persons involved in the operation will abide by the guidance within this document as well as the supplemental material referenced by this document. It is expected that all airmen, visual observers, sensor operators, or maintenance personnel will comply with this document and any published policy or procedure that has been established by the aircraft manufacturer or by internal policy. A onetime, dated signature from those involved in air operations (PM, PIC, MT, VO, SO) discloses and confirms that individuals are familiar with the content of this document, the policies established within, and minimum requirements set forth in all referenced areas. These signatures will remain valid for all flight operations conducted under the current document revision. A new, and significant document revision will require the collection of new signatures prior to operation under the new document.

All personnel currently conducting operations with UAS must have access to electronic or physical copies of the current documentation for reference. If conflicts between published documentation, established policy, local approval, and the Certificate of Authorization (COA) exist, the more restrictive policy shall be adopted unless a waiver to such restrictions can be achieved that would further enhance operations under the COA.

In general, this document is intended to contain overarching rules, policies, and requirements for conducting all flight operations and maintenance of Argonne National Laboratory owned or leased/loaned equipment. The failure to comply with these procedures may result in a temporary or permanent airman and/or operating certificate revocation.

Corrections, Modifications, or Comments

Recommendations or commentary regarding the content of this flight operations document should be submitted to the Global Security Sciences UAS Working Group.

Operations Personnel, Descriptions, Duties and Responsibilities

The following text describes the required duties of each position, required preflight and inflight duties, as well as the responsibilities to each level of management.

Project Manager

The Project Manager (PM), or designee, is responsible for providing initial and final oversight of operations to be conducted or operations that may be underway. They are responsible for the overall wellbeing of the mission and ensuring that an established framework exists that would allow for safe and successful UAS missions. The PM serves as the decision authority for policy, procedures, guidance, and other documentation that affect flight operations conducted under the responsibility, accountability, or authority currently authorized by the Blanket Certificate of Authorization and Department of Energy approvals. The PM possesses the authority to approve, suspend, or revoke a crewmember's authorization to operate if, in the PM's opinion, there has been conduct that can be considered as careless or reckless in nature, or for other reasons as necessary. Additional duties include, but are not limited to:

a) Establishing technical requirements for the mission and communicating those to the PIC,

b) Interactions with appropriate Argonne Health and Safety Officers/Aviation Officer/Cyber Security Officer to ensure any mission-specific safety/cyber concerns are identified and addressed accordingly,

c) Verification of approvals/permissions from property owners over which flights will occur, as necessary,

d) Oversight to ensure that all necessary documentation, certifications, and training have taken place for all participants prior to the flight,

e) Ensuring that all necessary mission-specific reporting (standard and unexpected) requirements are completed post-flight,

f) Coordinating lessons-learned meetings post-flight and ensuring that any occurrence or observation potentially pertinent to future flights and their success/safety are captured and incorporated in mission planning materials for subsequent flights,

g) Notifying appropriate on-site staff if operations will be conducted in proximity to Laboratory infrastructure or property. This may include notification to the Argonne Protective Force, Argonne Today, Building/Area Managers, Facilities Management & Services, the Aviation Safety Officer, and others as appropriate for the particular mission. An onsite notification should be issued near the same time as the Notice to Airman (NOTAM) is submitted to the Federal Aviation Administration. This is approximately 48-72 hours before the proposed operation.

Pilot in Command

The Pilot in Command (PIC) is the sole individual who is responsible for the operation of the aircraft. The PIC has the final authority and responsibility for the safety-of-flight of a specific aircraft operation. In order to serve as a PIC, each airman must demonstrate knowledge/competency in the aircraft to be flown, possess appropriate ratings, endorsements, and approvals that allow continued operation under the guidance set forth by the Department of Energy Blanket Certificate of Authorization and other oversight authorities. During an in-flight emergency requiring immediate action, the PIC may deviate from any rule to the extent required to meet that emergency. No airman may at any time under the DOE Blanket Certificate of Authorization act as the PIC for two or more active aircraft simultaneously while operating

within the National Airspace System. The use of a first-person view camera cannot satisfy "see-and-avoid" requirements but can be used as long as the requirement is satisfied through other ways.

Maintenance Technician

The Maintenance Technician (MT) is a qualified person who is directly responsible for the proper repair and maintenance of the fleet of small unmanned aircraft systems owned/leased by the Laboratory. Responsibilities include, but are not limited to, ensuring that all maintenance related tasks such as scheduling, initial and continuing airworthiness, inventory, tool control, and proper records of activity are documented and completed accordingly. Maintenance personnel must abide by the guidance established by the manufacturer of the airframe, payloads, or other components as required. If standards and tolerances have not been developed, the Maintenance Technician is responsible for employing best practices and judgement upon the inspection or repair of such components.

Visual Observer

A Visual Observer (VO) is a person acting as a flight crew member who assists the PIC and the person manipulating the controls to see and avoid other air traffic or objects aloft or on the ground. For all operations conducted under the Blanket Certificate of Authorization, a VO is required. It is their responsibility to provide additional oversight and to notify any or all persons if the safety of flight cannot be maintained due to unforeseen airborne or ground-based hazards. While the PIC has the final authority for the safety of the flight, the VO may be tasked with monitoring local air traffic communications and ensuring that the launch and recovery areas remain free from obstructions. During the flight of an unmanned aircraft system, the VO should limit non-essential ground duties. Unless otherwise noted, a VO cannot act in that capacity for multiple aircraft.

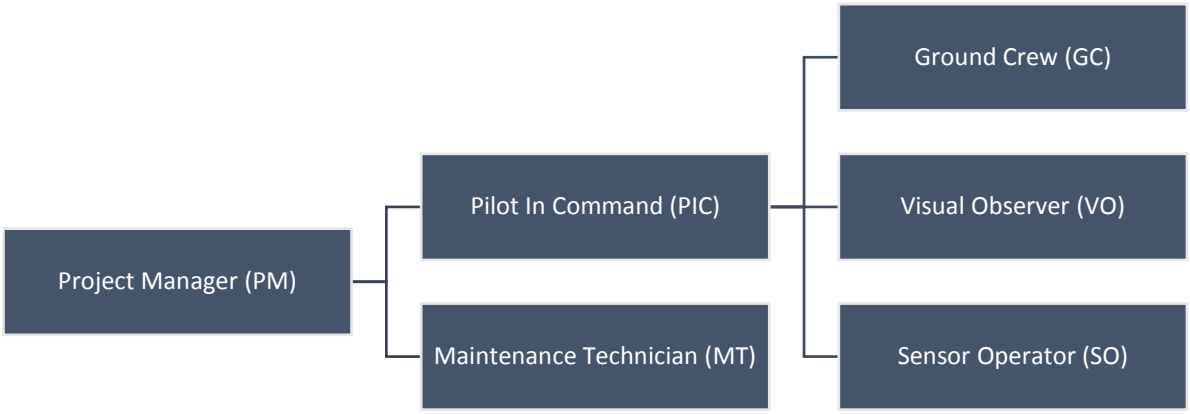
Ground Crew

If operations warrant the deployment of additional ground crew who are not currently reserved with pilotage duties (PIC, VO, SO), they shall be designated as ground crew. While the PIC has the final authority, the Ground Crew is equally responsible for ensuring that the launch and recovery areas remain free from obstructions and that miscellaneous tasks are completed. The Ground Crew is required to ensure that equipment required for a mission is properly set up, inspected, and stowed upon completion. Ground Crew, if properly trained in Air Traffic Control Communications, may assume partial responsibility for communication with local Air Traffic Control, or other duties to alleviate some of the PIC's work load.

Sensor Operator

Sensor Operators (SO), if deployed, are responsible for the management of custom sensors and payloads onboard the aircraft. They must ensure the effective capture, processing, and dissemination of acquired data from such payloads. It is the responsibility of the SO to provide the PIC with the required preflight/in-flight mission details so that the PIC may develop adequate flight planning and crew management tasks. This is to ensure that the operation will not violate the conditions of the COA, endanger the aircraft itself, or cause potential harm to persons or structures on the surface.

Organizational Flow Chart



Training

1. Before completing training flights, all personnel directly involved with the operation with the unmanned aircraft must complete Crew Resource Management Training, and ensure that this training has been received and completed within the last 12 calendar months. This is a U.S. Department of Energy requirement to operate under the Blanket Certificate of Authorization. It is recommended that individuals complete the FAA WINGS-Credit eligible Crew Resource Management (CRM) Online Course offered by KING Schools. Other approved training methods are listed in the latest rendition of the CRM Training document.

2. All operators of an unmanned aircraft system are required to conduct and document initial training at a specific training site that will allow for the conduct of scenario-based training exercises. This training should foster a high level of flight proficiency and promote efficient, standardized coordination among pilots, visual observers, and ground crew members. To ensure safety and compliance, the training site should be well clear of housing areas, roads, non-participating persons, and watercraft. When the U.S. Department of Energy, or an representative who is capable of approving aviation activities at Argonne National Laboratory has determined that sufficient training scenarios have been completed to achieve an acceptable level of competency, the Proponent (U.S. Department of Energy) is authorized to conduct UAS public aircraft operations in accordance with Title 49 USC §§ Part 40125 at any location within the National Airspace System under the provisions of this COA.

3. All Visual Observers (VO's) must complete and document completed training that ensures that the individual is aware of the requirement to communicate to the Pilot in Command (PIC) any information required to remain clear of conflicting traffic, terrain, and obstructions, maintain proper cloud clearances, and provide navigational awareness. This training, at a minimum, must include knowledge of:

    a. Their responsibility to assist PICs in complying with the requirements of:

        i. Section 91.111, Operating Near Other Aircraft,
        ii. Section 91.113, Right-of-Way Rules: Except Water Operations,
        iii. Section 91.115, Right-of-Way Rules: Water Operations,
        iv. Section 91.119, Minimum Safe Altitudes: General, and
        v. Section 91.155, Basic VFR Weather Minimums

    b. Air traffic and radio communications, including the use of approved air traffic control/pilot phraseology
    c. Appropriate sections of the Aeronautical Information Manual (AIM)

4. Pilot in Command and Visual Observers should complete and document training scenarios that include at a minimum the following topical areas:

    a. Launch / recovery techniques and procedures
    b. Normal operations
    c. Navigation methods
    d. Lost Link events

e. Emergencies
f. Other training recommended by the manufacturer

5. Training of any form (flight or ground), if completed, must be documented in the respective airmen and/or observer logbook, or locations which will allow for future review. Specific details are defined in the chapter titled Post-flight Activities of this manual.

Aircraft Repair, Airworthiness Requirements

1. Prior to any operation under the Blanket COA, the unmanned aircraft must be determined to be airworthy through the issuance of an Airworthiness Safety Release (AWR). Specific instructions for the certification of the aircraft are detailed in 2016-WSA-191-COA, Standard Provisions, B.

2. Complete a weight and balance for all sensors and payload combinations to be used onboard the aircraft to ensure attached hardware is within the limits as defined by the aircraft manufacturer. This information must be included with the aircraft at the time of the flight. Document this information for easy reference.

3. Any maintenance on any portion of the sUAS to include scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight must be documented and signed by an individual who is approved to perform such work on the aircraft in the appropriate aircraft logbooks. The maintenance staff or individual must be familiar with the current airworthiness determination process specific to the specific aircraft.

4. If an inspection results in the need to have components replaced, then the operator is required to complete this repair and perform a test flight with the aircraft in order to verify correct operation of the components/hardware in question prior to conducting subsequent flights with the aircraft. Whenever possible, the operator should maintain the sUAS and its components in accordance with manufacturer's instructions. The aircraft manufacturer may provide the maintenance program if documentation is provided.

5. In the absence of specific manufacturer guidance a basic maintenance guide is available for review at the end of this documentation in the section titled: *Suggested sUAS Maintenance and Inspection*

6. In order to operate under the Blanket COA, the following documentation must be completed:

    a. A current Airworthiness Safety Release (AWR) is on file. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

    b. All Service Bulletins (SB's) and Airworthiness Directives (AD's) issued by the manufacturer have been followed and tasks completed. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

    c. A test flight has been conducted after major changes to the software, hardware, airworthiness documentation has been updated, or new payload configurations have occurred. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

    d. Weight and balance configurations of new sensors and payloads have been determined to not have an adverse effect on the control of the aircraft. (2017-AHQ-901-COA, Standard

Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

e. The aircraft must be airworthy. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

Mission Planning

1. Define proposed Launch/Recovery Area and document latitude and longitude position(s), city, and other site descriptors that may assist with flight planning.

2. Review Authorization and Preliminary Hazards

    a. Does the proponent have the authority to launch/recover from the property/location of intended use? (2017-AHQ-901-COA, Authorization) (2016-WSA-191-COA, Authorization)

    b. Will the operation be conducted in or nearby areas administered by the National Park Service, U.S. Fish and Wildlife Service, or U.S. Forest Service? (2016-WSA-191-COA, Flight Standards, 15). If true, permission to launch/recover from these areas is required. (See 50 CFR §§ Part 27.34 and FAA Aeronautical Information Manual Section 4, paragraph 7-4-6.)

    c. Have state, local laws been reviewed to determine potential conflicts with the proposed operation? (2017-AHQ-901-COA, Authorization) (2016-WSA-191-COA, Flight Standards, 24)

    d. Will the operations be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures (excluding spectators)? (2016-WSA-191-COA, Flight Standards, 25)

    e. If spectators who are not directly associated with the operation of the aircraft will be present, does an adequate method exist to protect and mitigate risks? (2016-WSA-191-COA Air Traffic, Flight Standards, 16)

    f. **For operations under the 2017-AHQ-901-COA**. A waiver from the requirements of 14 CFR 91.119(b) and (c) is approved as follows:

        i. The groundspeed of the small UAS must not exceed 100 mph/87 knots.
        ii. Except for those operations where it is necessary to safeguard human life, no person may operate a small unmanned aircraft over a human being unless that human being is:
            1. Directly participating in the operation of the small unmanned aircraft; or
            2. Located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft.

            Note: People "directly participating in the operation of the small unmanned aircraft" may include qualified non-crewmembers, as defined in 49 USC 40125.

        iii. For those operations where it is necessary to operate over a human being in order to safeguard human life, the remote pilot in command must not operate any lower or in proximity to human beings necessary to accomplish the operation (2017-

AHQ-901-COA, Standard Provisions, H).

g. Has a NEPA Review been completed for the area of proposed launch and operations?

h. Will tethered operations be conducted? If yes, the operation must abide by the procedures outlined within 2017-AHQ-901-COA, Standard Provisions, C.

i. Will the operation require the PIC and VO to use a vehicle to remain in visual line of sight of the aircraft while in flight? If yes, consider safety items as addressed in WPC documentation. Ensure compliance with procedures outlined within 2017-AHQ-901-COA.

3. Complete Airspace Review

a. Will the operation be conducted entirely outside of the airspace of **public use** airports, heliports, glider ports, or water landing ports that are listed in the Airport/Facility directory, Chart Supplements, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Packages in proximity to the area of proposed operation as defined in the Blanket COA?

Note: If any public use airport is in proximity of the defined distances, the operation **cannot** continue. However, if airports are restricted to private use only, operations can continue. (Public-Use Airport Definition: 14 CFR Part 77.3) (2017-AHQ-901-COA, Air Traffic Control, A) (2016-WSA-191-COA, Air Traffic, C, 2)

i. 5 nautical miles (NM) from an airport having an operational control tower, or
ii. 3 NM from an airport having a published instrument flight procedure, but not having an operational control tower, or
iii. 2 NM from an airport not having a published instrument flight procedure or an operational control tower, or
iv. 2 NM from a heliport.

b. Determine and document the nearest aviation facility/airport and record the Unicom/CTAF, or other frequencies, phone numbers, as required to notify manned pilots of UAS operations on an aviation-band transceiver / portable radio. (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, B)

c. Define and document nearest ATC jurisdiction (Tower, Center, or Approach/Departure). (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, C, 3)

d. Will the flights be conducted in proximity to VR/IR Military Training Routes (MTR) or Special Use Airspace (SUA)? (2016-WSA-191-COA, Air Traffic, A, 2) If true, the operator **must** contact the scheduling agency 24 hours in advance to coordinate and de-conflict. **Note**: Approval from the scheduling agency is not required. (2017-AHQ-901-COA, Standard Provisions, I) (2016-WSA-191-COA, Air Traffic, A, 2)

e. Will the operational area be in proximity to a Victor Airway? Proximity, while undefined in the Blanket COA, will be defined as operating within 4 nm of either side of the centerline. (2016-WSA-191-COA Air Traffic, E, 1, b.) If true, Lost Link orbit/hover locations are prohibited from coinciding with the centerline of the airway. Operators may not orbit over busy roadways/interstate highways, or orbit over populated areas. (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA Air Traffic, E, 1, b.).

4. Determine NOTAM service volume required for site survey to be completed (Radius, or Individual Points). (2017-AHQ-901-COA, Air Traffic, D, 1-4) (2016-WSA-191-COA, Air Traffic, D, 1-3)

5. Review and confirm the documentation pertaining to the validity of airmen certificates and/or, endorsements for the PIC and VO's to be utilized on the day of the operation.

6. Review and verify that current aviation-related tasks have been addressed with respect to policies and procedures established at Argonne National Laboratory. At a minimum, LMS-PROC-261: *Aviation Safety* should be reviewed.

7. Alert the Argonne Aviation Safety Officer about proposed operations. Ensure that the Project Manager has notified the appropriate onsite/offsite staff regarding the proposed operation.

8. If operating in an area for an extended mission exceeding multiple days, to include the airspace directly over Argonne National Laboratory, the PIC must disclose to surrounding airports, heliports, and private airfields within 5 nautical miles the intention of the mission as well as duration, altitudes, and other information generally contained within a typical NOTAM.

9. Submit a NOTAM-D. **Note**: While it is possible to submit the NOTAM over the phone, it must be submitted between 24 and 72 hours in advance to the operation. Specific instructions for voice-based NOTAM submittal are contained within the Blanket COA (2017-AHQ-901-COA, Standard Provisions, D) (2016-WSA-191-COA, Standard Provisions, E).

    a. Define the proposed airspace with respect to a location as identified by a Very High Frequency Omnidirectional Range, Radial/Distance Measuring Equipment fix (VOR/DME). (2017-AHQ-901-COA, Standard Provisions, D) (2016-WSA-191-COA, Procedural Requirements, D, 1)

    b. Specify that operations will be conducted at or below 400' AGL. (2017-AHQ-901-COA, Standard Provisions, D) (2016-WSA-191-COA, Procedural Requirements, D, 1)

    c. Limit defined horizontal distance as much as possible – submit multiple NOTAM's if covering a large area (2017-AHQ-901-COA, Standard Provisions, D) (2016-WSA-191-COA, Standard Provisions, E, Note)

    Sample NOTAM Text

    NOTAM UAS Operating Area JOT_10/028
    DEFINED AS .5NM RADIUS OF JOT020009 (5NM W 1C5)
    SFC-400FT AGL 1610290446-1710292200.

Day of the Flight. Required Preflight Tasks

1. The PIC must conduct an onsite assessment of the operating environment and aircraft which involves the review of:

    a. Airworthiness documentation and repair

        i. A current Airworthiness Safety Release (AWR) is on file. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)
        ii. All Service Bulletins (SB's) and Airworthiness Directives (AD's) issued by the manufacturer have been followed and tasks completed. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)
        iii. A test flight has been conducted after major changes to the software, hardware, airworthiness documentation has been updated, or new payload configurations have occurred. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)
        iv. Weight and balance configurations of new sensors and payloads have been determined to not have an adverse effect on the control of the aircraft. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)
        v. The aircraft must be airworthy. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Standard Provisions, B)

    b. Registration certificate(s)

        i. The documentation on the aircraft is valid, legible, and labeled on the airframe in a conspicuous location that is easily visible to observers located on the ground if registered under 14 Part 47 and 45 or 48. If this is not possible, the registration information may be placed inside of a battery compartment, or inside of an area which requires no tooling to access as specified in 14 CFR Part 48. (2017-AHQ-901-COA, Standard Provisions, F) (2016-WSA-191-COA, Safety of Flight, H)
        ii. Access to a digital, or physical copy of the certificate found onboard the aircraft should also be available to the airman. If a paper copy is printed, it is recommended to carry this content with the aircraft's respective carrying case.

    c. Temporary Flight Restrictions (TFR's)

        i. TFR's (http://tfr.faa.gov/tfr2/list.html) may be imposed by way of a NOTAM (https://pilotweb.nas.faa.gov/PilotWeb/). Therefore, it is necessary for the sUAS PIC to check for NOTAMs before each flight to determine if there are any applicable airspace restrictions. (2017-AHQ-901-COA, Authorization) (2017-AHQ-901-COA, (2016-WSA-191-COA, Flight Standards, 15)

    d. Local weather conditions

i. The unmanned aircraft may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud, or when visibility is less than 3 statute miles from the PIC. Operations must be conducted in VFR weather conditions only. Flights conducted under Special VFR are currently prohibited. (2017-AHQ-901-COA, Standard Provisions) (2016-WSA-191-COA, Flight Standards, 18)

e. Night Operations

i. **For operations under the 2017-AHQ-901-COA** Small UAS operations may be conducted at night, as defined in 14 CFR § 1.1, provided:

- All operations under the approved COA must use one or more VO;
- Prior to conducting operations that are the subject of the COA, the remote PIC and VO must be trained to recognize and overcome visual illusions caused by darkness, and understand physiological conditions which may degrade night vision. This training must be documented and must be presented for inspection upon request from the Administrator or an authorized representative;
- The sUA must be equipped with lighted anti-collision lighting visible from distance of no less than 3 statute miles. The intensity of the anti-collision lighting may be reduced if, because of operating conditions, it would be in the interest of safety to do so. (2017-AHQ-901-COA, Standard Provisions, G)

ii. **For operations under the 2016-WSA-191-COA.** UAS operations will be conducted entirely during the daytime, as defined in 14 CFR Part 1.1. Operation during civil twilight and night are not authorized under the Blanket COA. Users must utilize official sources to determine this information. (http://aa.usno.navy.mil/data/docs/RS_OneYear.php) (2016-WSA-191-COA, Flight Standards, 17)

f. The proximity of air traffic, persons, and property

i. All flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures. (2016-WSA-191-COA, Flight Standards, 25) Note: A waiver for these rules is allowable when operating under the 2017-AHQ-901-COA, Standard Provisions, H and it is necessary to operate over a human being in order to safeguard human life.

ii. The aircraft operations will not interfere with other manned aviation operations and activities at all times. (2017-AHQ-901-COA, Standard Provisions, C) (2016-WSA-191-COA, Flight Standards, 23)

g. Emergency procedures

i. Documentation has been reviewed, is current and correct for the area of proposed operation, and is immediately available to the PIC.

ii. Aircraft manufacturer-issued emergency procedures are immediately available to the PIC.

iii. Lost Link procedures ensure the timely landing of the aircraft, ATC is notified if required, orbit points will not coincide with the centerline of published victor airways, aircraft will not transit over populated areas, and will deconflict from all other air traffic. (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, E, 1)
iv. If communication, or visual line of sight of the aircraft is lost between the PIC and VO's, the PIC will execute lost link procedures. (2017-AHQ-901-COA Air Traffic B) (2016-WSA-191-COA, Air Traffic, E, 2 and 3)

2. The PIC must determine that the Visual Observer (VO):

    a. Is properly trained and is aware of their reporting responsibility with respect to air traffic, flight obstructions, terrain, structures, cloud clearance requirements, navigational awareness, etc. (2016-WSA-191-COA, Safety of Flight, F)
    b. Can perform their required duties. (2016-WSA-191-COA, Safety of Flight, B, 1)
    c. Can maintain visual line of sight of the unmanned aircraft system, other air traffic, and throughout the entire operation. (2016-WSA-191-COA, Safety of Flight, B, 2)
    d. Can receive, decode, and utilize Air Traffic communications, including the approved air traffic control pilot/phraseology. (2016-WSA-191-COA, Safety of Flight, F, 2)
    e. Understands appropriate sections of the Aeronautical Information Manual (AIM). (2016-WSA-191-COA, Safety of Flight, F, 3)
    f. Will remain in continuous voice-based communication with the PIC at all times. (2016-WSA-191-COA, Safety of Flight, C)

3. The PIC will determine if the aircraft will have enough power/fuel to complete the intended mission and operate after for at least five additional minutes – or with the reserve power recommended by the manufacturer if greater than five minutes. (2016-WSA-191-COA, Flight Standards, 21).

4. The PIC confirms that the aircraft is configured to return to a predetermined location within the defined operating area in the event of: (2016-WSA-191-COA, Flight Standards, 19)

    a. Lost Visual Line of Sight between the aircraft and the PIC or VO'(s) (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, E, 2)
    b. Lost Communications between the PIC and VO'(s) (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, E, 3)
    c. Lost GPS, or if the aircraft experiences any other flight navigation errors (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Flight Standards, 19)
    d. Lost Link between the aircraft and the PIC's control interface. (2017-AHQ-901-COA, Air Traffic, B) (2016-WSA-191-COA, Air Traffic, E, 2)

5. A preflight inspection is completed to determine that the aircraft is in a condition for safe operation. This must include at a minimum, but is not limited to the usage of:

    a. Manufacturer and user guidance. (2017-AHQ-901-COA, Standard Provisions, C) (2016-WSA-191-COA, Flight Standards, 11)

b. Visual inspection of the airframe. (2017-AHQ-901-COA, Standard Provisions, C) (2016-WSA-191-COA, Flight Standards, 10)

c. Radio quality and navigation integrity checks through the usage of range checks, or computerized communication health signals generated by the ground control station, aircraft, or other aircraft-specific components. (2017-AHQ-901-COA, Standard Provisions, C) (2016-WSA-191-COA, Airworthiness, 3)

d. Altitude will not exceed the limits established in the specific authorization.

6. Document in the aircraft/ground control station maintenance logbooks the payload to be used, describing any changes to weight and balance, electrical loads, flight dynamics, etc. (2017-AHQ-901-COA, Standard Provisions, B) (2016-WSA-191-COA, Airworthiness, 1, C)

7. If spectators (Non-flight crew related guests) will be present during flight operations, the PIC needs to ensure minimum safety precautions are in place. The Blanket COA's provide an outline for specific procedures that the operator must follow. Reference 2017-AHQ-901-COA, Standard Provisions, H, or 2016-WSA-191-COA Flight Standards Special Provisions, 16 for further information.

8. An aviation-based hand-held transceiver is available to assist the monitoring of the surrounding airspace.

9. The PIC and VO must complete a Hazard Identification and Risk Assessment to highlight and mitigate an issue that may increase the risks associated with the operation. At the minimum, the PIC and the VO must complete the Personal Minimums (PAVE) (IMSAFE) and be familiar with the (DECIDE) mnemonics for Risk Management.

   Note: Alternative Risk Mitigation techniques are available as an attachment to the end of this document. These were adopted from the Advisory Circular AC 107-2 issued by AFS-800 for the operation of commercial small Unmanned Aircraft Systems in the National Airspace System under 14 CFR Part 107.

Post Flight Activities

1. NOTAM Cancelation

If operations are complete, or did not commence, and a NOTAM-D is still active, it is encouraged to remove the NOTAM as soon as applicable. Otherwise the NOTAM will remain until the end of the issuance period where it will be automatically removed from the Federal NOTAM System (FNS).

2. Daily/Monthly Flight History

a. The PIC must log the type and model flown, operating locations, number of flights, total number of operating hours, takeoff or landing damage, equipment malfunction, lost link events, or other equipment malfunctions/failures for monthly reports to be submitted to the FAA at the end of each month. (2017-AHQ-901-COA, Standard Provisions, E) (2016-WSA-191-COA, Air Traffic, D)

b. The PIC must transfer the information from the collected flights into a standardized document which details monthly activity for all operations conducted in any airspace for any purpose while operating under this COA. (2017-AHQ-901-COA, Standard Provisions, E) (2016-WSA-191-COA, Air Traffic, D, 1)

c. This information must be transmitted to the designated Aviation Safety Personnel responsible for the collection and distribution of this content to the FAA.

3. Logbooks

a. Training Endorsements

i. When training sessions are conducted, the following information is required in the logbook of each person for each flight or lesson logged:
   1. Date.
   2. Total flight time or lesson time.
   3. Location where the aircraft departed and arrived, or for lessons in a flight simulator or flight training device, the location where the lesson occurred.
   4. Type and identification of aircraft, flight simulator, flight training device, or aviation training device, as appropriate.
   5. The name of a safety pilot, if required by § 91.109 of this chapter.
   6. Type of pilot experience or training –
      a. Solo.
      b. Pilot in command.
      c. Second in command.
   7. Flight and ground training received from an authorized instructor.
   8. Training received in a flight simulator, flight training device, or aviation training device from an authorized instructor.
   9. Conditions of flight –
      a. Day or night.

b. Actual instrument.
10. Simulated instrument conditions in flight, a flight simulator, flight training device, or aviation training device.
11. Use of night vision goggles in an aircraft in flight, in a flight simulator, or in a flight training device.

b. Aircraft Logbooks (Flight Logs)

i. Must contain a new line entry with the following information after a flight is completed:
1. Date of the flight
2. Aircraft registration
3. Type/model
4. Conditions of the Flight
    a. Day or Night
    b. Actual Instrument
5. Departure Location
6. Crew involved
    a. Name of the Pilot in Command
    b. Name of the Visual Observer
7. Time of flight
8. Total airframe time
9. Purpose of the flight
10. Remarks (i.e., equipment/component failure)

c. Aircraft Repair / Maintenance Logbooks

i. Must contain a new line entry after the following work is completed on the aircraft by an individual who is adequately qualified to perform such work on the unmanned aircraft system and its components:
1. Date of the work performed
2. Description of the work performed
3. Signature and identifying certificate number of the person performing the repair on the aerial vehicle, or associated systems.
4. Example Report: "To address a service bulletin issued by the aircraft manufacturer, XYZ was performed on the unmanned aerial vehicle on ABC date by Smith, Jones 01234567. A functional flight test was conducted to ensure airworthiness, and the FAA was notified of this major change per the Airworthiness Certification requirements of the Blanket COA for Public Operators. A new Airworthiness Safety Release (AWR) was issued. No abnormalities to report".

d. Aircraft Operator and Visual Observer Logbook

i. Must contain a new line entry in both the Aircraft Operator and Visual Observer logbooks after the crew completes a flight:
1. Date of the flight

2. Aircraft Registration
3. Type/Model
4. Methods of differentiating between different types of operating time (Dual, Pilot-in-Command, Sensor Operator, Visual Observer, etc.)
5. Departure Location
6. Total number of Launches and Recoveries
7. Total time on flight
8. Total airframe time
9. Remarks
10. Training endorsements

Emergency Procedures

1. **Lost Link / Leaving Defined NOTAM Area / Controlled Airspace**

   a) In the event of lost link, the UA must initiate a flight maneuver that ensures timely landing of the aircraft.

   b) If the UA will leave the defined operating area, and the flight track of the UA could potentially enter controlled airspace, the PIC must notify the ATC facility having jurisdiction over the controlled airspace to advise them of the UASs last known altitude, speed, direction of flight and estimated flight time remaining and the Proponent's action to recover the UA.

2. **Lost Visual Line of Sight:**

   If an observer, loses sight of the UA, they must notify the PIC immediately. If the UA is visually reacquired promptly, the mission may continue. If not, the PIC will immediately execute the lost link procedures. If the PIC loses sight of the UA, the aircraft must initiate a flight maneuver that ensures the timely landing of the aircraft.

3. **Lost Communication with Visual Observers:**

   If communication is lost between the PIC and the observer(s), the PIC must immediately execute the lost link procedures.

4. **Incident / Accident / Mishap Reporting**

   Depending on the severity of the event, it may be required to notify all, or only a few parties. Evidence that may assist in accident reconstruction must remain unaltered until the proper reviews have been completed, details of the accident are logged, and consultation with the Argonne Aviation Safety Officer is completed. The following have been categorized based on a recommended time-sensitive reporting requirement.

   a. Emergency Services - If an incident/accident causes, or has the potential to cause significant harm to another life and property, the crew must contact emergency services **as soon as possible** to arrange for the protection of the person's life and/or the respective property. This call may be placed by anyone affiliated with the remotely piloted aircraft operation at any time, for any reason as they see fit.

   b. FAA Notification - If an incident or accident that meets the criteria as specified in the Reporting Requirements, the Proponent is required to submit a notification to the FAA **within 24 hours** of that event. For specific information, reference Reporting Documents in the 2017-AHQ-901-COA Blanket COA or the 2016-WSA-191-COA Blanket COA. A report is mandatory when the following occurs in general:

      i. Accidents
         1. Fatal injury
         2. Serious injury

3. Total unmanned aircraft loss
4. Substantial damage to a portion of the unmanned aircraft
5. Damage to property (other than the unmanned aircraft itself)

ii. Incidents or Unsafe/abnormal operation
1. Flight control or navigation malfunction/failure
2. Ground control malfunction/failure (other than loss link events)
3. Power plant failure
4. Fire
5. Midair collision
6. Electrical system failure
7. Deviation from any portion of the COA, ATC clearance, or Letter of Agreement/Procedures
8. Lost link event
    a. Flyaway
    b. Execution of a pre-planned/unplanned lost link procedure.

c. NASA Aviation Safety Reporting System (ASRS) – Pilots, air traffic controllers, flight attendants, mechanics, ground personnel, and others involved in aviation operations submit reports to the ASRS when they are involved in, or observe, an incident or situation in which aviation safety may have been compromised. All submissions are voluntary. Reports sent to the ASRS are held in strict confidence. The FAA considers the filing of a report with NASA concerning an incident or occurrence involving a violation of 49 U.S.C. subtitle VII or the 14 CFR to be indicative of a constructive attitude. Such an attitude will tend to prevent future violations. Accordingly, although a finding of violation may be made, neither a civil penalty nor certificate suspension will be imposed if certain criteria are met. Airman Certificate holders are strongly encouraged to submit a report at any time, for any reason. This reporting must be completed **within 10 days** after the violation, or date when the person became aware or should have been aware of the violation, he or she completed and delivered or mailed a written report of the incident or occurrence.
Reference: https://asrs.arc.nasa.gov/index.html

d. Supervisor/Aviation Safety Officer – Any operation of an unmanned aircraft system which is classified as an incident or accident must be reported to the PIC's supervisor and the Aviation Safety Personnel employed at the Laboratory as soon as possible.

Argonne ESQ Reporting – If an incident or accident is generated as a result of the operation of the unmanned aircraft system or its components, notification to Environment, Safety, & Quality Assurance (ESQ) is required. Operators are required to follow the guidelines set forth in the current renditions of LMS-PROC-86: *Injuries and Illnesses*, and LMS-PROC-157: *Incident Reporting*.
Reference: https://argonne.service-now.com

Risk Assessment Tools

A.1 Purpose of this Appendix. The information in this appendix is a presentation of aeronautical decision-making (ADM), Crew Resource Management (CRM), and an example of a viable risk assessment process. This process is used to identify hazards and classify the potential risk that those hazards could present in an operation. It also provides examples of potential criteria for the severity of consequences and likelihood of occurrence that may be used by a sUAS pilot in command (PIC).

A.2 **Aeronautical Decision-Making (ADM).** The ADM process addresses all aspects of decision making in a solo or crew environment and identifies the steps involved in good decision making. These steps for good decision making are as follows:

A.2.1 Identifying Personal Attitudes Hazardous to Safe Flight. Hazardous attitudes can affect unmanned operations if the PIC is not aware of the hazards, leading to such things as: getting behind the aircraft/situation, operating without adequate fuel/battery reserve, loss of positional or situational awareness, operating outside the envelope, and failure to complete all flight planning tasks, preflight inspections, and checklists. Operational pressure is a contributor to becoming subject to these pit-falls.

A.2.2 Learning Behavior Modification Techniques. Continuing to utilize risk assessment procedures for the operation will assist in identifying risk associated with the operation. Conducting an attitude assessment will identify situations where a hazardous attitude may be present.

A.2.3 Learning How to Recognize and Cope with Stress. Stress is ever present and one may already be familiar with situations that create stress in aviation. However, UAS operations may create stressors that differ from manned aviation. Such examples may include: working with an inexperienced crewmember, lack of standard crewmember training, interacting with the public and city officials, and understanding new regulatory requirements. Proper planning for the operation can reduce or eliminate stress, allowing one to focus more clearly on the operation.

A.2.4 Developing Risk Assessment Skills. As with any aviation operation, identifying associated hazards is the first step. Analyzing the likelihood and severity of the hazards occurring establishes the risk. In most cases, steps can be taken to mitigate, even eliminate, those risks. Actions such as using VO, completing a thorough preflight inspection, planning for weather, and familiarity with the airspace, proper aircraft loading, and performance planning can mitigate identified risks. Figure A-1, Hazard Identification and Risk Assessment Process Chart, is an example of a risk assessment tool. Others are also available for use.

A.2.5 Using All Available Resources with More Than One Crewmember (CRM). A characteristic of CRM is creating an environment where open communication is encouraged and expected, and involves the entire crew to maximize team performance. Many of the same resources that are available to manned aircraft operations are available to UAS operations. For example, PICs can take advantage of traditional CRM techniques by utilizing additional crewmembers, such as VOs and other ground crew. These crewmembers can provide information about traffic, airspace, weather, equipment, and aircraft loading and performance. Examples of good CRM include:

- Communication Procedures. One way to accomplish this is to have the VO maintain visual contact with the small UA and maintain awareness of the surrounding airspace, and then communicate flight status and any hazards to the PIC and person manipulating the controls so that appropriate action can be taken. Then, as conditions change, the PIC should brief the crew on the changes and any needed adjustments to ensure a safe outcome of the operation.
- Communication Methods. The PIC, person manipulating the controls, and VO must work out a method of communication, such as the use of a hand-held radio or other effective means, which would not create a distraction and allows them to understand each other. The PIC should evaluate which method is most appropriate for the operation; this should be determined prior to flight.
- Task Management. Tasks vary depending on the complexity of the operation. Depending upon the area of the operations, additional crewmembers may be needed to safely operate. Enough crewmembers should be utilized to ensure no one on the team becomes overloaded. Once a member of the team becomes over worked, there's a greater possibility of an incident/accident.

A.2.6 Other Resources. Take advantage of information from a weather briefing, air traffic control (ATC), the FAA, local pilots, and landowners. Technology can aid in decision making and improve situational awareness. Being able to collect the information from these resources and manage the information is key to situational awareness and could have a positive effect on decision making.

A.2.7 Evaluating the Effectiveness of One's ADM Skills. Successful decision making is measured by a pilot's consistent ability to keep himself or herself, any persons involved in the operation, and the aircraft in good condition regardless of the conditions of any given flight. As with manned operations, complacency and overconfidence can be risks, and so there are several checklists and models to assist in the decision making process. Use the IMSAFE checklist to ensure one is mentally and physically prepared for the flight. Use the DECIDE model to help continually evaluate each operation for hazards and analyze risk. Paragraph A.5.5 and the

current edition of AC 60-22, Aeronautical Decision Making, can provide additional information on these models and others.

A.3 **Hazard Identification.** Hazards in the sUAS and its operating environment must be identified, documented, and controlled. The analysis process used to define hazards needs to consider all components of the system, based on the equipment being used and the environment it is being operated in. The key question to ask during analysis of the sUAS and its operation is, "*what if?*" sUAS PICs are expected to exercise due diligence in identifying significant and reasonably foreseeable hazards related to their operations.

Figure A-1. Hazard Identification and Risk Assessment Process Chart

A.4 Risk Analysis and Assessment. The risk assessment should use a conventional breakdown of risk by its two components: likelihood of occurrence and severity.

A.5 Severity and Likelihood Criteria. There are several tools which could be utilized in determining severity and likelihood when evaluating a hazard. One tool is a risk matrix. Several examples of these are presented in Figure A-2, Safety Risk Matrix Examples. The definitions and construction of the matrix is left to the sUAS PIC to design. The definitions of each level of

severity and likelihood need to be defined in terms that are realistic for the operational environment. This ensures each PIC's decision tools are relevant to their operations and operational environment, recognizing the extensive diversity which exists. An example of severity and likelihood definitions is shown in Table A-1, Sample Severity and Likelihood Criteria.

Table A-1. Sample Severity and Likelihood Criteria

Severity of Consequences			Likelihood of Occurrence		
Severity Level	Definition	Value	Likelihood Level	Definition	Value
Catastrophic	Equipment destroyed, multiple deaths.	5	Frequent	Likely to occur many times	5
Hazardous	Large reduction in safety margins, physical distress, or a workload such that crewmembers cannot be relied upon to perform their tasks accurately or completely. Serious injury or death. Major equipment damage.	4	Occasional	Likely to occur sometimes	4
Major	Significant reduction in safety margins, reduction in the ability of crewmembers to cope with adverse operating conditions as a result of an increase in workload, or as result of conditions impairing their efficiency. Serious incident. Injury to persons.	3	Remote	Unlikely, but possible to occur	3
Minor	Nuisance. Operating limitations. Use of emergency procedures. Minor incident.	2	Improbable	Very unlikely to occur	2
Negligible	Little consequence.	1	Extremely Improbable	Almost inconceivable that the event will occur	1

A.6 Risk Acceptance. In the development of risk assessment criteria, sUAS PICs are expected to develop risk acceptance procedures, including acceptance criteria and designation of authority and responsibility for risk management decision making. The acceptability of risk can be evaluated using a risk matrix, such as those illustrated in Figure A-2. Table A-2, Safety Risk Matrix—Example shows three areas of acceptability. Risk matrices may be color coded; unacceptable (red), acceptable (green), and acceptable with mitigation (yellow).

A.6.1 Unacceptable (Red). Where combinations of severity and likelihood cause risk to fall into the red area, the risk would be assessed as unacceptable and further work would be required to design an intervention to eliminate that associated hazard or to control the factors that lead to higher risk likelihood or severity.

A.6.2 Acceptable (Green). Where the assessed risk falls into the green area, it may be accepted without further action. The objective in risk management should always be to reduce risk to as low as practicable regardless of whether or not the assessment shows that it can be accepted as is.

A.6.3 Acceptable with Mitigation (Yellow). Where the risk assessment falls into the yellow area, the risk may be accepted under defined conditions of mitigation. An example of this situation would be an assessment of the impact of a sUAS operation near a school yard. Scheduling the operation to take place when school is not in session could be one mitigation to prevent undue risk to the children that study and play there. Another mitigation could be restricting people from the area of operations by placing cones or security personnel to prevent unauthorized access during the sUAS flight operation.

Figure A-2. Safety Risk Matrix Examples

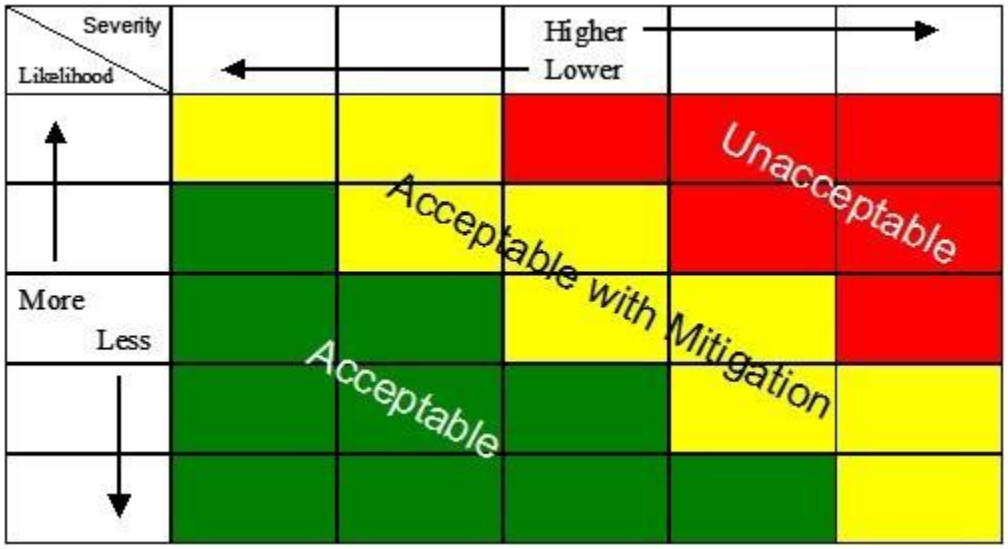


Table A-2. Safety Risk Matrix—Example

Risk Likelihood		Risk Severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely Improbable	1	1A	1B	1C	1D	1E

Note: The direction of higher/lower and more/less scales on a matrix is at the discretion of the PIC.

A.7 Other Risk Assessment Tools for Flight and Operational Risk Management. Other tools can also be used for flight or operational risk assessments and can be developed by the PICs themselves. The key thing is to ensure that all potential hazards and risks are identified and appropriate actions are taken to reduce the risk to persons and property not associated with the operations.

A.8 Reducing Risk. Risk analyses should concentrate not only on assigning levels of severity and likelihood, but on determining why these particular levels were selected. This is referred to as *root cause analysis*, and is the first step in developing effective controls to reduce risk to lower levels. In many cases, simple brainstorming sessions among crewmembers is the most effective and affordable method of finding ways to reduce risk. This also has the advantage of involving people who will ultimately be required to implement the controls developed.

A.9 It is also very easy to get quite bogged down in trying to identify all hazards and risks. That is not the purpose of a risk assessment. The focus should be upon those hazards which pose the greatest risks. As stated earlier, by documenting and compiling these processes, a PIC can build an arsenal of safety practices that will add to the safety and success of future operations.

Sample Hazard Identification and Risk Assessment.

A.10 Example. I am the PIC of a sUAS in the proximity of an accident scene shooting aerial footage. Much like pilots in manned aircraft must adhere to preflight action (part 91, § 91.103), I must adhere to preflight familiarization, inspection, and aircraft operations (§ 107.49 / Blanket COA). Let's say that there is an obvious takeoff and landing site that I intend to use. What if, while I am operating a manned aircraft (emergency medical services (EMS) helicopter) requires use of the same area and I am not left with a suitable landing site? Furthermore, I am running low on power. If I consider this situation prior to flight, I can use the Basic Hazard Identification and Mitigation Process. Through this process, I might determine that an acceptable level of risk can be achieved by also having an alternate landing site and possibly additional sites at which I can sacrifice the UA to avoid imposing risk to people on the ground or to manned aircraft operations. It is really a simple process: I must consider the hazards presented during this particular operation, determine the risk severity, and then develop a plan to lessen (or mitigate) the risk to an acceptable level. By documenting and compiling these processes, I can build an arsenal of safety practices that will add to the safety and success of future operations. The following are some proven methods that can help a new PIC along the way:

A.11 Hazard Identification. Using the Personal Minimums (PAVE) Checklist for Risk Management, I will set personal minimums based upon my specific flight experience, health habits, and tolerance for stress, just to name a few. After identifying hazards, I will then input them into the Hazard Identification and Risk Management Process Chart (Figure A-1).

1. **P**ersonal: Am I healthy for flight and what are my personal minimums based upon my experience operating this sUAS? During this step, I will often use the **IMSAFE** checklist in order to perform a more in-depth evaluation:
    - **I**llness – Am I suffering from any illness or symptom of an illness which might affect me in flight?
    - **M**edication – Am I currently taking any drugs (prescription or over-the-counter)?
    - **S**tress – Am I experiencing any psychological or emotional factors which might affect my performance?
    - **A**lcohol – Have I consumed alcohol within the last 8 to 24 hours?
    - **F**atigue – Have I received sufficient sleep and rest in the recent past?
    - **E**ating – Am I sufficiently nourished?
2. **A**ircraft: Have I conducted a preflight check of my sUAS (aircraft, control station (CS), takeoff and landing equipment, etc.) and determined it to be in a condition for safe operation? Is the filming equipment properly secured to the aircraft prior to flight?

3. En**V**iroment: What is the weather like? Am I comfortable and experienced enough to fly in the forecast weather conditions? Have I considered all of my options and left myself an "out?" Have I determined alternative landing spots in case of an emergency?

4. **E**xternal Pressures: Am I stressed or anxious? Is this a flight that will cause me to be stressed or anxious? Is there pressure to complete the flight operation quickly? Am I dealing with an unhealthy safety culture? Am I being honest with myself and others about my personal operational abilities and limitations?

A.12 Controlling Risk. After hazards and risks are fully understood through the preceding steps, risk controls must be designed and implemented. These may be additional or changed procedures, additional or modified equipment, the addition of VOs, or any of a number of other changes.

A.13 Residual and Substitute Risk. Residual risk is the risk remaining after mitigation has been completed. Often, this is a multistep process, continuing until risk has been mitigated down to an acceptable level necessary to begin or continue operation. After these controls are designed but before the operation begins or continues, an assessment must be made of whether the controls are likely to be effective and/or if they introduce new hazards to the operation. The latter condition, introduction of new hazards, is referred to as substitute risk, a situation where the cure is worse than the disease. The loop seen in Figure A-1 that returns back to the top of the diagram depicts the use of the preceding hazard identification, risk analysis, and risk assessment processes to determine if the modified operation is acceptable.

A.14 Starting the Operation. Once appropriate risk controls are developed and implemented, then the operation can begin.

Suggested sUAS Maintenance and Inspection

B.1 Applicability. This chapter provides guidance on how to inspect and maintain a sUAS. Additionally, Appendix C, sUAS Maintenance and Inspection Best Practices, contains expanded information and best practices for sUAS maintenance and inspection.

B.2 Maintenance. sUAS maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight. Whenever possible, the operator should maintain the sUAS and its components in accordance with manufacturer's instructions. The aircraft manufacturer may provide the maintenance program, or, if one is not provided, the operator may choose to develop one.

B.3 Scheduled Maintenance. The sUAS manufacturer may provide documentation for scheduled maintenance of the entire UA and associated system equipment. There may be components of the sUAS that are identified by the manufacturer to undergo scheduled periodic maintenance or replacement based on time-in-service limits (such as flight hours, cycles, and/or the calendar-days). All manufacturer scheduled maintenance instructions should be followed in the interest of achieving the longest and safest service life of the sUAS.

B.3.1.A If there are no scheduled maintenance instructions provided by the sUAS manufacturer or component manufacturer, the operator should establish a scheduled maintenance protocol. This could be done by documenting any repair, modification, overhaul, or replacement of a system component resulting from normal flight operations, and recording the time-in-service for that component at the time of the maintenance procedure. Over time, the operator should then be able to establish a reliable maintenance schedule for the sUAS and its components.

B.4 Unscheduled Maintenance. During the course of a preflight inspection, the PIC may discover that a sUAS component is in need of servicing (such as lubrication), repair, modification, overhaul, or replacement outside of the scheduled maintenance period as a result of normal flight operations or resulting from a mishap. In addition, the sUAS manufacturer or component manufacture may require an unscheduled system software update to correct a problem. In the event such a condition is found, the PIC should not conduct flight operations until the discrepancy is corrected.

B.5 Performing Maintenance. In some instances, the sUAS or component manufacturer may require certain maintenance tasks be performed by the manufacturer or by a person or facility (personnel) specified by the manufacturer. It is highly recommended that the maintenance be performed in accordance with the manufacturer's instructions. However, if the operator decides

not to use the manufacturer or personnel recommended by the manufacturer and is unable to perform the required maintenance, the operator should consider the expertise of maintenance personnel familiar with the specific sUAS and its components. In addition, though not required, the use of certificated maintenance providers are encouraged, which may include repair stations, holders of mechanic and repairman certificates, and persons working under the supervision of these mechanics and repairman.

B.5.1.A If the operator or other maintenance personnel are unable to repair, modify, or overhaul a sUAS or component back to its safe operational specification, then it is advisable to replace the sUAS or component with one that is in a condition for safe operation. It is important that all required maintenance be completed before each flight, and preferably in accordance with the manufacturer's instructions or, in lieu of that, within known industry best practices.

B.6 Preflight Inspection. Before each flight, the PIC must inspect the sUAS to ensure that it is in a condition for safe operation, such as inspecting for equipment damage or malfunction(s). The preflight inspection should be conducted in accordance with the sUAS manufacturer's inspection procedures when available (usually found in the manufacturer's owner or maintenance manual) and/or an inspection procedure developed by the sUAS owner or operator.

B.1.1 Creating an Inspection Program. As an option, the sUAS owner or operator may wish to create an inspection program for their UAS. The person creating an inspection program for a specific sUAS may find sufficient details to assist in the development of a suitable inspection program tailored to a specific sUAS in a variety of industry programs.

B.1.2 Scalable Preflight Inspection. The preflight check as part of the inspection program should include an appropriate UAS preflight inspection that is scalable to the UAS, program, and operation to be performed prior to each flight. An appropriate preflight inspection should encompass the entire system in order to determine a continued condition for safe operation prior to flight.

B.1.3 Title 14 CFR Part 43 Appendix D Guidelines. Another option and best practice may include the applicable portions of part 43 appendix D as an inspection guideline correlating to the UA only. System-related equipment, such as, but not limited to, the CS, data link, payload, or support equipment, are not included in the list in appendix D. Therefore, these items should be included in a comprehensive inspection program for the UAS.

B.1.4 Preflight Inspection Items. Even if the sUAS manufacturer has a written preflight inspection procedure, it is recommended that the PIC ensure that the following items are incorporated into the preflight inspection procedure required by the Blanket COA to help the PIC determine that

the sUAS is in a condition for safe operation. A preflight inspection, and subsequent flight tests to verify correct operation should include a visual or functional check of the following items:

1. Availability of required personal protective equipment (Sunglasses, gloves, reflective vests as required for the day of the operation).
2. Visual condition inspection of the UAS components;
3. Airframe structure (including undercarriage), all flight control surfaces, and linkages;
4. Inspection for fatigue cracks on structural components;
5. Registration markings, for proper display and legibility;
6. Moveable control surface(s), including airframe attachment point(s);
7. Servo motor(s), including attachment point(s);
8. Propulsion system, including powerplant(s), propeller(s), rotor(s), ducted fan(s), etc.;
9. Verify all systems (e.g., aircraft and control unit) have an adequate energy supply for the intended operation and are functioning properly;
10. Avionics, including control link transceiver, communication/navigation equipment, and antenna(s);
11. Calibrate UAS compass prior to any flight;
12. Control link transceiver, communication/navigation data link transceiver, and antenna(s);
13. Display panel, if used, is functioning properly;
14. Check ground support equipment, including takeoff and landing systems, for proper operation;
15. Check that control link correct functionality is established between the aircraft and the CS;
16. Check for correct movement of control surfaces using the CS;
17. Check onboard navigation and communication data links;
18. Check default behavior of the flight termination system, if installed;
19. Verify that the correct type and quantity of fuel/battery will supply power to the aircraft;
20. Check battery levels for the aircraft and CS;
21. Check that any equipment, such as a camera, is securely attached;
22. Verify communication with UAS and that the UAS has acquired GPS location from at least four satellites;

23. Start the UAS propellers to inspect for any imbalance or irregular operation;
24. Verify all controller operation for heading and altitude;
25. If required by flight path walk through, verify any noted obstructions that may interfere with the UAS; and
26. At a controlled low altitude, fly within range of any interference and recheck all controls and stability

Common sUAS Repair Items

C.1 In the interest of assisting varying background levels of sUAS knowledge and skill, below is a chart offering conditions that, if noticed during a preflight inspection or check, may support a determination that the UAS is not in a condition for safe operation. Further inspection to identify the scope of damage and extent of possible repair needed to remedy the unsafe condition may be necessary prior to flight.

Table A-1. sUAS Condition Chart

Conditions that may be found may include, but are not limited to, the following:

Condition	Action
1. Structural or skin cracking	Further inspect to determine scope of damage and existence of possible hidden damage that may compromise structural integrity. Assess the need and extent of repairs that may be needed for continued safe flight operations.
2. Delamination of bonded surfaces	Further inspect to determine scope of damage and existence of possible hidden damage that may compromise structural integrity. Assess the need and extent of repairs that may be needed for continued safe flight operations.
3. Liquid or gel leakage	Further inspect to determine source of the leakage. This condition may pose a risk of fire resulting in extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
4. Strong fuel smell	Further inspect to determine source of the smell. Leakage exiting the aircraft may be present and/or accumulating within a sealed compartment. This condition may pose a risk of fire resulting in extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
5. Smell of electrical burning or arcing	Further inspect to determine source of the possible electrical malfunction. An electrical hazard may pose a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
6. Visual indications of electrical burning or arcing (black	Further inspect to determine source of the possible electrical malfunction. An electrical hazard may pose a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe

soot tracings, sparking)	flight operations.
7. Noticeable sound (decibel) change during operation by the propulsion system	Further inspect entire aircraft with emphasis on the propulsion system components (i.e., motors and propellers) for damage and/or diminished performance. Assess the need and extent of repairs that may be needed for continued safe flight operations.
8. Control inputs not synchronized or delayed	Discontinue flight and/or avoid further flight operations until further inspection and testing of the control link between the ground control unit and the aircraft. Ensure accurate control communications are established and reliable prior to further flight to circumvent possible loss of control resulting in the risk of a collision or flyaway. Assess the need and extent of repairs that may be needed for continued safe flight operations.
9. Battery casing distorted (bulging)	Further inspect to determine integrity of the battery as a reliable power source. Distorted battery casings may indicate impending failure resulting in abrupt power loss and/or explosion. An electrical hazard may be present, posing a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
10. Diminishing flight time capability (electric powered propulsion systems)	Further inspect to determine integrity of the battery as a reliable power source. Diminishing battery capacity may indicate impending failure due to exhausted service life, internal, or external damage. An electrical hazard may be present, posing a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
11. Loose or missing hardware/fasteners	Further inspect to determine structural integrity of the aircraft and/or components with loose or missing hardware/fasteners. Loose or missing hardware/fasteners may pose a risk of negatively impacting flight characteristics, structural failure of the aircraft, dropped objects, loss of the aircraft, and risk to persons and property on the grounds. For continued safe flight operations, secure loose hardware/fasteners. Replace loose hardware/fasteners that cannot be secured. Replace missing hardware/fasteners.

Document Change Log

Revision 1.0 12/20/2016	Final Document Prepared
Revision 1.1 1/18/2017	Adjusted Document Formatting, Spacing Issues.
Revision 1.2 1/25/2017	Added job roles, responsibilities, and descriptions for each person involved in the operation. Added a signatory line for all persons involved in the operation. Placed Emergency Procedures into its own section. Updated Lost Link Procedures. Added signatory page into end of the document.
Revision 1.3 4/5/2017	Added the requirement to track all payload configurations as defined in the Airworthiness section of the Blanket COA documentation. Added a requirement to notify surrounding airports that fall outside of the defined Blanket COA guidelines if operations will be recurring over several days, ex: flights over the main Argonne campus.
Revision 1.4 1/26/2018	Embedded references to the 2017-AHQ-901-COA and required compliance items. Updated descriptions of PIC, VO. Added text that permits night operations, operation from a moving vehicle, in addition to "FPV" and "See-and-Avoid" requirements. Added alternative compliance methods for flights over persons as listed in the 2017-AHQ-901-COA.

Signatures

By signing below, you certify that you have read this documentation and that you know and understand the meaning and intent within. You are entering this agreement knowingly and voluntarily. Note: Significant revisions beyond punctuation or formatting errors may require the collection of new signatures. A summary highlighting the date and content of these major changes will be provided at the end of this documentation for quick reference.

Argonne UAS Flight and Ground Crew			
Printed Name	**Positions to Serve**	**Signature**	**Date**

OFFSITE AVIATION SAFETY PLAN, February 2018
SMALL UNMANNED AIRCRAFT SYSTEMS

2017-AHQ-901-COA
COA-WSA-191-COA

Argonne National Laboratory

Scope

This plan documents safety requirements for operating small Unmanned Aircraft Systems (sUAS) within the National Airspace System for the purposes of conducting the following operations: demonstration/currency flights, infrastructure inspections, sensor and airframe development, emergency response to incidents, disaster planning and response, fire operations, hazmat response, damage assessment, preparedness and response exercises, search and rescue, security and surveillance, critical infrastructure analysis support, emergency communications, special event planning and operations, transportation infrastructure analysis, demonstration flights and sensor/airframe development.

Background Information

Executive Summary:

Argonne proposes to operate small Unmanned Aircraft Systems (sUAS) from a multitude of locations within the National Airspace System. This Safety Plan documents the basis for how Argonne will provide an adequate separation of sUAS from commercial and general aviation traffic as well as furnish an adequate level of safety for the employees of Argonne, on-site contractors, and the general public. This Safety Plan embraces the concept of defense in depth that employs layers of engineered and administrative controls to create a working envelope that adequately reduces the probability of a sUAS having an accident (i.e. with unacceptable consequences) to extremely small levels. The goal of all who may be involved in the operation should be to identify, mitigate, and ensure that the risk is acceptable for the given mission purpose.

This document is designed to identify and disclose known and specific hazards and procedures to mitigate such risks while operating a Small Unmanned Aircraft System (sUAS) for demo/currency flights, infrastructure inspections, sensor & airframe development, and/or emergency operation support. Information was derived and constructed with respect to the requirements of *Blanket Area Public Agency COA 2016-WSA-191-COA issued to the Department of Energy (DOE), and Blanket Area sUAS Class G COA (DOE) 2017-AHQ-901-COA issued to the Department of Energy (DOE).*

It should be noted that this document is not designed to be a stand-alone document, but rather to be used in conjunction with each sUAS vendor's Aircraft Flight Manual/Pilot Operating Handbook (AFM/POH), the Argonne National Laboratory sUAS Airworthiness Statement, the FAA-approved Argonne COAs, and other documentation as required to operate legally, under developed authorizations, and accepted guidance. Operators must ensure that the risk mitigation methodology as defined below will not compete with established procedures by the aircraft manufacturer. Whenever possible, the more restrictive operating standard must be adopted to reduce potential operational risk.

Identified Hazards and Consequence:

The inherent hazard associated with operating a sUAS within the National Airspace System is twofold. The sUAS conceivably could result in a midair collision with a general aviation or commercial aircraft resulting

in a subsequent crash, and/or a sUAS could crash into an urbanized or densely populated area. Any failure of the primary power supply will in most cases cause an uncontrolled descent of the Unmanned Aircraft (UA) to occur. Due to the limited speed, weight, and size of these systems, an uncontrolled and unpowered collision with terrain, structures, or persons will result in minimal risk to persons or property, other than the UA itself. Aircraft operated under the Blanket Certificate of Authorization will include many advanced safety features designed to make the operation as safe as possible for both urban and non-urban environments. This includes but is not limited to built-in fault handling which allows the sUAS to detect a system fault while in the air, and to automatically fly back to its take-off location and land without any input from the operator. Faults that can be detected can include, but are not limited to: loss of communication, pre-set wind thresholds exceeded, sensor failures, trim configuration, penetration of airspace by other manned aircraft, as well as low battery levels. For these reasons, the likelihood of a collision with structures/persons on the surface resulting in damage during normal operation is believed to be very low.

Risk Mitigation:

Standard Operating Procedures

Offsite operations can introduce a number of challenges to the operator in their ability to succeed in the identification and mitigation of risks when compared to the access-controlled Laboratory environment. The following information is designed to assist the operator with a series of best-practices in a chronological list to ensure the safety of people on the ground, as well as the unmanned aircraft itself.

1. A review of federal airspace to determine legality and safety must be conducted prior to operation. This includes the development of a worksheet that provides rapid access to air traffic facilities for each location of proposed operation. These include air traffic controllers, approach/departure controllers, and or other airspace users during special events. This information must be summarized within documentation that is readily accessible to the Pilot in Command, the Visual Observer, and any other required crewmember involved in the operation in the event of a Loss Link, Loss of Visual Line of Sight, or other emergency.

2. Complete a review of state and local laws to determine applicability to the mission. Coordinate with the respective authorities if required to complete any associated paperwork or disclosures if required.

3. Coordinate with the land owner, or authorized representative to receive written authorization for the proposed activities with unmanned aircraft systems at the site of intended launch and recovery. This permission must be archived for later review if required.

4. Coordination with the land owner or authorized representative who is most familiar with the area should be requested to assist with the identification of hazards to the operator while transiting in vehicle, on foot, or in preparation for aircraft launch/recovery. Information about the type of aircraft to be operated, the location and time of proposed flights, and other useful information should be conveyed in an effort to minimize the risk to those who might not be directly involved in the operation.

5. Roles and responsibilities will be identified and delegated for each person involved in the operation of the aircraft, and site-specific activities.

6. The appropriate supervisors of the Pilot-in-Command, Visual Observer, and other participants in the proposed aerial activity should be notified. These include the notification of the Project Manager, the Argonne Aviation Safety Officer, and other parties as required if the proposed activities should occur to ensure continuity of the mission.

7. If specific procedures, guidance, or reference materials have not been provided by the land owner, persons involved in the operation should refer to the Work Planning and Control (WPC) documentation for a specific mission, in addition to best judgement to ensure the continued safety of the mission.

8. A general survey of the site should be completed using the latest digital imagery available (satellite or UAS based) and attempt to identify a method of separating the proposed launch/recovery point from non-participants. A survey should be completed to determine if the flight of the aircraft has the potential to fly closer than 500 feet from non-participating buildings, structures, or persons. If the flight is in support of an event to necessary to safeguard human life, the aircraft must not operate to create a danger to persons on the surface, or to the sUAS per the established guidance found in the 2017-AHQ-901-COA. Emergency procedures should be modified to ensure that the aircraft remains clear of non-participants as much as safely possible. The Pilot-in-Command should remember that particular hazards - to include a survey of power infrastructure, trees, and other obstructions – may only be identified while onsite.

9. In all scenarios, a consideration of physical barriers, obstructions, and other resources to protect the operation, restrict access to the launch/recovery, mission area, and other essential equipment is required.

Controls

Argonne will provide adequate separation of its sUAS from commercial and general aviation traffic, provide sufficient margin from operating over residential areas, and avoid populated areas of the Argonne campus through a combination of both *engineered* and *administrative* controls. These controls will reduce the probability of an accident involving an Argonne sUAS from remote to extremely unlikely levels thereby resulting in a residual risk that is acceptably small.

The following *administrative* controls will be used to ensure safe operation of sUAS over the Argonne campus:

- sUAS flights will be limited to 400 ft. AGL for operations under the COA-WSA-191-COA, and no higher than 700 ft. AGL under the 2017-AHQ-901-COA and will remain within Class G airspace in both circumstances;
- All flight operations will be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures, unless it is necessary to safeguard human life;
- Whenever possible the operator will employ geofencing restrictions on the operation of the sUAS to ensure that the aircraft remains within a predefined area.

- NOTAM will be filed with the FAA 24-48 hours in advance of sUAS operations over the Argonne campus*;
- sUAS flights will be limited to Visual Flight Rules (VFR) weather conditions during daylight hours for operations conducted under the 2016-WSA-191-COA. Operations at night will be limited to VFR weather conditions and must abide by the equipage and personnel requirements found within the 2017-AHQ-901-COA;
- Airworthiness has been established, tested, and certified by the manufacturer of each sUAS;
- sUAS flights will be conducted in accordance with a sUAS Aircraft Flight Manual/Pilot's Operating Handbook (AFM/POH), or other documentation as provided by the manufacturer of the sUAS;
- Pilot-In-Command (PIC) of the sUAS flights will be certificated as (at least) a Remote Pilot / Private Pilot certificate and maintain a current Third Class Medical Certificate;
- PIC will practice "see and avoid" practices in accordance with 14 CFR 91;
- PIC has been trained and qualified on the operation of the designated sUAS;
- Trained Visual Observers (VOs) that are in direct communication with PIC will be used on sUAS flights;
- Visual Observers will have Third Class medical certificates;
- Lost link procedures (described below) will address instances where communication links between the sUA portion of the sUAS and the PIC have been lost;
- sUAs will be operated within "visual-line-of-sight". This distance may vary based on the design and location of the operator, but this distance should not exceed ½ statute mile (SM);

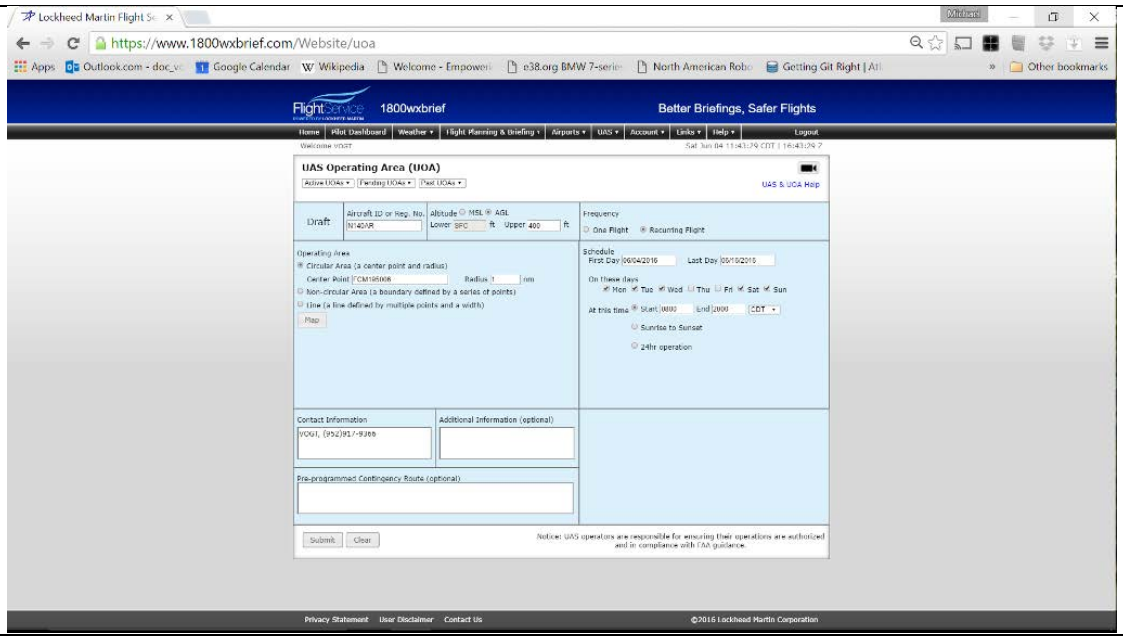
*Pre-Flight Reporting and NOTAM Filing

The following *engineered* controls will be used to support safe operation of sUAS over the Argonne campus:

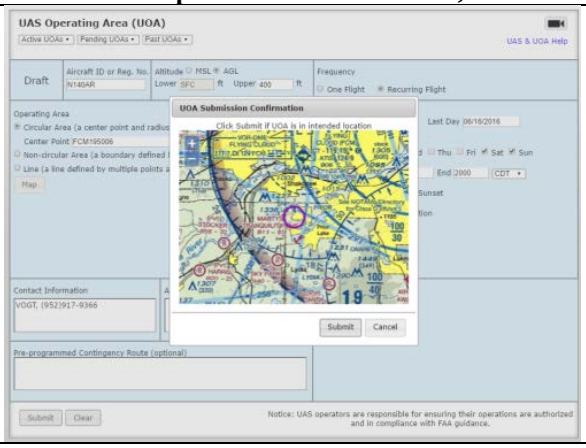
- sUAS designated for this COA are small tabletop aircraft that consist of lightweight materials (typically < 6 lbs, with the largest weighing potentially weighing 55 lbs);
- sUAS are typically powered by Lithium Polymer (LiPo) batteries that have an intentionally *limited capacity* to support powered flight that would by definition handicap errant flight outside of authorized COA airspace. LiPo batteries will be charged in a LiPo Guard or equivalent bag;
- sUAS are controlled remotely by the PIC who has the option of controlling flight manually or via preprogrammed flight paths along waypoints using a Ground Control System (GCS) that receives telemetry feeds from the GPS system and wireless links;
- A GPS receiver, magnetic compass, barometer, or a combination thereof is located on each sUAS that provides accurate location and altitude information to the PIC and to enhance the level of safety.
- Return to Launch (RTL) commands can be used by the PIC under certain unexpected conditions to interrupt preprogrammed flight to return to the launch location.

Airspace Environment:

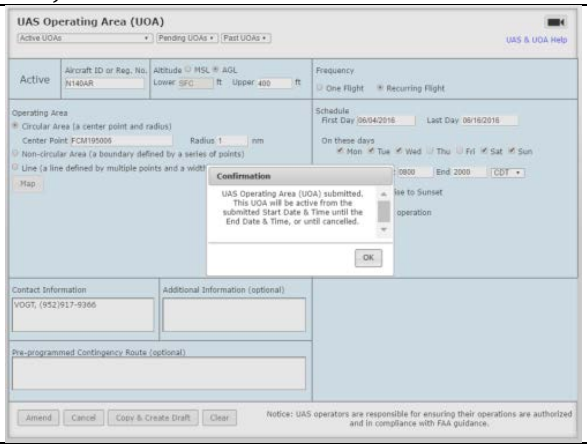
Prior to the operation of any sUAS for any mission at any location, the sUAS Pilot In Command (PIC, or designated alternate) will file a formal Notice to Airmen (NOTAM) with the FAA (via Lockheed Martin 1-800/WX-BRIEF or NOTAM Flight Service Station at 1-877/4-US-NTMS) 24-48 hrs prior to each planned day of operation. The submittal of a NOTAM through a Flight Service Station should be used as the preferred option.



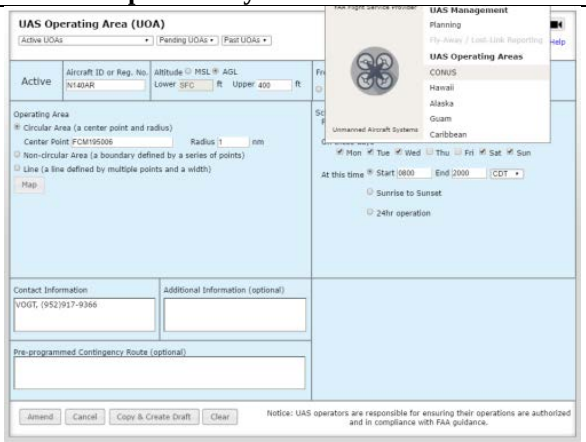
Step 1 – fill out aircraft info, date and duration, and aeronautical chart reference.



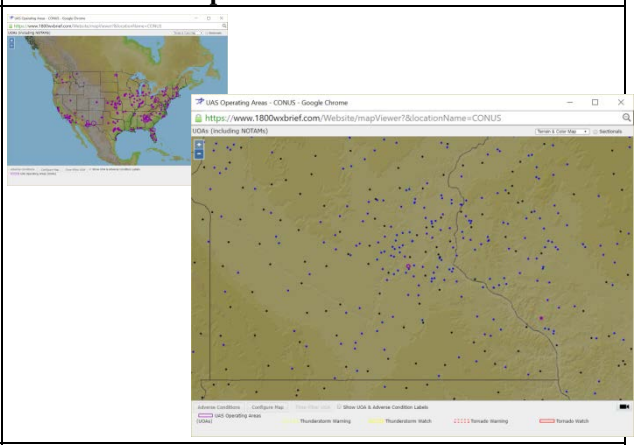
Step 2 – verify nav chart reference.



Step 3 – UOA is defined.



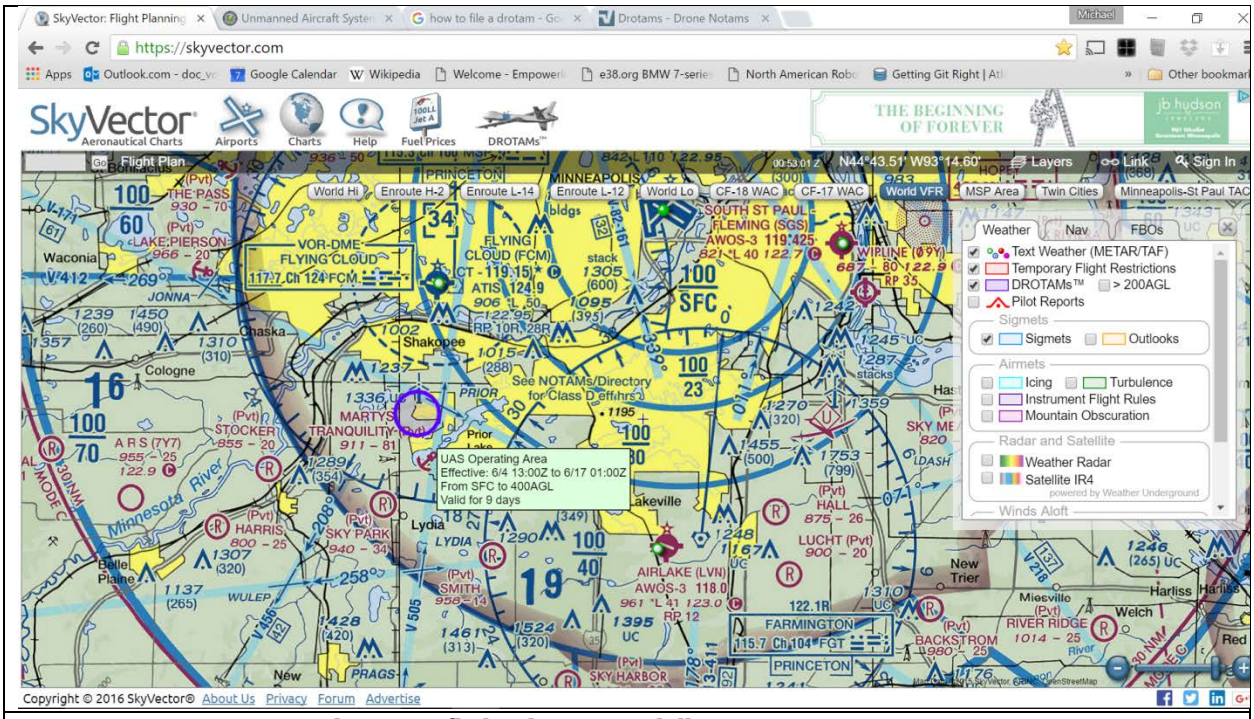
Step 4 – Inspect other UAS UOA's.



Step 5 – Verify UOA demarcation.

If used, Lockheed Martin has made inspecting the Flight Services and filing a NOTAM a simple procedure. Some hints are provided to use proper FAA phrase-ology in defining the location of the desired unmanned aircraft Operating Area (UOA), but a simple radio button interface is used to define the duration. The calendar settings automatically send out NOTAMs that satisfy the FAA requirements for preceding the event. For convenience, more than a week at a time and repeated events can be scheduled.

A separate flight planning service, SkyVector https://skyvector.com, inherits the data for UAS NOTAMs and displays it superimposed over standardized aeronautical navigation charts. This improves the interpretation of each DROTAM schedule and area coverage.



SkyVector flight planning tool illustrating DROTAMs

ATC Communications

During UAS operations, the PIC must possess a minimum of two methods of communication: (1) The PIC must have access to a portable/handheld radio and monitor and announce operations on the appropriate Unicom/CTAF/Tower frequencies to alert manned pilots of UAS operations with a radio equivalent to the ICOM radio mentioned below, and (2) The PIC must have access to a cell phone which has been preprogramed or contains a database of essential contacts in the event of an errant UAS. These phone numbers must include the local Approach/Departure facility, nearby airport control towers, and other uncontrolled airports as required.

Whenever possible, the PIC must use a radio which features a programmable memory to allow for the rapid toggle to certain frequencies the event of an emergency. The PIC must reference and store the latest aeronautical information as published by the Federal Aviation Administration.

	• **VOR reception with CDI display** • **DVOR function shows the radial to or from the VOR** • **Duplex operation (listen on NAV, talk on COM)** • **200 memory channels** • **Dedicated 121.5 emergency key** • **NOAA weather stations** • **Receives and transmits 118.000-136.975 MHz** • **Receives 108.000-117.975 MHz and 161.650-163.274 MHz**
ICM IC-A24 Aviation Transceiver Specifications	

Contingency Planning

All of the Argonne UAS employ some method of celestial-based navigation (typically GPS) as part of their avionics/autopilots. This grants the operator and the aircraft the capability to autonomously navigate to one more pre-determined stored waypoint - Home or the Launch Point that will be used in conjunction with the Return-to-Launch (RTL) command as a basic contingency maneuver.

These aircraft, which are typically hand-launched and skid-landed aircraft pose little threat to landing on any open ground whether having vegetative ground cover or man-made ground cover. As engineering controls, all of the initial sUAs are of a small size and light weight, also minimizing any potential for ground property damage resulting from an uncontrolled landing.

Within this manual, administrative and engineered controls do not require, or directly specify *specific* points at which the aircraft must land the aircraft in the event of a problem. Offsite operations pose a challenge for the Pilot-in-Command and Visual Observer to identify possible launch and recovery areas in the event of a Return to Home command is initiated. Prior to the launch of any aircraft, the Pilot-in-Command is required to identify a minimum of one primary launch and recovery area. An attempt should be made to identify another area that might be used as an alternative in the event of changing atmospheric conditions, or the primary recovery area becomes contaminated with debris, other persons, other aircraft, etc.

To ensure the continued safety of the mission specific procedures have been identified in the event of an aircraft's lost link, lost visual line of sight, or lost communication.

Lost Link Procedures:

a. In the event of lost link, the UA must initiate a flight maneuver that ensures timely landing of the aircraft. Lost link airborne operations shall be predictable and the UA shall remain within the defined operating area filed in the NOTAM for that specific operation. In the event that the UA leaves the defined operating area, and the flight track of the UA could potentially enter controlled airspace, the PIC will immediately contact the appropriate ATC facility having jurisdiction over the controlled airspace to advise them of the UASs last known altitude, speed, direction of flight and estimated flight time remaining and the Proponent's action to recover the UA.

b. The UA lost link will be programmed to ensure that lost link flight does not fly over persons and the landing location is within the view of the PIC.

c. Rally and home locations will be programmed to remain within the area defined in the NOTAM where flight operations are being conducted.

d. Lost link procedures will not transit or orbit over populated areas, Victor airways, or busy roadways/interstate highways.

e. Lost link procedures will be programmed to remain within the operations area and altitude, avoid unexpected turn-around and/or altitude changes, and will provide sufficient time to communicate with ATC if necessary.

Lost Visual Line of Sight:

If an observer loses sight of the UA, they must notify the PIC immediately. If the UA is visually reacquired promptly, the mission may continue. If not, the PIC will immediately execute the lost link procedures.

Lost Communications:

If communication is lost between the PIC and the observer(s), the PIC must immediately execute the lost link procedures.

Summary of Site Specific Requirements

Unless authorized by a special provision, all UAS operations under the Blanket COA at the Argonne UOA will be conducted only if all of the following conditions are met:

1) Interactions with appropriate supervisors to include the Aviation Safety Officer have been completed to ensure any mission-specific safety/cyber concerns are identified and addressed accordingly.
2) Coordination with the land owner or authorized representative who is most familiar with the area of proposed operations should be requested to assist with the identification of hazards to the operator while transiting in vehicle, on foot, or in preparation for aircraft launch/recovery.
3) The land owner or authorized representative will confirm that appropriate on-site staff at the location of proposed operation have been notified of the proposed operation and the purpose of the flight.
4) A notification should be issued near the same time as the Notice to Airman (NOTAM) is submitted to the Federal Aviation Administration. For non-emergencies, this notification should occur approximately 48-72 hours before the proposed operation as required.
5) Unnecessary exposure to persons on the surface is limited. Operations must be conducted away from populated areas, heavily trafficked roads, or open-air assembly of people to the greatest extent possible as permitted under the Blanket Certificate of Authorization. Aircraft shall not be operated closer than 500 feet to nonparticipating vessels, vehicles, and structures. Specific procedures must be followed as defined in the Blanket Certificate of Authorization for flights in close proximity to participants and nonparticipants.
6) Ensuring that flights will be conducted in "visual-line-of-sight" in Visual Meteorological Conditions (VMC) pertaining to the designated class of airspace. VMC are conditions in which pilots or operators have sufficient visibility to fly the aircraft maintaining visual separation from terrain and from other aircraft.
7) The entire operation will remain within uncontrolled, Class G airspace at an altitude not exceeding 400 or 1200 ft. AGL (Depending on the COA). Operators will ensure that the aircraft will maintain cloud clearance requirements as defined as less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.
8) Operations may only be conducted during daylight hours unless the aircraft is properly equipped with anti-collision lighting and the aircrew meets the requirements as necessary for safe operation. UAS daylight operations are those operations that occur between the beginning of morning civil twilight and the end of evening civil twilight, as published in the American Air Almanac, converted to local time. (Note: this is equal to approximately 30 minutes before sunrise until 30 minutes after sunset).
9) sUAS will be limited to 87 knots or less.
10) A preflight inspection will be conducted to ensure sUAS will be airworthy and in a condition for safe flight prior to each mission.
11) A configuration control program will be used to track replacement of sUAS hardware and software to ensure airworthiness of the sUAS.
12) Pilots will give way to manned aircraft at all times.

Airport/Facility Contacts Quick Reference

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Airport/Facility Name	IDENT
Frequencies/Phone Numbers	
Location Relative to Site	NORTH EAST SOUTH WEST DISTANCE
Airport Manager Name	
Other Information	

Document Change Log

Revision 1.0 9/20/2017	Draft document prepared. Revised to accompany for the recent minimum medical certificate change from a 2nd Class to a 3rd Class for PIC's and VO's
Revision 1.1 11/3/2017	Clarified ATC communication procedure in Standard Operating Procedures.
Revision 1.2 1/26/2018	Revised the document to include references to 2017-AHQ-901-COA. Changed maximum permitted altitude from 400 ft. to 1,200 ft. AGL so long as the aircraft remains within Class G airspace. Added language that permits night-time operation with an aircraft that is properly equipped and aircrew that is properly trained. Updated Lost Link Procedures to ensure compliance with both the 2017-AHQ-901-COA, and 2016-WSA-191-COA. Changed minimum pilot requirements from Private Pilot to Remote Pilot.
Revision 1.2.1 2/6/2018	Reversed the preferred the procedure for submitting a NOTAM, removed Peter Washburn as an approver.

Signatures

By signing below, you certify that you have read this documentation and that you know and understand the meaning and intent within. You are entering this agreement knowingly and voluntarily. Note: Significant revisions beyond punctuation or formatting errors may require the collection of new signatures. A summary highlighting the date and content of these major changes will be provided at the end of this documentation for quick reference.

Documentation Control			
Printed Name	**Role/Description**	**Signature**	**Date**
David Gartman	Preparer (EVS)		
Robert Johnson	Preparer (GSS)		
Matthew Kwiatkowski	Reviewer		

Argonne UAS Flight and Ground Crew			
Printed Name	**Role/Description**	**Signature**	**Date**