FESHM 10170: AVIATION SAFETY POLICY AND PROCEDURES

Revision History

Author	Description of Change	Revision Date
Chuck Morrison	Remove all references to Work Smart Standard	June 2022
Chuck Morrison	Added Appendix 5- UAS Aviation Safety Plan (ASP)	August 2021
Chuck Morrison	• Changed Time on Top (TOT) to Time of Takeoff. • Changed Security Operations Center to Security Operations Center (SOC). • avops@fnal.gov LISTSERVE link was removed.	June 2021
Chuck Morrison	ANL drone pilots are authorized to support FNAL under Public Agency sUAS COA #2020-CSA-5383-COA.	July 2020
Chuck Morrison	Updated the Introduction to add operations at SURF.	December 2017
Chuck Morrison	• Para 4.1.a.: A new (EZ) form will be submitted if the flight will not occur within the date range specified. • Form F10170 Revised.	March 2017
Chuck Morrison	• Spelled out the requirements for Unmanned Aircraft Systems (UAS) in Appendix 4. • Barnstormer President added as Assistant Aviation Safety Officer and UAS SME. • Appendix 4- Unmanned Aircraft Systems was added.	March 2016
Chuck Morrison	• Links were proved for forms and manuals. • Notifications Table was updated. • The Aviation Subcontractor Certification letter required from the CAS provider is obsolete. The Office of Aviation Mgmt. provides users with names of approved CAS providers. • The Fermilab Association of Rocketry no longer exists, all references were deleted. • Clarified the Reports requirement for the calendar. A reporting deadline to the Directorate was also entered. • The flow down of requirements to be added to purchase req.'s is included as Appendix 3 to implement DOE O 440.2 and the Chicago Office Aviation Implementation Document.	February 2014
Rafael Coll	Added FESHM Chapter formatting template and changes to the requisition/contracting of the CAS process. The flow diagram of the process was also updated.	December 2013

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1.0 INTRODUCTION

This policy applies to all organizations that request aviation services or sponsor events that may impact civilian aviation and those who arrange for and/or coordinate landings, over flights, passenger use of aircraft at Fermi and SURF. This policy also includes the request for Argonne National Laboratory (ANL) small, unmanned aircraft systems (sUAS/drone) support. The Directorate must approve any deviations from the policy described below.

This policy does not apply, in part or whole, to situations involving medical emergencies on site. In such cases, operational decisions (including choice of landing site) will be deferred to the discretion of the Fermilab Incident Commander. Instructions on handling medical evacuations can be found in the Fire Department emergency procedure FD-EO-320 (Medical Helicopter Evacuation Procedures).

This chapter only applies to the Fermilab site. Leased spaces will follow the rules and regulations set forth by the partnering institute and/or state or local codes and standards.

2.0 DEFINITIONS AND ACRONYMS

2.1 DEFINITIONS

Commercial Aviation Services (CAS) – Includes leased aircraft and aircraft chartered or rented for exclusive use.

Charter Aircraft – An aircraft operated and maintained by a commercial aviation service provider that is hired by Fermilab under a contractual agreement specifying performance and a one-time exclusive use.

Crew Member – A person assigned to operate or assist in operating an aircraft during flight time. Crew members perform duties directly related to the operation of the aircraft such as pilots, co-pilots flight engineers and navigators.

Flight Crew Member – A pilot, flight engineer, flight navigator or cabin safety personnel assigned to duty in an aircraft during flight time.

FOD Walk – Foreign Object Damage Walk is an activity whereas the landing area is inspected and debris is removed prior to landing a turbine powered aircraft in order to prevent damage to the compressor blades or to bystanders.

Government Aircraft – Any (Federal or Commercial Aviation Service) aircraft owned, leased, chartered, or rented by an executive agency other than a branch of the Armed Forces or an intelligence agency.

Mission – The objective that must be accomplished by the chartered flight. Anticipated Fermilab missions are aerial photography of the site and aerial surveillance of the deer population.

Passenger – Any individual on-board an aircraft who is not a flight crewmember, crewmember, or qualified non-crewmember.

Pilot in Command (PIC) – The PIC is, by Federal Aviation Regulations (FARs), responsible for the safe operation of the flight (FAR 1.1, 91.3).

Qualified Non-Crew Member – A person flying onboard a Government aircraft whose skills, duties or expertise are essential to performing, or associated with performing the (non-travel related) Governmental mission requirement for which the aircraft was dispatched. Qualified non-crew members may be researchers, electronic technicians, system operators, photographers, emergency medical personnel, biologists, etc.

Small Unmanned Aircraft System (sUAS) – An unmanned aircraft weighing less than 55 pounds on takeoff, including everything that is onboard or attached to the aircraft.

Unmanned Aircraft Systems & Unmanned Aerial Vehicles – Colloquially known as a drone, is an aircraft without a human pilot on board. Its flight is controlled either autonomously by computers in the vehicle or under the remote control of a pilot on the ground or in another vehicle.

2.2 ACRONYMS

ANL – Argonne National Laboratory
ASO – Aviation Safety Officer
CAS – Commercial Aviation Services
CFR – Code of Federal Regulations
CSO – Chief Safety Officer
ETA – Estimated Time of Arrival
FOD – Foreign Object Damage
PDF – Portable Document Format
PIC – Pilot in Command
sUAS – Small Unmanned Aircraft System
TOT – Time of Takeoff
UAS – Unmanned Aircraft Systems
UAV – Unmanned Aerial Vehicles

3.0 RESPONSIBILITIES

3.1 Chief Safety Officer

- Provides management and implementation of DOE Aviation Safety Orders and Standards as provided.
- Appoints the Aviation Safety Officer.

3.2 Aviation Safety Officer & Assistant Aviation Safety Officer

- Implements this manual. Submit quarterly reports to the Fermi Site Office detailing aviation activities for quarters where aviation missions were flown, that are subject to these reporting requirements.
- A member of the Fermilab Barnstormers radio control model club, Academy of Model Aeronautics Charter #616 shall serve as Alternate Aviation Safety Officer.

4.0 PROCEDURES

4.1 Approvals

a. Any organization that arranges for or coordinates the use of aircraft or sUAS will initiate and complete a Flight Request and Mission Profile (EZ) form and shall comply with all lead times as specified on the form. This form can be obtained from the ESH Section web page DocDB link as a PDF file. A new (EZ) form will be submitted if the flight will not occur within the date range specified. This form also identifies mission flight hazards and provides controls. The CAS or sUAS PIC will sign the Form F10170, in the space indicating contact will be maintained with the DuPage Tower and flight below 500 ft. AGL over Fermilab is prohibited, except for approved landing, accident avoidance, emergency landing or sUAS flights. The PIC will return the signed form to the requester, prior to routing for approvals. The mission details will be coordinated with and evaluated by the Fermilab ASO, reviewed by the Chief Safety Officer and submitted for approval to the Director. Once approved by the Director, the form shall be forwarded to the DOE-FSO Office for a final approval. Upon their approval, the purchase of CAS may occur. There is no cost for ANL sUAS support flights under the Bilateral DOE Laboratory Utilization User Agreement.

b. Once completed, the form must be forwarded to ESH Admin at MS-119 (WH7E) for processing. See the Appendix 1- Aviation Mission Flow Chart at the end of this chapter for a pictorial of the process.

c. ESH Section Admin will post all directorate approved missions in PDF to the ESH web page under DocDB Document #434 and will notify all parties that a new mission profile is posted.

4.2 Notifications

Any organization who arranges for or coordinates the use of aircraft shall notify various groups of the impending operation. Notification shall be made through the ASO, as soon as the requester receives the information and no later than twenty-four (24) hours before TOT. Provide mission profile, type of aircraft & tail number and estimated time of arrival of the aircraft. See the Notification Table below.

Office	Email/Phone number or extension
DOE-ASO (24 hr. notice)	Peter.Washburn@science.doe.gov
DOE- FSO Safety	John.scott@ch.doe.gov/Ext. 3281
DOE- FSO Safeguards & Security	David.chovancek@science.doe.gov
COO	Ext. 4287
ESH Chief Safety Officer	Ext. 2977
Fermilab Security Chief	Ext. 8041
Fermilab Fire Department	Ext. 3428
Security Operations Center/Security	Ext. 3414
ESH Section Admin	ESH_Admin@fnal.gov/ Ext. 5811
Office of Communications	Ext. 3351

4.3 Aviation Service Purchase Order Preparation

Before entering into a purchase order to charter aircraft of any type from a CAS provider, the selected service must be authorized by the DOE Office of Aviation Management; maintain an Argus Gold rating or higher; maintain a Wyvern rating; or be approved by US Department of Defense (DoD). The name of the aviation services provider must appear in the list of providers found in the spreadsheet. The latest spreadsheet can be found published in the DOE-HQ Aviation Management Office website. This applies to providers operating under 14CFR Part 91 and 135 but excludes scheduled air carriers operating under 14 CFR Part 121.

***Note**: Third party CAS providers are included even though Fermilab may not have a direct business relationship or a direct contract for the purchase of services. For example, a photographer is hired by Fermilab who in turn hires a CAS provider. The CAS provider must be in the authorized US DOE CAS Accepted Operators list, or have a Wyvern or Argus Gold rating or higher, or be previously approved by DoD. AM Air Service of Schaumburg maintains an Argus Gold Rating and are recommended* AM Air Service LLC website.

a. Unless otherwise specified, all aviation operations purchased will be conducted during daylight hours and will strictly adhere to, and comply with, VFR FAA Regulations.

b. Before mission operations commence, the person responsible for the aviation charter-service purchase will obtain the model of the aircraft, tail number, name of the aircraft operator and telephone number, name of the pilot in command and the estimated time of arrival at Fermilab. This will allow for any last-minute coordination in case of changing conditions.

c. Fermilab employees, users and visitors will not ride as passengers in aircraft doing work for Fermilab or a Fermilab subcontractor unless previously authorized as "essential" by the Directorate. List mission essential employees by name and employee number in the back of Form F10170/1 in the space provided for DOE ASSOCIATED PERSONS ON BOARD.

d. All Fermilab employees who are qualified non-crewmembers and on chartered aircraft will be required to receive a passenger safety briefing given by the Pilot-in-Command (PIC) prior to flight. See requirements flow down in Appendix 3.

e. When Procurement places a purchase order that includes the use of a helicopter, every attempt shall be made to make use of the nearby DuPage Airport facility and avoid landings and takeoffs from the Fermilab site unless prior authorization is granted by the Directorate with the approval of the Flight Request and Mission Profile form.

f. The purchase order will include a copy of the Flight Request and Mission Profile (EZ) form and Appendix 3 requirements. Purchase order will be sent to DOE-FSO for final approval before it is returned to Procurement to complete the purchase of the services.

5.0 DESIGNATED LANDING SITE

There are no facilities to land fixed wing aircraft at Fermilab. Such operations will utilize the facilities of one of several local municipal airfields.

The Anthony Frelo Field, commonly called the Barnstormers Field on Old Batavia Road, geographical coordinates N41˚ 51' 03"x W88˚ 15' 25", is designated as the Fermilab helicopter landing site. A

secondary landing site is the paved area or grassy strip east of the Firehouse, where enhanced firefighting capabilities are available. For safety and support reasons, only the designated locations described in this procedure are to be used for helicopter landings and takeoffs other than landings for Medevac training as stated under Section 6.0 of this procedure.

Emergency Medevac helicopters can land on any open area on Fermilab property designated by the Incident Commander to expedite extrication of an injured party. All safety procedures must be observed. Close coordination between the Fire Department and the Security Department is of the utmost importance to protect bystanders and other vehicular traffic during the resolution of the emergency.

6.0 HELICOPTER MEDEVAC TRAINING FOR FIRE DEPARTMENT PERSONNEL

Periodically, Fire Department personnel require refresher training on Medevac procedures for seriously injured patients. This training is designed to hone skills in landing, loading and coordination/assistance to flight medical personnel. This is accomplished by arranging visits from the various air ambulance services that operate in the Chicagoland area such as Rush-Presbyterian, the University of Chicago system and the Northern Illinois Medical Center. Fermilab supports and encourages these visits.

Note: The Fire Chief is given authorization to arrange for Medevac visits as necessary and to land a helicopter on Frelo Field or adjacent to the fire station, in lieu of the Flight Request process, as long as the mission is coordinated with the ASO and the following conditions are met:

a. Flight conditions must be VFR (Visual Flight Rules).

b. The Fermilab Fire Chief or Battalion Chief will make notifications using the contacts in the Notifications Table as soon as the information becomes available (See requirements under the NOTIFICATIONS paragraph 4.2).

c. No Fermilab employee is allowed to ride on the helicopter unless specifically authorized in writing by the Directorate.

d. The Security Operations Center will notify Security.

e. If the mission profile changes due to weather or other external emergencies notification must be made again to the Security Operations Center as soon as the change occurs. The Security Operations Center will then notify Security of the change in mission profile.

f. Preparation for on-site helicopter landings and takeoffs- The Fermilab ESH Guideline Appendix 2- “Helicopter Landings SOP” at the end of this chapter will be followed in preparation for helicopter landings and takeoffs.

7.0 OFFICE OF COMMUNICATIONS

When contacted by news organizations, helicopter or fixed wing aircraft flights by these or other organizations wishing to loiter over Fermilab airspace must be made aware of Notice to Airmen (NOTAM) FDC 4/0811. This NOTAM advises pilots to avoid the airspace above, or in proximity to sites such as power plants (Nuclear, Hydro-Electric or Coal), Dams, Refineries, Industrial Complexes, Military Facilities and other similar facilities. Fermilab is considered an industrial complex.

Loitering may trigger an intercept by military aircraft. If intercepted, pilots must follow the procedures in the FAA Airman Information Manual (AIM) Chapter 5, Section 6, Paragraph 5-6-2. It is recommended that these operators maintain radio contact with the nearest Flight Service Station or air traffic control facility and advise them of their activities to avoid a possible intercept.

8.0 REPORTS

8.1 Commercial Aviation Services User

Once the aviation services are provided and paid for, the requester shall forward to the Aviation Safety Officer MS-119 (WH7E ES&H) a report with the data elements stated below, a copy of the purchase requisition and a copy of the invoice from the CAS provider:

Data Element	Definition
(m)= mandatory data element. All other elements may be reported if the information is available.	
Agreement Begin Date (m)	Date on which the type of service that includes use of charter aircraft, contract aircraft, rental aircraft, and related activities in support of an executive agency, starts.
Agreement Comment	Relevant remarks which add clarifications to the aircraft CAS Cost and Hours Flown information.
Agreement End Date	Date on which the type of service that includes use of charter aircraft, contract aircraft, rental aircraft, and related activities in support of an executive agency, ends.
Agreement Number	Reference number for the type of service that includes use of charter aircraft, contract aircraft, rental aircraft, and related activities in support of an executive agency.
Agreement Type (m)	Indicates the type of commercial aviation service in support of an executive agency, i.e. charter, full service contract, rental, ISSA, and lease.

Flight Time (m)	The amount of time, expressed in hours and tenths of an hour, from when the aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing.
Alert Ground Utilization Time (new)	That time, expressed in hours and tenths of an hour, an Alert Aircraft is: 1. Airworthy and not being utilized to meet other program needs, 2. Not undergoing any maintenance (including inspection), modification, testing, calibration or alteration. **Alert Aircraft:** An operational government aircraft that is configured (including any mission equipment) and dedicated to meet a mission that requires a rapid response with a flight crew and essential personnel, if applicable, readily available for departure.
In-House Cost	Operating expenses provided by the using Government agency that benefits from the commercial service, such as pilot and fuel expenses. For ISSA agreement, in addition to reporting the in-house costs, the benefiting (operating) agency/bureau must report all costs (fuel, crew, etc.) incurred to the owning agency/bureau that, in turn, will report these costs to FAIRS.
ISSA Vendor Agency	Identifies any executive department or independent establishment in the executive branch of the Government, including any wholly owned Government corporation, which is providing the service, i.e., the ISSA provider (Federal). (Only use for agreement type, ISSA)
ISSA Vendor Bureau/Office/Service	Identifies the reporting subunit within the executive agency, i.e., the ISSA provider.
Manufacturer (m)	Identifies the original manufacturer of the aircraft as designated on the aircraft data plate.
Mission (m)	Represents the principal purpose for which the aircraft was dispatched. One mission may be designated per sortie (one takeoff and landing).
Model (m)	Identifies the model of the aircraft as designated on the aircraft data plate.

Paid-Out Cost (m)	Operating expenses paid out to commercial or other Government agency providers of the CAS. Paid-out costs include operations and administrative overhead costs allocated to the CAS.
Registration Mark	3. Identifies the unique identification mark--usually numbers and letters--displayed on Government aircraft (including foreign aircraft hired as CAS). "Tail number" is commonly used for "registration mark". For Fermilab purposes use the aircraft registration number.
Report Period Begin Date (m)	4. Beginning date of the period for which the CAS or Fleet Aircraft cost and hours flown data are submitted. This is the date for which agency costs begin to accrue, regardless of ownership or other agency use.
Report Period End Date(m)	Ending date of the period for which the CAS or Fleet Aircraft cost and hours flown data are submitted. This is the date for which agency costs cease to accrue, regardless of when paid or disbursed.
Vendor Name	Name of vendor hired to perform mission.
Vendor Location	Location of vendor hired to perform mission.

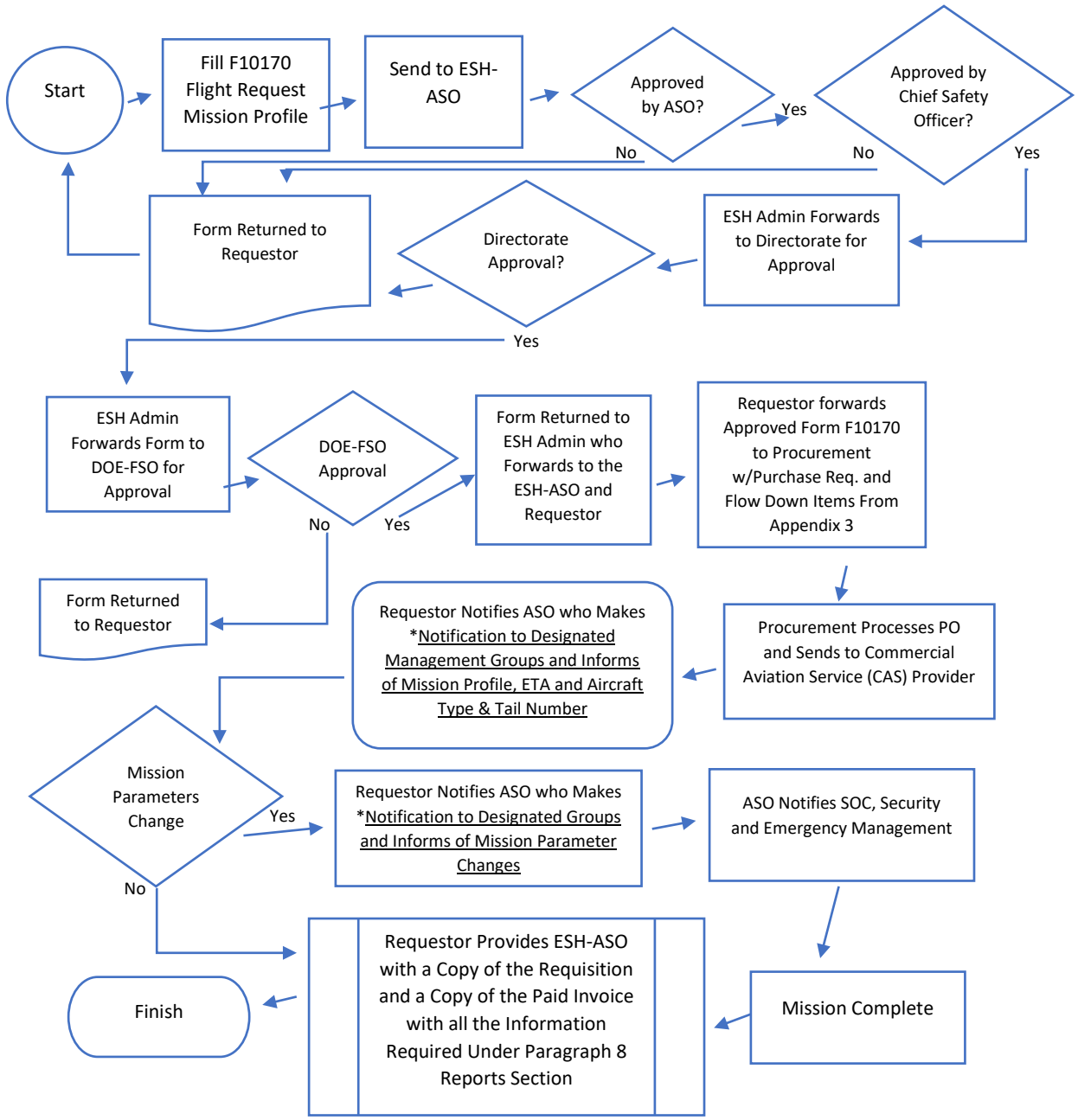
8.2 Aviation Safety Officer Reports

The Aviation Safety Officer will submit quarterly reports to the DOE- Fermi Site Office detailing aviation activities for the prior three months. Quarterly reports are based on fiscal year quarters. These reports are due to the Directorate within seven (7) calendar days after the quarter ends. **Only quarters where aviation missions were flown are subjected to these reporting requirements**. UAS missions flown under 14 CFR Part 107 are not subject to this report.

9.0 OTHER RELATED DOCUMENTS AND DIRECTIVES

- DOE O 440.2 (latest rev)- Aviation Management and Safety
- DOE CAS Providers Approved List
- 14 CFR Part 107 Small Unmanned Aircraft Systems

10.0 APPENDIX 1- AVIATION MISSION PROFILE FLOW DIAGRAM



11.0 APPENDIX 2- HELICOPTER LANDINGS STANDARD OPERATING PROCEDURE (SOP)

1. Purpose

To establish and coordinate support operations for implementing the Fermilab Aviation Safety Policy.

2. Scope

These procedures outline the responsibilities of Fire, Security and Security Operations Center personnel as they relate to helicopter routine overflights, landings and takeoffs at the Fermilab site.

3. Designated Landing Sites

The Anthony Frelo Field, commonly called the Barnstormers Field, on Old Batavia Road, geographical coordinates N41°51’ 03”x W88° 15’ 25”, is designated as the preferred Fermilab helicopter landing site. A secondary site is the paved road in front of the Fermilab Fire House or the grassy area located immediately east of the fire house.

4. Operational Responsibilities

   a. When notified of a planned helicopter landing, the Fermilab employee who requested the services will advise the Security Operations Center of the details of the operation.

   b. The Security Operations Center will notify the Security Department.

   c. The Fire Department On-Duty Battalion Chief will detail a minimum of one firefighting vehicle, a driver and a firefighter to be present at the helicopter landing site 15 minutes before the scheduled landing and at all times during takeoffs. Prior to landing, the Fire Department Battalion Chief with the assistance of a Security detail, will ensure the area is clear of any foreign objects that may cause damage or injury to personnel if blown by the rotor wash during landing or takeoff. This is a FOD walk.

5. Security Department SOPs

   a. A minimum of two security officers will be detailed to the landing site during all routine helicopter landings and takeoffs to enforce ground safety requirements and control traffic and pedestrians as necessary.

   b. The Shift Lieutenant shall conduct a FOD walk of the landing site with the Fire Department no more than one hour nor less than 15 minutes prior to a scheduled landing.

12.0 APPENDIX 3- FLOW DOWN OF REQUIREMENTS FOR COMMERCIAL AVIATION SERVICE (CAS) PROVIDER PURCHASE ORDER

The flow down of requirements in the box below shall be part of the purchase order that is sent to the CAS provider and implements DOE O 440.2 Series- Aviation Management and Safety and the DOE Chicago Office Aviation Implementation Document (AID).

****

1) (Insert name of Commercial Aviation Services provider) will comply with 14 CFR Chapter I; 40 CFR Subtitle B Chapter I; and 49 CFR, Subtitle B, Subchapter C, Chapter XII, while in service to DOE or its contractors, and any other laws and regulations that pertain to the type of operation conducted.

2) The Pilot in Command (PIC) will ensure that the aircraft is operated within the manufacturer and FAA weight and balance limitations for which the aircraft will be operated.

3) The Anthony Frelo Field, commonly called the Barnstormers Site, on Old Batavia Road, geographical coordinates N41°51' 03"x W88° 15' 25", is designated as the preferred Fermilab helicopter landing site. A secondary site is the paved road in front of the Fermilab Fire House or the grassy area located immediately east of the fire house. These two fields are only to be used for emergency purposes if time and the nature of the emergency allows. Otherwise, any area of Fermilab may be used to provide a safe landing for the aircraft, crew, passengers or qualified non-crewmembers at the discretion of the PIC. Otherwise the (insert name of local airport) airport will be used for takeoff and landings under normal circumstances.

4) Passenger manifests will be prepared for all flights carrying DOE and/or contractor personnel aboard an aircraft as a passenger, or a qualified non-crewmember. As a minimum, the Passenger manifests will include the full name of each reportable individual for carried during the flight and a telephone number of an emergency contact.

5) The PIC shall provide a passenger safety briefing that meets the requirements set forth in 14 CFR Part 135.117, and that there is a process for informing personnel of their rights established in the NTSB/SPC-99-04, *Federal Plan for Aviation Accidents Involving Aircraft Operated by or Chartered by Federal Agencies*, Appendix F, "Disclosure for Civilians Traveling Aboard Federal Government Aircraft".

6) The CAS will comply with all applicable FAA civil aircraft regulations.

13.0 APPENDIX 4- UNMANNED AIRCRAFT SYSTEMS

Unmanned Aircraft Systems (UAS) that are conducted in civil status under 14 CFR 107 are subject to regulation by the FAA to ensure safety of flight, and safety of people and property on the ground. UAS operations that are conducted in Public status are regulated by Department of Energy. Incidents involving unauthorized and unsafe use of small, remote-controlled aircraft have risen dramatically. The FAA is taking an incremental approach to safe UAS integration as the agency acquires a better understanding of operational issues such as training requirements, operational specifications and technology considerations.

1. UAS operations by the general public at Fermilab is strictly prohibited.

2. UAS operations funded and operated by FRA personnel must meet the requirements of the FAA and be approved by DOE Headquarters, via the DOE Fermi Site Office.

3. UAS operations by commercial entities at Fermilab must meet the requirements of the FAA and be approved by DOE Headquarters, via the DOE Fermi Site Office.

4. UAS operations by the Fermilab Barnstormers and their approved guests must meet the requirements of the FAA (i.e. 14 CFR 101) for hobby/recreational flying and be conducted at Frelo Airfield on Old Batavia Road, geographical coordinates N41°51’ 03”x W88° 15’ 25”. The Barnstormers Aero Club AMA #0616 maintain a current Letter of Agreement with DuPage Airport to operate in controlled airspace. Their operations are not covered under 14 CFR Part 107 and the ASP at Appendix 5.

5. The careless, reckless or unauthorized use of UAS’s at Fermilab will be reported to local law enforcement. Notification of an incident, accident or other suspected violation will be made to the FAA Central Regional Operation Center at 817-222-5006, 9-asw-operation-center@faa.gov .

14.0 Appendix 5- Unmanned Aircraft System (UAS) Aviation Safety Plan (ASP)

Scope

This plan documents safety requirements for Fermi National Accelerator Laboratory (Fermilab) operating small Unmanned Aircraft Systems (sUAS) within the National Airspace System, under either a FAA approved Certificate of Authorization (COA) or Title 14 CFR Part 107 Civil Operation of Small Unmanned Aircraft Systems, for the purposes of conducting the following Commercial Aircraft Operations: Scientific Research, Sensor/Airframe Development, Demonstration Flights, Emergency Preparedness Activities, Security and Surveillance, Infrastructure Inspections, Wildlife Monitoring, Radiological Assistance Program (RAP) Support and Presidential Policy Directive/PPD-21 Support.

Executive Summary

Fermilab shall operate small Unmanned Aircraft Systems (sUAS) from a multitude of locations within the National Airspace System. These areas include flights over the Fermilab site and also at off campus locations that will be determined, on an as-needed basis to support the Fermilab mission. This Safety Plan documents the basis for how Fermilab 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 Fermilab, contractors, users, and the general public. This Safety Plan utilizes 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 an sUAS having an accident, 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 an sUAS. Information was derived and constructed with respect to the requirements of 14 CFR Part 107.

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 Fermilab sUAS Airworthiness Statements, 14 CFR Part 107, 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.

Description of Missions

The mission types planned for sUAS include the following: Scientific Research, Sensor/sUAS airframe development, currency flights, emergency preparedness activities, security and surveillance, infrastructure inspections, wildlife monitoring, radiological assistance program (RAP) support, and Presidential Policy Directive (PPD)-21 support.

Fermilab will determine on a flight to flight basis whether a specific mission meets the definition of the missions listed above. If a mission does fall within that scope, then the flight can be conducted in "Public" status in accordance with the DOE Blanket COA. If the flight falls outside of the mission types defined in the PAO letter, Fermilab has 2 options. One option is to conduct the flight under "civil" status 14 CFR Part 107 or request DOE review and approval of another mission type for inclusion in a revision to the PAO letter. Blanket COA operations are currently limited to the southern portion of the Fermilab campus that is in Class G airspace. Operations over the northern part of the campus must either be performed under another FAA approved COA (i.e. specific to the airspace over the Fermi campus) or in civil status under 14 CFR 107.

Site Description

sUAS flights will be performed over the Fermilab site and at other selected off campus locations to support programmatic needs. A description of the Fermilab site is provided below. If flights are conducted off-site to support programmatic needs, a description of the designated flight area will be provided in a memorandum to the DOE Fermi Site Office and DOE Argonne Site Office Aviation Safety Manager for information.

Fermi National Accelerator Laboratory**:** Fermilab is located approximately 30 miles west of Chicago, Illinois in Kane and DuPage Counties. The 6,800 acre site contains approximately 36 miles of roads and approximately 366 buildings, of which approximately 70 are considered normally occupied. The site perimeter is unfenced but does have road gates and staffed control points for access control. Fermilab has a distribution of more heavily occupied buildings NE to SW through the site and very sparse in the surrounding woods and open grass fields. The terrain is relatively flat and is laced with several waterways including the headwaters of three creeks and several ponds. The climatic conditions can range from high heat and humidity in mid to late summer and extreme cold in winter months.

Airspace Environment

Fermi National Accelerator Laboratory: Fermilab is located in the western suburbs of Chicago underneath the overlying *Class B* airspace associated with O'Hare International Airport (ORD). Fermilab is located about 2 SM (statute miles) south of DuPage Airport (DPA) and is located in controlled *Class D* airspace from the surface up to 3300 feet MSL (means sea level) and 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 include Aurora Airport (ARR), and Naper (pvt).

The center point for the Fermilab site is defined as 5 nautical miles on the 120 radial of the DuPage VOR (DPA). This area can be defined as 41°51' 03"N x 88° 15' 25"W.

Off-site Locations: Other off site locations can be used when the mission need arises. When ATC authorization is required it must be requested and granted before any operation in that airspace. When ATC authorization is not required the RPIC shall monitor the Common Traffic Advisory Frequency (CTAF) of any nearby airport to stay aware of manned aircraft communications and operations.

Fermilab Notification Requirements

Operations over the Fermilab Site: Notification of appropriate DOE and Fermilab staff is required in accordance with paragraph 4.2 notifications. This notification includes the Chief Operating Officer, ESH Chief Safety Officer, Emergency Services Preparedness Manager, Security Chief, Fire Chief, Security Operations Center, Office of Communications, DOE-ASO, DOE-FSO, DOE-Safety and DOE-Safeguards & Security.

Description of Aircraft

The sUAS that will be used to conduct aerial missions are small , tabletop aircraft typically made of lightweight, fragile materials. Fermilab will be using an Inspired Flight IF 1200 NDAA compliant sUAS:

Inspired Flight IF1200 Hexacopter

Model	IF 1200
Registration	**FA33TAR33P**
Manufacturer	Inspired Flight
Powerplant	Multirotor
Max Gross Weight	44 lbs.
Wind Resistance	19.4 knots continuous, 23.3 knot gusts
Max Ground Speed	49 mph
Performance	Max ascent speed: 5 m/s (16 ft/s), Max decent speed: 3 m/s (10 ft/s)
Max Ceiling	6km, 20K ft
Endurance and Signal Range	35 minutes, 2 nm
Radiofrequency	900 MHz, 2.4~2.4835GHz
Instrument Payload	RGB Camera, Infrared Camera, Thermal Camera

Spectrum Analysis

All frequencies used by each sUAS are approved under the FCC non-licensed band (e.g. 2.4 GHz, 5.8 GHz, 902-928 MHz, 433 MHz) usage and are allowed without FCC approval. Any use of radio frequencies that are not in the unlicensed band will be reviewed by the respective Fermilab Radio frequency Spectrum Manager (Telecommunications Office) prior to use to either ensure that FCC approval is not required or coordinate approval from the FCC. In addition, sUAS usage will be evaluated to ensure that there is no interference with Fermilab facility equipment.

Airworthiness

The FAA allows for self-certification of sUAS Airworthiness for flights that are conducted under Public status (i.e. flown under an FAA approved COA). For flights conducted under Civil status 14 CFR Part 107, there is no requirement for a documented airworthiness statement, only a preflight inspection.

At a minimum, the preflight inspection shall include a visual and functional check of the following items:

1. Visual condition inspection of the UAS components.
2. Airframe structure (including undercarriage), all flight control surfaces, and linkages.
3. Registration markings, for proper display and legibility.
4. Moveable control surfaces, including airframe attachment points.
5. Servo motor(s), including attachment point(s).
6. Propulsion system, including power plant, propellers, rotors, duct fans, etc.
7. Verify all systems (e.g., aircraft and control unit) have an adequate energy (fuel/battery) supply for the intended operation and are functioning properly.
8. Avionics, including control link transceiver, communication/navigation equipment, and antennas.
9. Calibrate UAS compass prior to all flights.
10. Control link transceiver, communication/navigation data link transceiver, and antennas.
11. Display panel, if used, is functioning properly.
12. Ground support equipment, including takeoff and landing systems, for proper operation.
13. Control link correct functionality is established between the aircraft and the CS.
14. Correct movement of control surfaces using the CS.
15. Onboard navigation and communication data links.
16. Flight termination system, if installed.
17. Obstacle avoidance system, if installed.
18. Battery level for the aircraft and CS.
19. All equipment (camera, payload, etc.) is securely attached.
20. Verify communication with UAS and that the UAS has acquired GPS location (if GPS is applicable to the operation and/or aircraft).
21. Start the UAS propellers to inspect for any imbalance or irregular operation.
22. Verify all control operations for accuracy and display of heading and altitude (if available).
23. If required by flight path walk through, verify any noted obstructions that may interfere with the UAS.

24. At a controlled low altitude, fly within range of any interference and recheck all controls and stability.
25. Confirm any and all software, controller, or aircraft settings to ensure they have been properly set for the impending flight or mission.

A configuration control program will be used to track replacement of sUAS hardware and software to ensure airworthiness of the sUAS.

The Cybersecurity best practices for operating sUAS that were identified by the National Risk Management Center (NRMC) of the Department of Homeland Security (DHS) (June 11, 2019) will be followed by Fermilab.

Hazards/Accident Analysis

Methodology: The following methodology for performing a hazard, accident analysis that will be used to evaluate the risk of operation of sUAS. The first step includes the identification of hazards. Next, analysis will be performed to develop the scenarios in which a hazard can result in an adverse outcome. Finally, the worst accident scenarios will be analyzed with respect to the identification of the probability of a scenario occurring and severity of the outcome from the accident. For each scenario, an evaluation of unmitigated risk will be performed. Then, both engineered and administrative controls will be applied to demonstrate how the unmitigated risk will be reduced to acceptable levels. The risk matrix that is documented in the *ARM-related Unmanned Aircraft System (UAS) and Tethered Balloon System (TBS) Operational Requirements and Approval* (August 2019) will be used to qualitatively evaluate the residual amount of risk after controls are applied.

It should be noted that engineered controls will be the preferred controls to be relied upon. In addition, the concept of defense in depth will be used such that, no one failure of a control will result in an accident occurring.

Hazard Identification: The hazards associated with the operation of sUAS include the following.

- Electrical (Battery) (chemical) fire from a short circuit in the sUAS battery;
- Chemical contamination (leaking Li battery, chemical);
- Inclement weather (environmental hazard);
- Crew fatigue (ergonomic hazard);
- Lack of crew proficiency;
- Errant sUAS (physical);
- Loss of control of sUAS (physical);
    - Loss of sUAS functionality
    - Loss of control link
    - Loss of GPS
    - GCS failure
- Crew Error;
    - Failure to see and avoid
- Crew member incapacitated;
- Motor/Propeller failure in flight;

- Mid Air collision;
- Terrain, land, property, equipment, building collision;

Hazard Analysis Discussion: There are several hazards involved with the operation of sUAS. Two of the hazards will be analyzed in more detail. 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 either onsite or offsite into an urbanized or densely populated area causing damage to property or injury to a member of the public. 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 (e.g. each Model is less than 10 lbs.), 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 14 CFR Part 107 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 takeoff location and land without any input from the operator. Faults that can be detected include but are not limited to the following: 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 has been evaluated to be very low. Available FAA data such as (Summary of unmanned Aircraft Accident/Incident Data, https://www.faa.gov/about/initiatives/maintenance_hf/library/documents/media/human_factors_maintenance/a_summary_of_unmanned_aircraft_accident-incident_data.human_factors_implications.doc) shows that UAS accident rates are low. Taking the precautionary measures, built in safety mechanisms and procedures into account, reduces the risk of a sUAS mission resulting in major damage or injury to persons or property with exclusion of the sUAS itself.

Rotor and fixed-wing aircraft have the capability to operate for extended duration (i.e. up to 30-45 minutes) and a certain range. At Fermilab, it is likely that an sUAS could reach the nearby DuPage Airport and the populated subdivisions surrounding Fermilab and adjacent to Aurora Airport. However, none can reach other airports such as De Kalb Taylor Airport or O'Hare Airport. Fermilab flights would not 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 700 ft. Above Ground Level (AGL) into the Class E airspace above Fermilab, 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, due to the engineered features discussed in the following section.

This physical arrangement and the ideal location of the sUAS operating fields limits the proximity between airborne sUAS and human vehicle and pedestrian traffic.

The RPIC (or designated alternate) will file a Notice to Airmen (NOTAM) with the FAA by contacting the NOTAM Flight Service Station at 1-877-4-US-NTMS (1-877-487- 6867). These NOTAMs will be filed at least 24-72 hours before each planned day of operation. The submittal of a NOTAM through a Flight Service Station should be used as the preferred option.

DuPage Airport ATC Tower will be notified before each sUAS flight at Fermilab via telephone (630) 587-7800 or the Low Altitude Authorization and Notification Capability (LAANC). LAANC automates the application and approval process for airspace authorization for operations conducted under 14 CFR 107. Notification of Fermilab sUAS operation to Aurora Airport (ARR) is not needed because the airport is further away (> 5 SM).

Engineered and Administrative Controls

Fermilab 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 Fermilab site and off site locations through a combination of both *engineered* and *administrative* controls. These controls will reduce the probability of an accident involving a Fermilab sUAS to extremely unlikely levels thereby resulting in a residual risk that is acceptably small.

The following *administrative* controls will be used to ensure safe operations of sUAS in any location within the National Airspace System:

- sUAS flights will be limited to no higher than 400 ft. AGL, unless it's flown within a 400-foot radius of a structure; and does not fly higher than 400 feet above the structure's immediate uppermost limit, under Title 14 CFR Part 107;
- sUAS will be limited to a groundspeed of 87 knots (100 mph) or less;
- Flight operations will remain clear of nonparticipating persons, vessels, vehicles, and structures, unless under safe cover;
- 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 Fermilab site and will not overfly residential areas except to resolve an in-flight emergency;
- NOTAM will be filed with the FAA 24-72 hours in advance of sUAS operations over the Fermilab site and off-campus locations;
- The minimum flight visibility, as observed from the location of the control station must be no less than 3 statute miles.
- The minimum distance of the sUAS from clouds must be no less than 500 feet below and or no less than 2,000 feet horizontally from clouds.
- 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;
- If the PIC possesses only a Remote Pilot certificate, flight operations will be limited to no higher than 400 ft. AGL per DOE's Aviation Management and Safety SCMS program.
- PIC will "see and avoid" hazards in accordance with 14 CFR 91.113;
- PIC has been trained and qualified on the operation of the designated sUAS;
- At least one Trained Visual Observer (VO) that is in direct communication with the PIC will be used on sUAS flights;
- Lost link procedures (described below) will address instances where communication links between the UA 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);
- The Pilot in Command of an unmanned aircraft shall not operate near a facility, building, or structure than required to safely and efficiently perform the mission. For sensitive locations, the operator should maintain a defined buffer to ensure facility and operator security while minimizing possible disruptions to the site. It is suggested that the unmanned aircraft should remain at a minimum distance of 100 feet unless special conditions warrant an enhanced inspection.
- 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).

The following *engineered* controls will be used to support safe operation of sUAS from any location within the National Airspace System:

- sUAS designated for this COA are small tabletop aircraft that consist of lightweight materials (typically < 6 lbs, with the largest 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 airspace. LiPo batteries will be charged in a LiPo Guard or equivalent bag that will mitigate the effects of a fire;
- 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.
- sUAS will have anti-collision lighting visible from a distance of at least 3 statute miles if operations are conducted at night.

Risk Analysis

The table shown below represents the residual amount of risk associated with the hazards after both the engineered and administratively controls have been applied. It should be noted that the risk documented below was evaluated qualitatively.

Summary of Risk

Hazard	Consequence	Severity/ Likelihood	Risk	Controls
Electrical Fire	UAS or system damaged or destroyed	2E	Low RAC III	RPIC will ensure there is a fire extinguisher with the UAS crew and they are trained in its use.
Battery fire during charging	Injury or damage to personnel or property	4E	Low RAC III	LiPo bag/guard will be used to charge batteries. Locate charging station away from personnel common areas. Use PPE and insert and remove batteries only while station is not powered.
Crew Fatigue	Crew member unable to perform duties or makes errors as RPIC	4E	Low RAC III	RPIC ensures crew members are fit for duty. Duty time is < 4 hours per day. All crew members have "Stop Work" authority. Visual Observers identify other aircraft & abnormal conditions.
Crew member incapacitated	Crew member unable to perform duties.	5E	Low RAC III	Flight terminates if a crew member becomes incapacitated. RPIC must verify fitness for duty prior to flight.
Crew Error	UA performs according to crew's mistake (i.e., waypoint improperly loaded).	3D	Low RAC III	The RPIC, VO and other crew members will use Crew Resource Management (CRM) to identify and prevent errors and mishaps.
Inclement weather	Unable to safely continue flight.	5B	Low RAC III	The RPIC will obtain the weather forecast and review current conditions prior to flight. Flights will only be conducted in VFR conditions within the UA manufacturer's wind limitations.
Chemical contamination	UA's lithium battery becomes punctured.	5E	Low RAC III	RPIC will inspect batteries prior to use.
Motor/Rotor fails in flight	Injury to persons on ground and damage to property due to UAS impact.	3D	Low RAC III	No UAS will be operated over persons or property that can be damaged.
Lacerations from spinning rotors	Injury to personnel.	3E	Low RAC III	Non-crew members will remain a safe distance from operational UASs.

Terrain and structure collision	Damage due to UA Collison.	3E	Low RAC III	The RPIC will fly in a manner as not to allow the UA to collide with structures or terrain. The VO will assist in preventing collisions with obstacles.
Mid-air collision with manned aircraft	Crash of sUAS and manned aircraft causing injury.	2E	Low RAC III	The RPIC will file a NOTOM to alert other aircraft and notify DuPage Airport ATC via LANNC or telephone. VO's will be used to watch for manned and unmanned aircraft.
Loss of UAS Functionality	UA crash or fly away.	3D	Low RAC III	The RPIC will inspect the UA prior to flight to ensure proper functionality.
Loss of control link	Loss of telemetry or command of UA.	5C	Low RAC III	Lost link procedures are confirmed by the RPIC prior to each flight to ensure the UA will return to home upon loss of control link.
Loss of GPS	UA will drift with the wind.	5D	Low RAC III	The RPIC will operate the UA normally, accounting for wind drift.
GCS Failure	Loss of telemetry or command of UA.	5D	Low RAC III	The RPIC will ensure the GCS has sufficient battery life for every mission.

Risk Analysis Methodology

Mishap Severity

Mishap severity is an assessment of the consequences of the most credible mishap that could be caused by a specific hazard. Mishap severity (Table 1) categorization provides a qualitative measure of the most credible mishaps resulting from flight crew error, environmental conditions, design inadequacies, procedural deficiencies, or UAS component failure or malfunction. **Rationale for the selection of hazards and the associated most credible mishap shall be documented in the risk analysis section of the ASP.**

Table 1. Severity Definitions

Minimal **5**	**Minor** **4**	**Major** **3**	**Hazardous** **2**	**Catastrophic** **1**
Negligible effects.	• Physical discomfort. • Slight UAS damage. • Property damage <$500. • Non-reportable spill.	• Injury; lost workdays. • Major UAS damage. • Property damage ≥ $500. • Reportable spill; environmental damage.	• Serious injury; hospitalization. • Mission stops; UAS loss. • Property damage; loss of use. • Recoverable impact to the environment.	• Death or debilitating permanent injury. • Property damage; loss of use 6 months or more. • Permanent damage to the environment.

Mishap Likelihood

Mishap likelihood (Table 2) is the assessment of the frequency that a mishap will occur during the duration of the flight. Likelihood can be derived from historical data, or, for new UAS missions (e.g., a new UAS, new or modified GCS, instrument payload; flight location), or from extrapolation of similar operations. **Rationale for assigning mishap likelihood must be documented in the risk analysis.**

Table 2. Likelihood Definitions

	Qualitative	Quantitative – Time/Calendar-based Occurrences Domain-wide/System-wide
Frequent A	Expected to occur routinely	Expected to occur more than 100 times per year (or more than approximately 10 times a month)
Probable B	Expected to occur often	Expected to occur between 10 and 100 times per year (or approximately 1-10 times a month)
Remote C	Expected to occur infrequently	Expected to occur one time every 1 month to 1 year
Extremely Remote D	Expected to occur rarely	Expected to occur one time every 1 to 10 years
Extremely Improbable E	Unlikely to occur, but not impossible	Expected to occur less than one time every 10 years

Risk Analysis Chart

The Aviation Risk Analysis Chart is used to assign a Risk Analysis Code (RAC) to the UAS operation described in this ASP.

Table 3. Risk Analysis Chart

Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	[Green]	[Yellow]	[Red]	[Red]	[Red]
Probable B	[Green]	[Yellow]	[Yellow]	[Red]	[Red]
Remote C	[Green]	[Green]	[Yellow]	[Yellow]	[Red]
Extremely Remote D	[Green]	[Green]	[Green]	[Yellow]	[Red] * / [Yellow]
Extremely Improbable E	[Green]	[Green]	[Green]	[Green]	[Yellow]

High Risk [Red]
Medium Risk [Yellow]
Low Risk [Green]

* High Risk with Single Point and/or Common Cause Failures

High Risk = RAC I
Medium Risk = RAC II
Low Risk = RAC III

Note: When referencing a RAC, the Consequence/Likelihood that resulted in the specific RAC should be denoted. For example, RAC I (Ca/F) would indicate a Catastrophic, Frequent event; a RAC II (Ma/R) would indicate a Major, Remote event.

In summary, Fermilab has a unique aircraft operating environment due to the proximity to local airports and O'Hare's overlying *Class B* airspace. Fermilab has systematically analyzed both the consequence and probability of sUAS operations in the *Class D* and G airspace over the Fermilab Site and Class G airspace located off site. With respect to off-campus locations in Class G airspace, Fermilab will review each location on a case-by-case basis for the consideration of additional controls. Any additional controls unique to an off-campus location will be documented in an addendum to this ASP and submitted to the DOE Fermi Site Office Manager for approval. 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.

Preflight Readiness Verification

RPICs are required to obtain all available information to support safe operation of the sUAS flights. This includes obtaining a weather briefing, review of NOTAMs, TFRs, conducting a preflight of the sUAS, and a verification that the sUAS is airworthy, RPIC currency, verification of lack of medical deficiency, etc.

The PIC verifies:
- Training or flight currency of each flight crew member.
- Airworthiness of the UAS being operated.
- Operational status of equipment.
- Approval and authorization to conduct the UAS operation.
- Completion of Work Planning Control requirements
- Notification requirements completed

The PIC:
- Completes the pre-flight briefing covering:
    - Purpose and duration of flight.
    - Crew assignments.
    - Flight-specific hazards and controls.
    - Weather conditions and forecast
    - Response to adverse flight conditions (e.g., Lost Link; loss of control; adverse weather conditions).
    - Any applicable NOTAMs
- Authorizes and oversees flight preparation.
- Assures completion of the UAS pre-flight checklist

Emergency Procedures and Reporting

All of the Fermilab sUAS 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 far 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 document, 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 loss of GPS capability, lost link, lost visual line of sight, or lost communication, manned aircraft incursion, medical emergency.

Loss of GPS

Not all airframes have GPS functionality. The GPS can be used to supplement controls as well as to be used for pre-programmed flights. A loss of GPS signal or function does not immediately constitute an emergency. Depending on the flight status/mode, mission parameters and manufactures recommendations the following are required:

- It is the responsibility of the PIC to understand the GPS failure modes of the airframe they are operating and understand the restrictions as described in the airframe user manual.
- If the manufacturer recommends landing the aircraft due to any GPS malfunction, loss of signal or failure of the device, the PIC will terminate the mission.
- If the manufacturer has manual flight modes available on the aircraft, the PIC will decide either if it is safe to continue the mission under manual PIC inputs or to terminate the mission to correct the GPS failure or to regain GPS signal.

Lost Link Procedures

- In the event of lost link, the UA must initiate a flight maneuver that ensures timely landing of the aircraft. Lost link airborne operations are designed to keep the UA 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.
- 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.
- Rally and home locations will be programmed to remain within the area defined in the NOTAM where flight operations are being conducted.
- Lost link procedures will not transit or orbit over populated areas, Victor airways, or busy roadways/interstate highways.
- 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.
- Determine if DOE, NTSB or FAA reporting is 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.

Manned Aircraft Incursion

If the flight area has a manned aircraft incursion, the sUAS must take action to maneuver out of the way, always giving right of way to the manned aircraft.

Unmanned Aircraft Incursion

If the flight has an unmanned aircraft incursion, both aircraft must take action to maneuver out of the way. If a UAS is converging head-on, both aircraft should adjust course to the right.

Medical Emergency

If there is a medical emergency, a 3131 call will be initiated on the Fermilab site and 911 off site.

ATC Communications (All Operations)

During UAS operations, the RPIC must possess a minimum of two methods of communication: (1) The RPIC 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.

Airport/Facility Contacts Quick Reference

A list of contact frequencies and contact phone numbers are provided below for information purposes:

Nearby Airport/Facility Contacts

DuPage Airport (DPA) 120.90
Located 3NM North of FNAL
2700 International Drive,
West Chicago, IL 60185
Phone 630-587-7800

Aurora Airport (ARR) 120.60
Located 10 NM Southwest of FNAL
43w363 US-30,
Sugar Grove, IL 60554
Phone 630-256-3120

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