Final Report
ASSURE A28: Disaster Preparedness and Response Using UAS
Attachment 5 – Concept of Operations (CONOPS) for Pandemic Use of Large UAS (lUAS)

June 1, 2022

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TABLE OF CONTENTS

TABLE OF ACRONYMS

ACUASI	Alaska for Unmanned Aircraft Systems Integration
BVLOS	Beyond Visual Line of Sight
CONOP	Concept of Operation
DAA	Detect and Avoid
DLI	Divert Land Immediately
EO	Electro-Optical
FAA	Federal Aviation Administration
GCS	Ground Control Station
GEOJSON	Geographic JavaScript Object Notation
IFR	Instrument Flight Rules
JPEG	Joint Photographic Experts Group
KML	Keyhole Markup Language
NAS	National Airspace System
ORA	Operational Risk Assessment
PIC	Pilot in Command
RTB	Return to Base
SGI	Special Government Interest
SHP	Shape file
SOSC	System Operations Support Center
TIFF	Tag Image File Format
UAS	Uncrewed/Unmanned Aircraft System

ATTACHMENT 5 - CONCEPT OF OPERATIONS (CONOPS) FOR PANDEMIC USE OF IUAS

Lead organization will demonstrate that the CONOP has been reviewed. The CONOP will be accepted if the document contains sufficient information to proceed to an Operational Risk Assessment (ORA). The CONOP is to be submitted by the lead organization for the mission.

Approval by (Name/Org)	Title	Date	Approve Digital Signature

This CONOP will include all items needed to build out a successful mission. There will be sections included that are specific to each disaster response in the CONOP, such as under purpose of mission. Any specific information needed in the CONOP for a disaster response will be included before the summary section.

This CONOP document follows the "5-paragraph order" format, leveraged from the military operations world. The purpose is to allow operational team members to determine whether an applicant explicitly identifies key information that will be necessary for a subsequent **ORA**. These paragraphs spell out the acronym **S-M-E-A-C, for "Situation", "Mission", "Execution", "Administration & Logistics", "Command & Signal"**. This is known as the "SMEAC Sheet".

List of Revisions			
Revision Description	Approved by	Approve Digital Signature	Release Date (DD/MM/YY)

Notes on a CONOP:

The CONOP is viewed as an "evolving" document that records an analysis performed during the requirements generation process and should contain the following:

- A clear statement of the goals and objectives
- Strategies, tactics, policies, and constraints that describe how security will affect the program
- Organizations, activities, and interactions that describe who will participate and what these stakeholders do in that process
- A clear statement of the responsibilities and authority of the roles played in the process
- The specific operational processes, in overview fashion, that provide a process model in terms of when and in what order these operation processes take place, including such things as dependencies and concurrencies
- Processes for initiating the program, developing the products and components, maintaining the products, and components, and possibly for retiring the program and its products and components

CONOP:

- Narrate the processes to be followed
- Define the roles of the various stakeholders involved in the process
- Outline a methodology to realize the goals and objectives of the mission

1.1 Concept of Operation (CONOP)

No road or river transportation between major hub and smaller community

Essential supplies need to travel from Fairbanks to Nenana, Alaska

Operation:

Medical and Critical Supply Delivery: Major Hub to Rural Community

(Fairbanks to Nenana and back)

Duration of Operation:

Half a Day (Two flights each of few hours and removal of goods)

Outcomes/Actionable intelligence :

- Large UAS operations move critical cargo to a rural community
- Successful switching unmanned/uncrewed aircraft system (UAS) tracking between two Ground Control Stations (GCS)
- Application of communication tools and practices for large UAS operations in United States National Airspace System (NAS)
- Successful transfer of cargo and critical supplies by rural community team
- Successful return of large UAS to main hub to prepare for future supply delivery mission

Metrics of success:

- Large UAS successfully takes off from Fairbanks with payload onboard
- Team at Nenana take over control of large UAS; still tracked by team at Fairbanks
- Team at Nenana land aircraft, team at Fairbanks tracks it
- Team at Nenana unload critical supplies and take-off again to go back to Fairbanks
- Team at Fairbanks sees supplies given to those in need at Nenana
- Team at Fairbanks take over control of large UAS; still tracked by team at Nenana
- Team at Fairbanks land aircraft, team at Nenana track it
- Safe landing at Nenana with Beyond Visual Line Of Sight (BVLOS) operations
- Supplies received by team that need it at Nenana
- Team at Fairbanks and Nenana able to simultaneously track aircraft throughout
- Safe return of large UAS to Fairbanks so that it could be reused for follow-on mission

1.2 CONOP Quad Chart: Medical and Critical Supply Delivery: Major Hub to Rural Community [Fairbanks to Nenana and back]

1.2.1 Mission Purpose/Objectives

Purpose: Pandemic event, Rural community low on critical supplies, no road access, Airborne only possible. Manned systems unable to fly due to Instrument Flight Rules (IFR) conditions. River is unsafe to use due to thin ice and ice blocks.

Goals: Take-off from Fairbanks, Safe operations in National Airspace System. Detect and Avoid capability with BVLOS mission. Land at Nenana [different from the original flight crew, second crew managing landing and switch during mission]. Extra ground crew at Nenana remove supplies and support UAS to return to Fairbanks.

Objectives: Large UAS operations with real-time data of flight route. Supplies received at Nenana. UAS return take-off occurs. Mission tracked at both GCS, Fairbanks and Nenana.

1.2.2 Mission Procedures/Approach

Large UAS: Operations from Fairbanks → Nenana → Fairbanks

Time of day - Early morning to represent overnight request for supplies

Type of operations - BVLOS with certificate of authorization (COA) or waiver

Operations on ground at Fairbanks

Original Flight Team will be based at Fairbanks overnight

Pre-Flight checklist

Take-off from Fairbanks

Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway

Watching landing at Nenana via own GCS and BVLOS

Follow unloading and take-off from Nenana back to Fairbanks

Flight from Nenana to Fairbanks - Switch flight ops to Fairbanks at halfway

Manage landing back at Fairbanks

Operations on ground at Nenana

Ground team based as Nenana overnight

Setup to track flight in parallel to flight time

Own Pre-Flight Checklist

Track take-off @ Fairbanks

Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway

Lead landing at Nenana, meet aircraft and unload

Prepare flight for take-off back to Fairbanks

Lead take-off at Nenana

Flight from Nenana to Fairbanks - Switch flight ops to Fairbanks at halfway

Follow landing back at Fairbanks via their own GCS and BVLOS

1.2.3 Mission Results

Observations: Real-time optical data from UAS along route, tracking of UAS at take-off location GCS as well as landing GCS. Recording supplies being unloaded and aircraft return take-off back to original location

Products: Optical data from on-board system. Detect and Avoid (DAA) tracking from GCS. Supplies received at Nenana. Record of all flight logs showing aircraft take-off from Fairbanks, landed at Nenana and then returned to Fairbanks with take-off from Nenana [note that original flight crew will stay at Fairbanks and flight crew + extra ground crew for supply removal @ Nenana]

1.2.4 Mission Milestones

Outcomes/Actionable Intelligence

Large UAS operations move critical cargo to a rural community

Switching UAS tracking between two GCS

Application of communication tools and practices for large UAS operations in NAS

Transfer of cargo and critical supplies by rural community team

Return of large UAS to main hub to prepare for future supply delivery mission

Metrics of success

Large UAS successfully takes off from Fairbanks with payload onboard

Team at Nenana take over control of large UAS; still tracked by team at Fairbanks

Team at Nenana land aircraft, team at Fairbanks tracks it

Team at Nenana unload critical supplies and take-off again to go back to Fairbanks

Team at Fairbanks sees supplies given to those in need at Nenana

Team at Fairbanks take over control of large UAS; still tracked by team at Nenana

Team at Fairbanks land aircraft, team at Nenana track it

Safe landing at Nenana with BVLOS operations

Supplies received by team that need it at Nenana

Team at Fairbanks and Nenana able to simultaneously track aircraft throughout

Safe return of large UAS to Fairbanks so that it could be reused for follow-on mission

1.3 Situation

1.3.1 Overview

Purpose of the mission: Delivery critical medical and community supplies between two locations, when the second site is cut off from the road network during a pandemic event and the river is unsafe to use due to thin ice and ice blocks. Also, they do not want people moving between communities to minimize impact and any potential spread.

Goals: Large UAS flown from Fairbanks to Nenana and back. First mission is with needed medical and community supplies. Return flight with items needed by Fairbanks from Nenana so not an empty return. Demonstrate onboard DAA system support BVLOS operations. Demonstrate that supplies can be transferred between two communities in Alaska when other transportation means prevent transfer of essential supplies.

UAS mission lead: University of Alaska Fairbanks Alaska Center for Unmanned Aircraft Systems Integration (ACUASI) team with support from community members in Fairbanks and Nenana.

- Large UAS: Supply delivery between two communities
  - Original launch site: Flight crew needed to operate large UAS
  - Landing site for drop off: Engineering/supply delivery tree
  - Sensor: Electro-Optical (EO) visible and thermal sensors for safety and reviewing route
  - Ground team #1: Fairbanks for takeoff with supplies and return of UAS
  - Ground team #2: Nenana for landing, removal of supplies, take-off to Fairbanks
  - Data feeds through ground control stations to main operations team in Fairbanks as well as the original site for supplies and final location for supplies

1.3.2 Location

Fairbanks International Airport

Latitude: 64.8153544° N Longitude:147.8566592° W

IATA: FAI ICAO: PAFA FAA LID: FAI

https://www.airnav.com/airport/FAI

Nenana Municipal Airport

Latitude: 64.5473000° N Longitude:149.0739250° W

IATA: ENN ICAO: PANN FAA LID: ENN

https://www.airnav.com/airport/ENN

All maps in Appendix 3

1.3.3 Systems

Location: Central Operation

- Based at Fairbanks but no in same location as ops team)
- Coordination with flight teams
- ACUASI: Director of Operations Adkins
- Fairbanks community lead
- Nenana community lead

1st flight: Fairbanks to Nenana, Outward leg

- Large UAS
    - SeaHunter/Sentry type from Fairbanks International Airport, Alaska (PAFA)
    - Endurance for several hours per flight, 41 miles or 66 km direct
    - Pilots and support crew for large UAS
        - External Pilot, Crew Chief, Internal Pilot, and Supplemental Pilot
        - Additional operator to manage data feed from onboard payload
    - Minimum Payload
        - EO feed is sent back to GCS and onto operations center
        - Supplies needed by Nenana
    - Optical and thermal payload integrated for nadir viewing and support flight

2nd flight: Nenana to Fairbanks, Return leg

- Large UAS
    - SeaHunter/Sentry type from Nenana Municipal Airport, Alaska (ENN)
    - Endurance for several hours per flight, 41 miles or 66 km direct
    - Pilots and support crew for large UAS
        - External Pilot, Crew Chief, Internal Pilot, and Supplemental Pilot
        - Additional operator to manage data feed from onboard payload
    - Minimum Payload
        - EO feed is sent back to GCS and onto operations center
        - Empty payload or supplies to send to Fairbanks
    - Optical and thermal payload integrated for nadir viewing and support flight

1.4 Mission

Disaster:

Delivery critical medical and community supplies between two locations, when the second site is cut off from the road network during a pandemic event and the river is unsafe to use due to thin ice and ice blocks. Also, they do not want people moving between communities to minimize impact and any potential spread.

Observations:

Real-time EO data collected along the UAS route. Flights crews at each community will be tracking the UAS, with a take-off location GCS as well as landing GCS at the community receiving the supplies. The flight crew will provide all recording of the supplies being unloaded. The aircraft will return to the take-off at the original location.

Response mission:

This will be at the request of Nenana who needs supplies, with Fairbanks having sufficient medical and every-day supplies to send to the smaller community. Fairbanks will determine that a UAS is the only potential support that can get the supplies to Nenana in a timely manner.

Stakeholders:

Local community of Nenana. Those in Fairbanks who provide the supplies and can spare them to ensure they do not run out and to minimize the risk to the smaller community's population.

Goals:

Large UAS flown from Fairbanks to Nenana and back. First mission is with needed medical and community supplies. Return flight with items needed by Fairbanks from Nenana so not an empty return. Demonstrate onboard DAA system support BVLOS operations. Demonstrate that supplies can be transferred between two communities in Alaska when other transportation means prevent transfer of essential supplies.

Objectives:

Large UAS operations with real-time EO data of flight route fed back to both GCS as well as central operations in Fairbanks. Supplies successfully received in Nenana and by those in need. Large UAS returns take-off from Nenana and comes back to the original site at Fairbanks airport. Mission is tracked at both GCS, one in Fairbanks and one in Nenana.

Real-time Mission Products:

- EO visible data from on-board system with DAA tracking from GCS
- Supplies received at Nenana

Post-Mission (fast response) Products:

Record of all flight logs showing aircraft take-off from Fairbanks, landed at Nenana, and then returned to Fairbanks with take-off from Nenana.

1.5 Execution

1.5.1 Operations Plan

Large UAS

- Early morning to represent overnight request for supplies
- BVLOS or extended visual line of sight with waiver
- Operations from Fairbanks → Nenana → Fairbanks
    - Operations on ground at Fairbanks
        - Team will be based at Fairbanks overnight

            - Pre-Flight checklist then take-off from Fairbanks
            - Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway
            - Watching landing at location Nenana via own GCS and BVLOS
            - Follow unloading and take-off from Nenana back to Fairbanks
            - Flight from Nenana to Fairbanks - Switch flight to Nenana at halfway
            - Manage landing back at Fairbanks
        - Operations on ground at Nenana
            - Ground team based as Nenana overnight
            - Setup to track flight in parallel to flight time
            - Own Pre-Flight checklist and Track take-off at Fairbanks
            - Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway
            - Lead landing at location Nenana, meet aircraft and unload
            - Prepare flight for take-off back to Fairbanks
            - Lead the take-off at Nenana
            - Flight from Nenana to Fairbanks - Switch ops to Fairbanks at halfway
            - Follow landing back at Fairbanks via their own GCS and BVLOS
- Flight conditions - IFR as manned/crewed unable to fly and need for rapid response

1.5.2 Data collection, processing, and dissemination

<u>Large UAS</u>

- Data in flight:
    - High Precision global position system locations and time synchronization
    - Flight routes and logs sent to both GCS at Fairbanks and Nenana
    - Optical data streamed to two GCS (one at Fairbanks and one at Nenana)
    - On-board storage of data, downloaded upon landing and processed
    - Recording of unloading at Nenana
- Products post flight:
    - Flight logs
    - Optical imagery from on-board
    - GCS data from both locations
    - Recordings of two ground crews
    - All recordings from ground based DAA systems under BVLOS

1.6 Administration & Logistics

1.6.1 Planning and local logistics

Large UAS flight teams need accommodation in both communities and have a locally based team in Nenana to support operations. Crew in Fairbanks will need logistical support to access the runway and house the aircraft at Fairbanks airport and provide GCS to track aircraft. UAS flight team and ground team will need accommodation and logistical support at Nenana to access the landed plane, unload supplies, and prepare aircraft for return.

Any required waivers will be in place before missions start. A Special Government Interest (SGI) waiver will be submitted to support all small UAS missions to ensure that sufficient permissions are acquired, if needed, so that they do not need to be submitted during the missions and any time lost.

1.6.2 Hazards/Risk

The following information provides specific hazards that may occur from supporting the emergency response to the pandemic event.

Hazard 1: Loss of capability for one of two GCS used in mission

- Risk: This hazard comes from loss of tracking of aircraft between two GCS's and an issue on switching control and being able to support operations. Possible effects are one GCS staying in control and being unable to track the UAS to its final location and thus requiring Return To Base (RTB) and the mission cannot be completed.
- Mitigation: Before the missions start, the two GCS crew's will be in communication and ensure that they have backup power. Also, the Pilots In Command (PICs) will be aware of the geographical limitations of their tracking capabilities and the procedures to follow if one GCS is unable to operate. Lead organization that is operating the GCS will share its safety management system with the disaster response team leads so all are aware of procedures should this hazard occur. If one GCS does lose capability, the PIC at the functioning GCS will continue to be in control of the UAS and will work with their flight crew to ensure safe operations. If required, a Divert Land Immediately (DLI) will be used or a Return to Land to the original take-off site or to a safe chosen landing site.

Hazard #2: Loss of communications between crew at two GCS

- Risk: This hazard comes from two flight crews and two GCS used for the UAS operations and a drop in communications between them when based in different locations. Possible effects are a drop in GCS tracking of the UAS and/or no confirmation of the handing from the UAS from one GCS to another.
- Mitigation: Before the mission starts, the two PICs will check all communications between the two GCS's and backup communication tools that they are using to ensure that at least one GCS is tracking the UAS. They will have a procedure setup on how to perform the handoff between the two GCS's and their contingency plan if they lose communications. If there is a drop in communication, the original take-off site will stay in control of the UAS tracking as they would have been the lead until the handover. If there is no return to joint communications, then the take-off site PIC will set the RTB on the aircraft, and this will inform the second GCS PIC that the communication issue has prevented them from completing the mission.

Hazard #3: Ground team unable to access payload bay of large UAS

- Risk: This hazard comes from the ground crew at the second site being unable to offload the supplies and/or unable to access the payload bay. Possible effects are a failure to drop off the supplies at the needed location and/or a return to the original take-off site within completing the mission.
- Mitigation: The ground team at each site will be trained in how to access the payload bay for the small UAS and will have communications with the two PICs at the GCS as well as the

flight teams. Depending on the mission type, the ground team can be part of the flight team. The ground team will follow the safety procedures for the aircraft to determine where the issues reside and if this can be fixed on site using their flight crew's equipment. If the payload bay cannot be opened, then the flight crew will take over and ensure that the aircraft is safe for its return flight back to the original take-off site. Then this site will have the equipment needed to fix the payload bay issue and support another mission to deliver the payload contents.

Hazard #4: Loss of capability for one of two GCS used in mission

- Risk: This hazard comes from an aircraft loss of control between two GCS and only one of the GCS can track the UAS. Possible effects are an uncontrolled aircraft that is unable to be tracked in the NAS or an aircraft that is unable to reach its destination and that must return to its original take-off location while being unable to complete its mission.
- Mitigation: Before the mission starts, the two PICs will check all communications between the two GCS's and all backup communication tools that they are using to ensure that at least one GCS is tracking the UAS. They will have a procedure setup on how to perform the handoff between the two GCS's and their contingency plan if they lose communications. If there is a drop in communication, the original take-off site will stay in control of the UAS tracking as they would have been the lead until the handover. If there is no return to joint communications, then the take-off site PIC will set the RTB on the aircraft and this will inform the second GCS PIC that the communication issue has prevented them from completing the mission.

Hazard #5: Loss of power and navigational connection to large UAS in NAS

- Risk: This hazard comes from a loss of power and control of the large UAS providing higher altitude eyes on the response. Possible effects are no higher altitude data to keep eyes on the full extent of the event and/or act as a communications hub and a RTB or uncontrolled descent of the UAS.
- Mitigation: Mitigation would include assigning ditch points for the UAS in the CONOP, so the team is prepared for safe landings, if unable to return to home. The crew member responsible for mission team safety and the ground control station will inform the PIC or mission manager on loss of power. Depending on the vehicle capabilities, it may not be possible to reach a prescribed ditch point during a power loss. However, if the vehicle can reach the ditch point, these points should be monitored for pedestrian/ground traffic to ensure safe landing is possible. Visual observers in place for visual line of sight operations will be used to support the PIC in understanding any risks on the ground below the aircraft's location when power is lost. If there are multiple UAS flights at the same time and in the same airspace supporting a disaster response, then pre-mission coordination on each flights alternative landing zones will occur to mitigate any mid-air collisions from DLI or RTB flights.

Hazard #6: Lack of fuel in large UAS performing multiple missions

- Risk: This hazard comes from the large UAS, that is performing two flights with stop over, having enough fuel/power to complete the flights and all operations needed for removal of the supplies. Possible effects are the large UAS being unable to complete the two flights and having to return to the original take-off location. The lack of fuel could lead to loss of capability to control the UAS and a controlled or uncontrolled descent into terrain/terrestrial entities.
- Mitigation: The mission team will leave at least 1 hour of reserve fuel on board throughout the entire flight profile. The mission team will ensure that the flight checklists include details on population density and communities along their flight route. Alternative landing sites will be identified so that the PIC can manually fly the UAS to the new landing zone or the aircraft can be assigned to a new landing site if automated flight is still possible under safe operations. If there are multiple UAS flights at the same time and in the same airspace supporting a disaster response, pre-mission coordination on each flight's alternative landing zones will occur to mitigate any mid-air collisions from DLI or RTB flights.

1.6.3 Community outreach and connections

Communication with Fairbanks airport beforehand to ensure that the large UAS can takeoff and not impact manned/crewed operations in the region and that would use the airport. Central operations would communicate with the Fairbanks to set up for tracking the UAS. Ground crew in Nenana would need to communicate with organizations requiring the supplies. Flight crews and central operations would need to submit requests to obtain waivers, where needed.

1.6.4 Disaster response mission specific information

Spot forecast from National Weather Service at FAI and ENN. This is downloaded to the flight checklist documentation for each crew and GCS.

1.6.5 Mission Summary

Disaster:

Delivery critical medical and community supplies between two locations, when the second site is cut off from the road network during a pandemic event and the river is unsafe to use due to thin ice and ice blocks. Also, they do not want people moving between communities to minimize impact and any potential spread.

Objectives:

Large UAS operations with real-time EO data of flight route fed back to both GCS as well as central operations in Fairbanks. Supplies successfully received in Nenana and by those in need. Large UAS returns take-off from Nenana and comes back to the original site at Fairbanks airport. Mission is tracked at both GCS, one in Fairbanks and one in Nenana.

Flight Missions:

Large UAS flown from Fairbanks to Nenana and back. First mission is with needed medical and community supplies. Return flight with items needed by Fairbanks from Nenana so not an empty return. Demonstrate onboard DAA system support BVLOS operations. Demonstrate that supplies can be transferred between two communities in Alaska when other transportation means prevent transfer of essential supplies.

Metrics of success:

- Large UAS successfully takes off from Fairbanks with payload onboard
- Team at Nenana take over control of large UAS; still tracked by team at Fairbanks
- Team at Nenana land aircraft, team at Fairbanks tracks it
- Team at Nenana unload critical supplies and take-off again to go back to Fairbanks
- Team at Fairbanks sees supplies given to those in need at Nenana
- Team at Fairbanks take over control of large UAS; still tracked by team at Nenana
- Team at Fairbanks land aircraft, team at Nenana track it
- Safe landing at Nenana with BVLOS operations
- Supplies received by team that need it at Nenana
- Team at Fairbanks and Nenana able to simultaneously track aircraft throughout
- Safe return of large UAS to Fairbanks so that it could be reused for follow-on mission

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1.7 Command & Signal

Aim: This section should provide an overview of the command and communication systems to be used. This supports anyone reviewing and evaluating the CONOP to efficiently assess those sufficient communications are in place to connect the UAS flight crew with additional organizations connected to and supporting the disaster response and/or preparedness.

For some of the details included in this section, the plans will cross reference to the ORA, as they will be mitigation plans to ensure safe flight operations and minimize the risk of hazards that can impact flight operations.

Include details on:

- Type of communications tools used to connect PIC, Observer, and other crew members
- Security measures in place to protect the flight crew
- Hand-off process, where appropriate, between the PIC and visual observer(s)
- Flight team lost link and emergency procedures to ensure safe flight operations
- Communication tools use to connect the flight team and local ATC

Note: for each communication tool to be used, this section should also include signals used such as radio frequencies, flight control frequencies, etc.

1.8 Supplementary appendices to accompany CONOP

1.8.1 *Appendix 1: Operational Details – One Pager*

Mission and Disaster Preparedness/Response

Medical and Critical Supply Delivery: Major Hub to Rural Community
[Fairbanks to Nenana and back]

Mission Purpose/Objectives

Purpose: Pandemic event, Rural community low on critical supplies, no road access, Airborne only possible. Manned systems unable to fly due to IFR conditions. River is unsafe to use due to thin ice and ice blocks.

Goals: Take-off from Fairbanks, Safe operations in National Airspace System. Detect and Avoid capability with beyond visual line of sight (BVLOS) mission. Land at Nenana [different from the original flight crew, second crew managing landing and switch during mission]. Extra ground crew at Nenana remove supplies and support UAS to return to Fairbanks.

Objectives: Large UAS operations with real-time data of flight route. Supplies received at Nenana. UAS return take-off occurs. Mission tracked at both ground control station (GCS), Fairbanks and Nenana.

Mission Results

Observations: Real-time optical data from UAS along route, tracking of UAS at take-off location ground control station (GCS) as well as landing GCS. Recording supplies being unloaded and aircraft return take-off back to original location

Products: Optical data from on-board system. Detect and Avoid (DAA) tracking from GCS. Supplies received at Nenana. Record of all flight logs showing aircraft take-off from Fairbanks, landed at Nenana and then returned to Fairbanks with take-off from Nenana [note that original flight crew will stay at Fairbanks and flight crew + extra ground crew for supply removal @ Nenana]

Mission Procedures/Approach

Large UAS: Operations from Fairbanks → Nenana → Fairbanks
Time of day - Early morning to represent overnight request for supplies
Type of operations - BVLOS with certificate of authorization (COA) or waiver

Operations on ground at Fairbanks
Original Flight Team will be based at Fairbanks overnight
Pre-Flight checklist
Take-off from Fairbanks
Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway
Watching landing at Nenana via own GCS and BVLOS
Follow unloading and take-off from Nenana back to Fairbanks
Flight from Nenana to Fairbanks - Switch flight ops to Fairbanks at halfway
Manage landing back at Fairbanks

Operations on ground at Nenana
Ground team based as Nenana overnight
Setup to track flight in parallel to flight time
Own Pre-Flight Checklist
Track take-off @ Fairbanks
Flight from Fairbanks to Nenana - Switch flight ops to Nenana at halfway
Lead landing at Nenana, meet aircraft and unload
Prepare flight for take-off back to Fairbanks
Lead take-off at Nenana
Flight from Nenana to Fairbanks - Switch flight ops to Fairbanks at halfway

Mission Milestones

Outcomes/Actionable Intelligence
Large UAS operations move critical cargo to a rural community
Switching UAS tracking between two GCS
Application of communication tools and practices for large UAS operations in NAS
Transfer of cargo and critical supplies by rural community team
Return of large UAS to main hub to prepare for future supply delivery mission

Metrics of success
Large UAS successfully takes off from Fairbanks with payload onboard
Team at Nenana take over control of large UAS; still tracked by team at Fairbanks
Team at Nenana land aircraft, team at Fairbanks tracks it
Team at Nenana unload critical supplies and take-off again to go back to Fairbanks
Team at Fairbanks sees supplies given to those in need at Nenana
Team at Fairbanks take over control of large UAS; still tracked by team at Nenana
Team at Fairbanks land aircraft, team at Nenana track it
Safe landing at Nenana with BVLOS operations
Supplies received by team that need it at Nenana
Team at Fairbanks and Nenana able to simultaneously track aircraft throughout
Safe return of large UAS to Fairbanks so that it could be reused for follow-on mission

1.8.2 Appendix 2: Flight Checklists

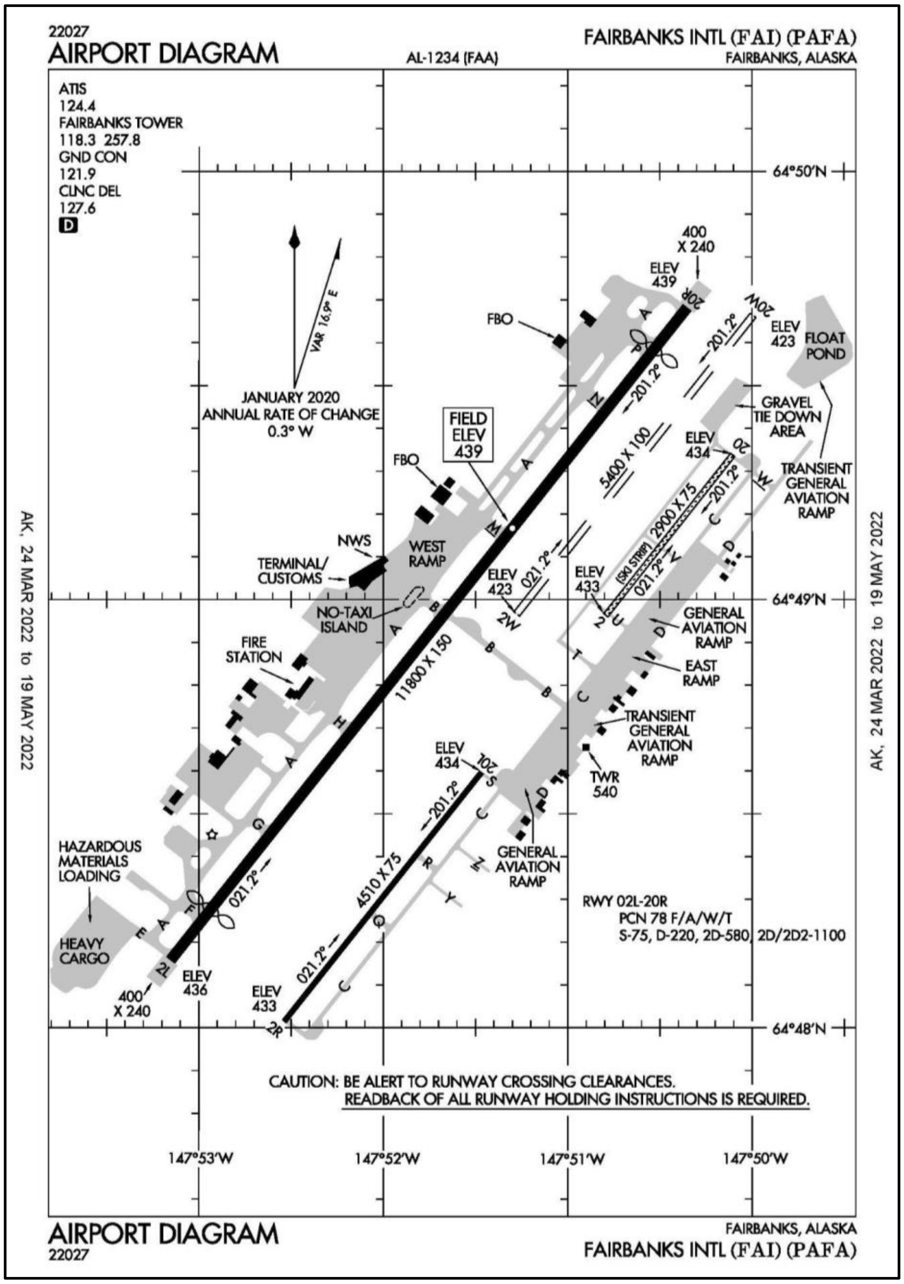
Aim: This appendix collects all flight checklists the mission team would complete pre-, during, and post-flight while at the mission location as well as pre- and post-operation before arriving and after leaving the mission location. Each flight checklist is included in a supplementary document. These checklists are to supplement the maintenance checklists that would go with the organization leading the missions for the disaster response and/or preparedness that they use to ensure the safety of their aircraft and equipment. These maintenance checklists will likely be a part of the organization's own safety assessment process.

Include details on:

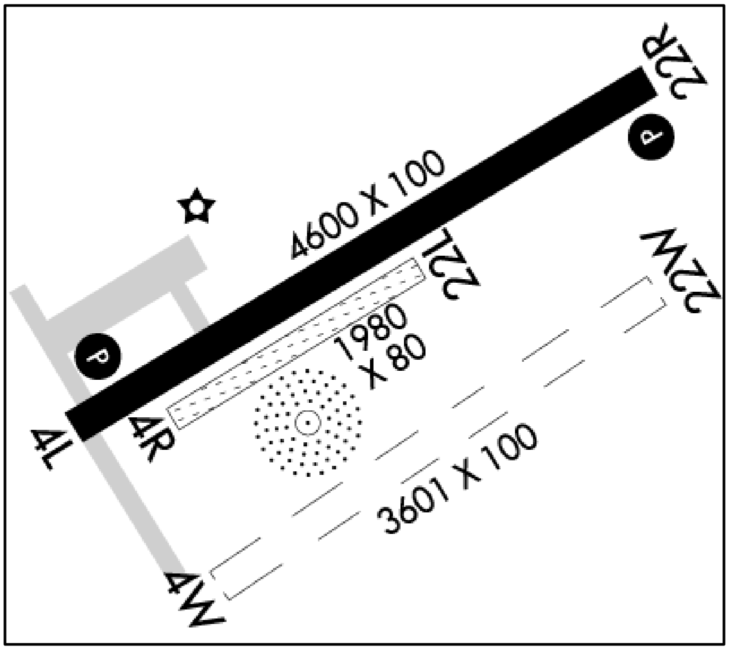
- Before CONOP development: Site Survey (details on assessment of mission location)
- Before Operations: Mission checklist (complete at home for lead organization)
- Pre-deployment: Checklist to complete prior to leaving for mission site
- Deployment: Checklists for flight operations, once arrived at mission site
- Pre-flight: Checklist to follow prior to flight including example of flight readiness review
- Post-flight: Checklists to follow including log sheet
- Post-mission: Checklists to follow at the end of all flights for the mission

1.8.3 Appendix 3: Additional Requirements

Map of Fairbanks International Airport

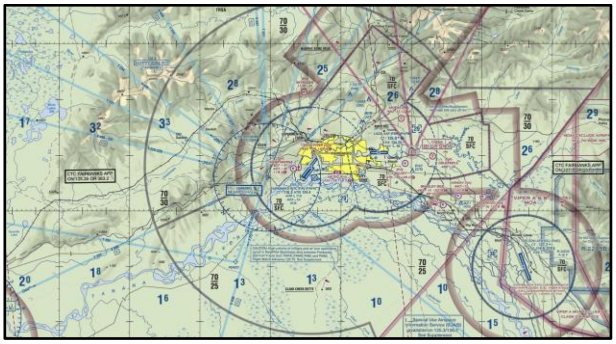


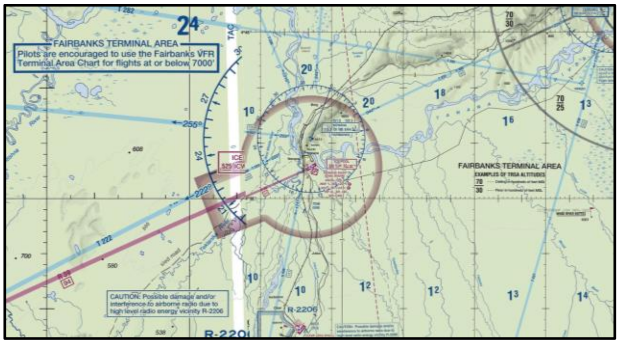
[Map of Nenana Municipal Airport]



Sectional charts

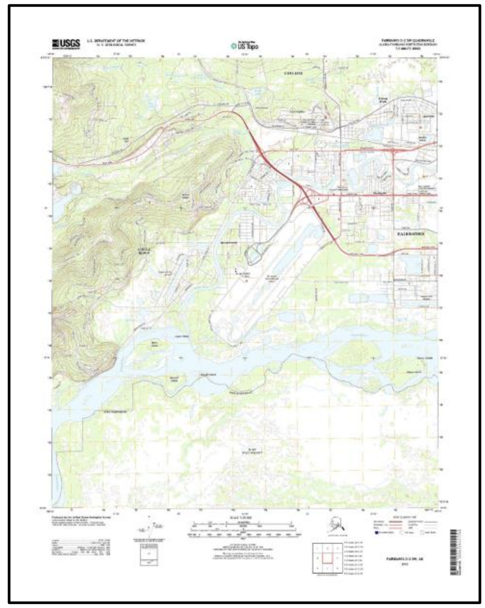
[Fairbanks International Airport] [Nenana Municipal Airport]



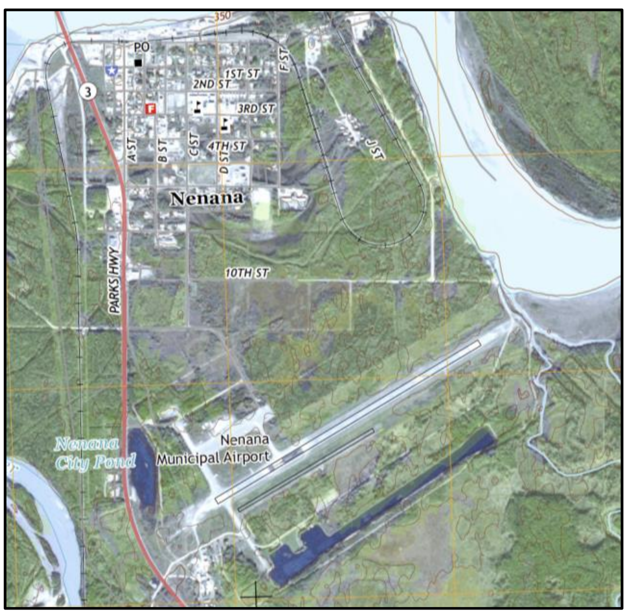


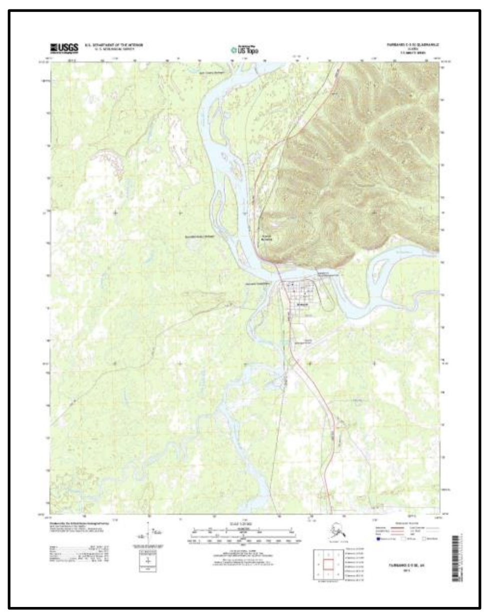
[United States Geological Survey 7.5-minute topographic map]

Fairbanks International Airport - [Fairbanks D-2 SW]



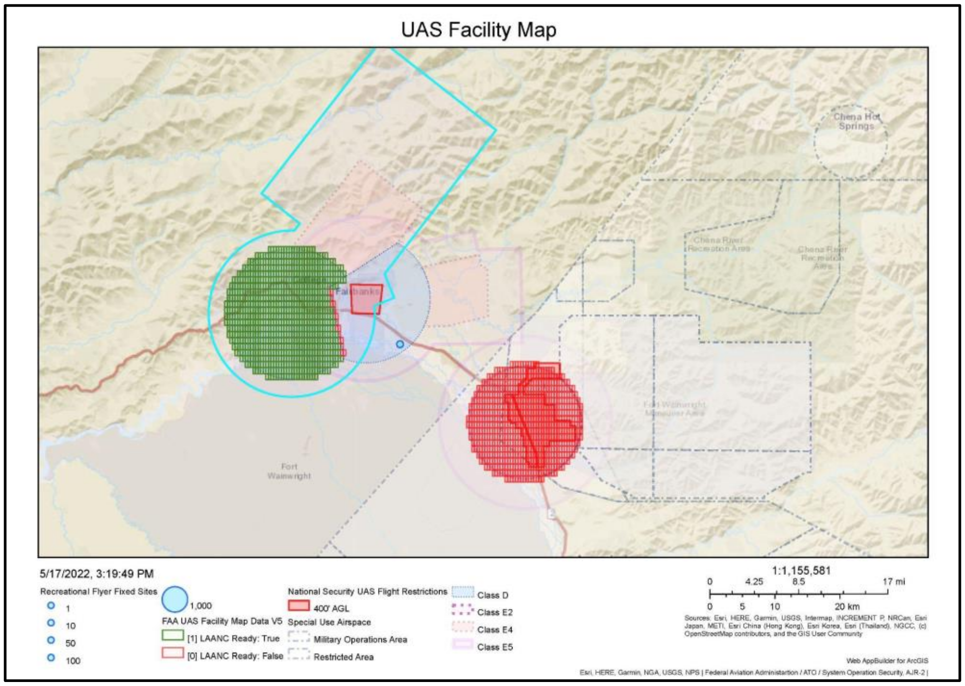
Nenana Municipal Airport - [Fairbanks C-5 SE]



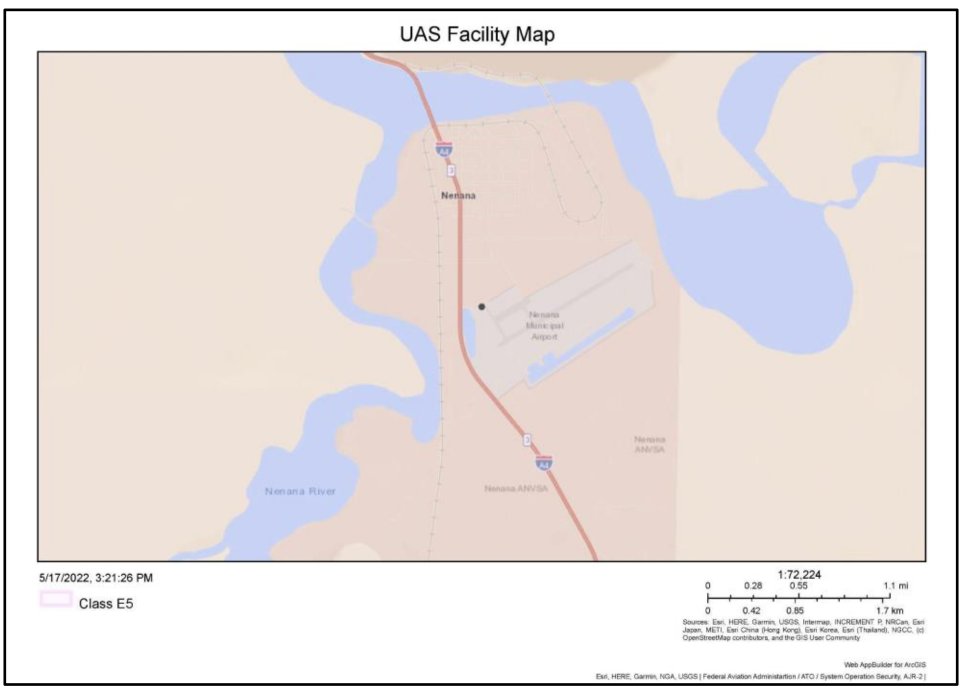


[Low Altitude Authorization and Notification Capability Facility Maps](#)

Fairbanks International Airport



Nenana Municipal Airport



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ASSURE
Alliance for System Safety of UAS through Research Excellence

1.8.4 Appendix 4: Special Government Interests (SGI) Process Documentation

- Federal Aviation Administration (FAA) Order JO7200.23B

Processing of UAS Requests. Effective: July 14, 2020

  - Page 16 to 19: Chapter 6. 14CFR Part 91, COA Processing
  - Page 17 – SGI information: The SGI process will be managed by Systems Operations Security as per FAA Order JO 7210.3

- FAA Order JO7210.3CC

Facility Operation and Administration. Effective: June 17, 2021

  - Page 469: Section 21-5-4. UAS SGI Addendum Request Process and Coordination
  - System Operations Support Center (SOSC) Contact Phone Number - 202-267-8276

- FAA Request Form for Expedited SGI Waiver or Authorization for UAS Operation – Form # SOSC 2020/02/20 1125Z

1.8.5 Appendix 5: Data Archive Plan

Processing specifications

- Imagery and video collected at maximum resolution
- Sufficient overlap to support Structure from Motion processed
- Full motion video captured where possible from available payload

File formats

- Detailed descriptions: https://www.ogc.org/docs/is
- EO visible and multispectral visible - near-infrared imagery
  - Joint Photographic Experts Group (JPEG): containing lossy and compressed data
  - Tag Image File Format (TIFF): store raster graphics and image information
- Broadband thermal infrared imagery
  - Radiometric JPEG: JPEG and TIFF for thermal data
  - Stores Temperature data as well as red green blue JPEG of thermal data
- EO visible and multispectral visible - near-infrared video
  - MPEG-4 format (MP4, note MOV from EO visible on dual camera system)
  - High compression international audio-visual coding standard
- Broadband thermal infrared video
  - SEQ/FFF - Proprietary FLIR video formats that store images and thermal data
  - MOV - MPEG 4 video container file
- Point clouds – Light Detection and Ranging data
  - LAS (binary file format) or LAZ (compressed LAS file)
- Geospatial data - GEOTIFF
  - Standard file for GIS with embedded geolocation data
- Google Keyhole Markup Language (KML)
  - KML (default Google Earth geospatial format)
  - Keyhole Market Zipped (compressed KML file format)
- Geographic JavaScript Object Notation (GEOJSON)
  - GEOJSON (coordinates as text in JavaScript Object Notation form

- Shapefile (SHP)
    - SHP (feature geometry), SHX (shape index position), DBF (attribute data)
    - PRJ (projection system metadata), XML (associated metadata)

Data archiving locations

- In-Flight:
    - Onboard storage of all data as well as through specific GCS
    - Data streamed through GCS to operations center to support secondary archive
- Post-Flight:
    - Online secure file storage per UAS and per mission (password protected)
    - Folders for raw sensor data as well as flight logs and route data

Folders to store post-processed data and all planning documents

1.8.6 Appendix 6: Rationale behind each section in CONOP

Situation

High level situation awareness and sufficient information to clearly define each element.

Template items

- *Organization's business (manufacturer, operator, system integrator, etc.).*
- *Geographic operating boundaries (lack of specifics implies very broad NAS access).*
- *Describe if launch/ fly/ recover only over private property with owner's permission.*
- *Define the minimum and maximum operating altitude of the vehicle.*
- *Describe if operating within or BVLOS.*
- *Define command and control link.*
- *Provide details on dimensions and materials for vehicle design.*
- *Identify the vehicle's maximum cruise speed and maximum operating gross weight.*
- *Describe Proposed Airspace Classes (A, B, C, D, E, F, etc.).*
- *Define the Proposed Operating Airspace (character aspects – regardless of class).*
- *Describe location of the control station.*

Mission:

Sufficient, clear, and concise statement of what the flight team and lead organization and/or stakeholders for the disaster response mission request want to accomplish. Provide the most important large-scale information and provide sufficient information and clearly define each element.

- *Describe the intended mission of the UAS (surveillance, response, preparedness, etc.).*

Execution:

Thoroughly state how you will "execute" the mission and provide sufficient information and clearly define each element.

- *Identify Airspace Considerations (peculiarities and congestion, special use, etc.)*
- *Give information on Launch and Recovery Details / Location(s)*
- *Identify and describe the vehicle's proximity to people, infrastructure, and surface vehicles*
- *Identify and describe the vehicle's proximity to other NAS users*
- *Identify whether you want to Flight into Known Icing (FIKI)*
- *Identify meteorological conditions you want to operate in Visual / Instrument conditions*
- *Identify the flight rules you want to operate in Visual / Instrument Flight Rules*
- *Describe whether your geographic and airspace boundaries are physically contiguous*
- *Identify Automation Level (occasional autopilot, 100% autonomous, manual control, etc.)*
- *Identify minimum crew and support personnel*
- *Identify the role(s) of the crew and support personnel*
- *Identify whether you will fly over people not involved in the operation*
- *Identify any requests for airspace be blocked off for your exclusive use*
- *Identify your operator/vehicle ratio (1:1, etc.)*
- *Identify day and/or night operations*
- *Describe your plan for safety of Operator(s) and Observer(s)*
- *Describe the training level of each team member*

Command & Signal:

Sufficiently provide information of their plans involving command and communication functions between different portions of the UAS and stakeholders. Clearly describe how you will command and signal amongst the various components of the entire system (vehicle, control station, control link, observers, etc.)

- *Describe Communication between Operator, Observer, Crew Members (visual, radio, etc.)*
- *Describe the Electronic Security of the Control Link*
- *Describe the Physical Security of the operator and control station*

- *Describe real time situational awareness features*
- *Describe the # of operators, and hand-off between control*
- *Describe Lost Link Procedures or loss of Positive Control*
- *Describe Communication Expectations with Air Traffic Control*
- *Describe Emergency Procedures*

<u>Administration & Logistics:</u>

Adequately provide the information or instructions pertaining to how and with whom they will coordinate to conduct the operations.

- *Details on Community Outreach (Flying / Non-Flying Public, municipalities, airports, etc.)*
- *Describe when if flight routes will be filed with Air Traffic Control (Visual Flight Rules / IFR)*
- *Identify Liaisons with Air Traffic Control*
- *Identify MISHAP Reporting Procedures*
- *Identify when notices to airmen will be posted*