

## **Attachment 4**

### **Demonstration Mission Requirements**

#### **Rescue Operations Support Unmanned Aircraft System (ROS UAS) Development Program**

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This Document is to be used for Educational Purposes Only

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# 1 Introduction

This document provides safety requirements for conducting flight demonstrations at the Austin Radio Control Association (ARCA) field.

Personnel safety is of utmost concern. The customer review team reserves the right to terminate the demonstration mission any time when safety or Contractor compliance become an issue. For example, systems exhibiting dangerous behavior are be subject to termination. Other grounds for termination include, but are not limited to, persistent violations of the no-fly zone boundaries, failure to follow instructions from the evaluation team, and a lack of situational awareness.

Contact the CO if there are any questions about the demonstration mission and safety requirements.

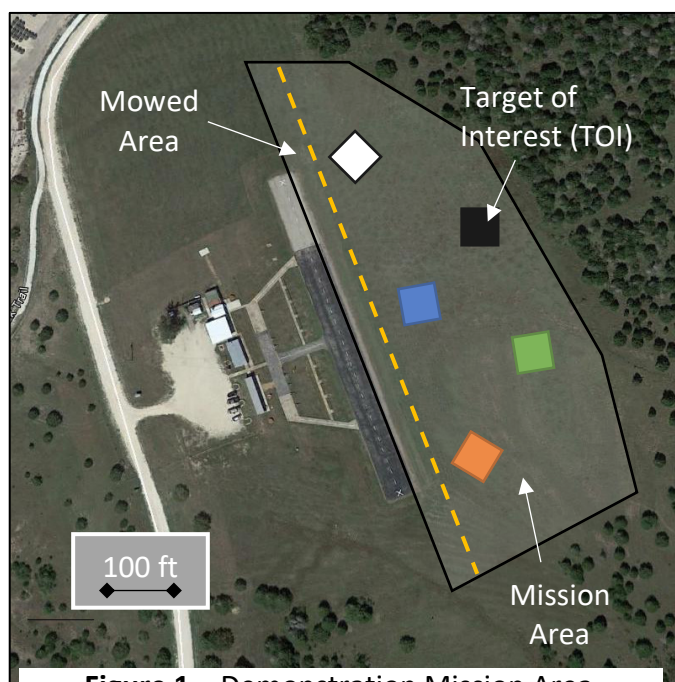
## 2 Demonstration Mission Requirements (DMR)

### 2.1 Demonstration Planning

The demonstration mission plan, presented at a Flight Readiness Review (FRR), shall include predicted mission speeds, altitudes and bank angles appropriate for the demonstration day atmospheric conditions (barometric pressure, temperature, and winds).

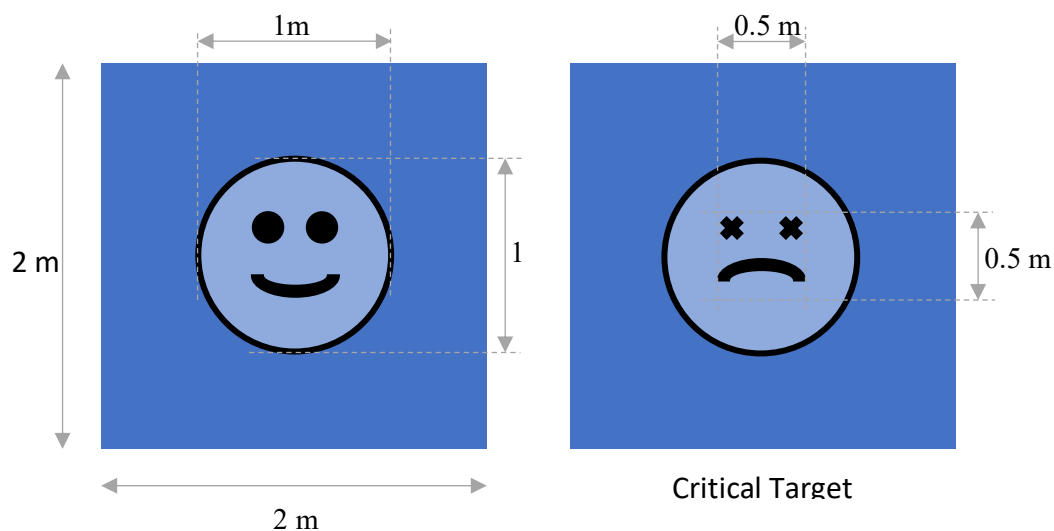
### 2.2 Demonstration Area

The demonstration mission shall be conducted at the Austin Radio Control Association (ARCA) field described at [austinrc.org](http://austinrc.org). In Figure 1, the field is approximately to scale, but the targets shown are not and do not reflect actual coloring or placement.



**Figure 1 – Demonstration Mission Area**

The demonstration mission area is a grassy area east of the runway, beyond the mowed area, as shown in Figure 1. It covers approximately 300,000 ft<sup>2</sup>. Up to five 2×2 meter, Targets of Interest (TOI), representing subscale rooftops, are randomly scattered about the mission area. Objects approximately 1×1 meter in diameter are placed on some TOI, indicating that they are candidate targets (CAT), potentially needing a rescue response. One CAT, the Critical Target (CRT), has a 50×50 cm feature, shown in Figure 2, which identifies it as needing assistance.



**Figure 2 – Example of Candidate and Critical Targets**

## 2.3 System Setup

Pre-flight system setup consists of Contractor activities needed to get the ground support and aircraft ready for flight. Timed setup shall occur at or before a time designated by the Customer. At the discretion of the Test Director, the Contractor may request and receive approval for an earlier timed setup, e.g., to enable an in-flight functional system check.

Forty-five minutes of pre-flight setup time is available prior to the demonstration flight for air vehicle, ground station and communications equipment assembly, setup, and demonstration of safe operational functionality. Timed setup starts when all equipment is unloaded from transport vehicles and placed in a Customer designated location adjacent to the flight line. Setup concludes with an official vehicle weight and balance check. If setup continues in excess of the 45 minutes, the mission clock starts immediately and is paused when setup is complete.

## 2.4 Mission Brief and Commencement

Before flight, a pre-mission brief is conducted while the mission clock paused. After the pre-mission brief is complete, clearance to taxi is requested from a designated Customer evaluation team member. Information needed for approval includes a Contractor prediction of ground roll at actual atmospheric conditions at takeoff plus wind speed and direction. Upon approval, the Customer safety pilot performs taxi to the runway threshold.

## 2.5 Takeoff

Only one aircraft shall use the runway for takeoffs and landings at any given time. Systems using alternative launch and/or recovery methods shall operate from adjacent designated takeoff and landing areas. Clearance from a designated Customer evaluation team member shall be requested prior to takeoff. The mission clock starts (or resumes) and the flight clock starts when the takeoff roll begins.

## 2.6 Mission Capability Demonstration

The mission capability demonstration proceeds as quickly as possible through the five mission phases in order – deployment, search, surveillance, package delivery, and return to base – and concludes with delivery of mission data and map. The flight clock is limited to 40 minutes to preclude running out of power. The Customer safety pilot lands the aircraft immediately if the maximum flight time is exceeded or there are other safety concerns.

## 2.7 Deployment

Upon reaching cruise altitude, the aircraft simulates a rapid deployment from base to the search area by flying orbits over the demonstration area to meet the KPP1 distance and speed

requirements in CDD Section 5.1. Once the Contractor has finished the deployment, the evaluators shall be notified, and the mission proceeds to the surveillance phase.

## 2.8 Search

The search phase starts after the Contractor has declared arrival at the search area. The aircraft then flies over and photographs each TOI. Once the Contractor has finished the search, the evaluators shall be notified, and the mission proceeds to the surveillance phase.

At the end of the mission, the Contractor shall submit:

- An image from the camera for each TOI found (up to five)
- The over-flight time (UTC hh:mm:ss.s) for each image
- The aircraft GPS coordinates at the time each image was taken

Search performance is evaluated by comparing the reported GPS coordinates of the TOI with the known GPS coordinates of the TOI. The differences for all TOIs are summed and scored as described in CDD Section 5.2.

## 2.9 Surveillance

The surveillance phase starts after the Contractor has declared end of search. The two Contractor-identified CATs shall be surveilled for at least three minutes each. Each surveillance segment shall provide continuous video of the target while in a stable orbit. The evaluators observe live video to assess surveillance quality. The beginning and end of each surveillance segment shall be announced and recorded. Once the Contractor has finished surveillance, the evaluators shall be notified. Then the mission proceeds to the delivery phase.

At the end of the mission, the Contractor shall submit a surveillance log, in Customer format, of aircraft GPS telemetry during the surveillance segments along with the surveillance segment start and end times.

To evaluate surveillance performance, the observing evaluator measures the time the CAT is in view during the surveillance segment. The segment start and end times are used to extract trajectory data from the GPS telemetry log. The trajectory for each segment is compared to a circle, and its center is compared to the known location of the nearest CAT. The segment timing and trajectory are scored as in CDD Section 5.2.

## 2.10 Package Delivery

The package delivery phase starts after the Contractor has declared the end of surveillance. ADP(s), as defined in CDD Section 8.2, shall be delivered to the critical target (CRT) while flying a stable, upwind, constant-heading trajectory. Any number of ADPs may be delivered. However, only one drop shall be made per pass over the CRT. Approval to drop shall be requested before

each pass. The beginning of a pass and its associated drop time shall be announced and recorded. Once the Contractor has finished the delivery phase, the evaluators shall be notified.

At the end of the mission, the Contractor shall submit 3 images, separated by at least 1 second, from the camera for each pass: at the beginning of the pass, in the middle of the pass, and over the CRT. The Contractor shall submit a log, in customer format, of aircraft GPS telemetry from the delivery phase along with the pass start and end times.

ADP delivery performance is determined by the ADP impact distance to the CRT (miss distance). The miss distance is measured with a tape measure from the center of the CRT square area (the rooftop) to the center of the ADP impact. See CDD Section 5.2 for scoring information.

The camera control TPM is based on accurately pointing the camera crosshairs at the target in the first two images of the pass, as described in CDD Section 5.3.

### 2.11 Return to Base and Landing

The return to base phase starts after the Contractor declares completion of package delivery. The aircraft shall simulate return to base from the search area by flying orbits over the demonstration area to meet the KPP1 distance and speed requirements in CDD Section 5.1. Upon completion of the return to base, the aircraft lands. The flight clock is stopped when the aircraft comes to a complete stop on the runway.

### 2.12 Mission Completion

The mission is complete – and the mission clock ends – once the following has occurred:

- All aircraft are grounded and have cleared the runway
- All transmitters are off
- The customer has been notified that the mission attempt is complete
- The customer has received the mission data package (see Section 2.13) and mission area map (see Section 2.14).

### 2.13 Mission Data Package

A Mission Data Package derived from on-board EagleTree digital data shall be submitted in Contractor format on a USB flash drive containing:

- All code and/or scripts required to view and apply the data
- TOI images from search phase (up to five) with corresponding aircraft GPS coordinates
- Surveillance segment start and end times
- Drop pass start and end times
- Three images of each drop pass
- Log of aircraft GPS data (3D position & velocity) encompassing surveillance and delivery
- Mission area map if in digital form, otherwise on paper.

## 2.14 Mission Area Map

The Contractor shall produce and deliver a mission area map, in physical or digital form. The map shall be constructed to provide actionable information to public safety responders. All TOIs, CATs, and CRTs shall be located on the map with their GPS locations called out.

The map is evaluated on positional accuracy, detail of content, and presentation. The content and presentation are judged qualitatively for "quality". Examples of qualitative judging from lowest-scoring to highest are given in Table 2.14.

**Table 2.14** - Example map judging criteria ordered roughly by "quality"

Format	Imagery	Intelligence
Hand-drawn map	None	None
Published digital map	Video freeze frame	Images keyed to map
Published digital map	Imbedded images	Multiple views keyed to TOI
Mission generated map	Imbedded video	Quality video keyed to TOI



### 3 Demonstration Safety Requirements (DSR)

#### 3.1 Maximum Altitude

All ground and flight operations shall be conducted in accordance with FAA Small Unmanned Aircraft Rule (Part 107). In particular, the maximum flight altitude shall be less than 400 feet AGL.

#### 3.2 Minimum Altitude

All phases of flight operations, except takeoff and landing, shall be conducted above 100 feet AGL, to ensure personnel safety and UAS survivability.

#### 3.3 Academy of Model Aeronautics Safety Handbook

All ground and flight operations shall be conducted in accordance with the “Academy of Model Aeronautics Safety Handbook (dated 1 Jan 2018)”.

#### 3.4 ARCA Field Rules and Code of Common Sense

All ground and flight operations at the ARCA Field shall be conducted in accordance with the “Austin Radio Control Association Field Rules and Code of Common Sense” (dated Oct 2016), including adhering to no-fly zones and boundaries.

#### 3.5 Customer Designated Pilot

All flights shall be controlled by the Customer designated pilot.