Program Letter for Nighthawk UAS Experimental Certificate

Registered Owner Name:	**Aircraft Builder:**
Applied Research Associates, Inc. (ARA)	Applied Research Associates, Inc.
Registered Owner Address:	**Year Manufactured:**
250 Beanville Rd	2013
Randolph, VT 05060	**Aircraft Serial Number:**
Aircraft Description:	AV-101
Nighthawk UAS (Analog Version)	**Aircraft Model Designation:**
Aircraft Registration:	Nighthawk IV
N489EA	**Engine Model:**
	AXi 2212/20 Gold Line – electric motor
	Propeller Model:
	Graupner CAM Folding Prop 20-11

1. Overview of Project. The applicant must provide a general explanation and overview of the project, indicating any past flight history or experience for consideration. The applicant must provide enough detail for the FAA to understand the program's purpose and need for an experimental certificate for a UAS or OPA, including the following:

a. Definition of the Experimental Purpose. Provide a definition of the experimental purpose(s) under which the aircraft is to be operated (14 CFR § 21.191, Experimental certificates).

The Nighthawk UAS activity is in support of engineering research and development for enhancements to operating capabilities, and verification of design changes implemented within the hardware or software for operating the Nighthawk. Several development activities are underway related to alternate payload modules, longer endurance batteries, enhanced wireless radio communication links, as well as refinement to the autopilot module that will be supported by experimental operations. As these configurations are available they will be reviewed with the FAA for inclusion under the experimental certificate approval. The initial configuration aligns with the production aircraft.

The Nighthawk UAS will also be used for crew training of personnel in the operation of the Nighthawk. This training will involve operation and checkout of personnel for currency requirements on operating the Nighthawk UAS as well as training additional personnel in the operation of the UAS while under the supervision of trained operators.

The Nighthawk UAS will also be used in support of market survey to perform demonstrations of capabilities for potential customers, to determine mission applicability, and to identify enhancement opportunities to meet potential customer needs.

b. Description of the Purpose/Scope of the Experimental Program. Provide a description of the purpose/scope of the experimental program for each experimental purpose sought (§ 21.193(b) and (d), Experimental certificates: general).

The scope of the experimental activity associated with the Nighthawk UAS is to perform operational verification checks associated with the UAS. These checks verify the proper operation of the UAS including integration and operation of the autopilot, communication system and payload interfaces. Specifically, the testing is geared toward verifying the following items:

- *Ability to properly load and execute a mission plan*
- *Ability to successfully launch the UAS*
- *Verify dynamic performance of installed GPS receiver to acquire and track satellites*
- *Verify the ability to establish and maintain a planned mobility path*
- *Verify communication data link performance*
- *Verify landing performance*
- *Determine performance of payloads (e.g., camera and video feedback)*
- *Observe proper flight characteristics during the test flight*

Flight test operations will utilize profiles similar to the production flight test needs to support initial verification flight test activities related to system enhancements.

c. Description of the Purpose/Scope of the Special Flight Permit Program. Provide the purpose of the flight. Include all information required by § 21.199(a), Issue of special flight permits.

N/A (this application is for an Experimental Certificate, not a Special Flight Permit)

2. Definition of Flight Areas. Provide a definition of the area(s) in which the experimental flights and, if applicable, production flight testing will be conducted. Indicate whether or not the same flight test area will be used for both purposes. Include the following:

a. The areas over which the flights are requested to be conducted and the address of base operation (§ 21.193(d)(3)).

The proposed areas of operation are defined by the operating areas shown in Section 2b. Main base of operations is on ARA leased property; this area will be used for both experimental and production flight testing. The address for the base of operations is: Applied Research Associates, Inc., 250 Beanville Road, Randolph, VT 05060.

Additionally, we have selected three alternate operating areas located in Texas, Virginia and Florida for the purpose of experimental flights. See Section 2b for a detailed description of these areas.

b. The proposed flight test area using latitude and longitude on an aeronautical chart or aerial photograph. For example, if the perimeter of the proposed flight test area is in the shape of a rectangle, the latitude and longitude of the corners must be stated. The distance of each leg of the perimeter must be stated.

Vermont Operating Area

The operating area for Nighthawk UAS operations (as shown in Figure 1 and Figure 2) is an area surrounding the ARA Randolph, VT facility. This operating area encompasses three potential launch points (see Figure 2), where the primary point will be the ARA facility. The area is bounded by a southern line from Lat(43°54'24"N) Lon(72°39'32"W) running easterly for approximately 1.8 nm to Lat(43°54'32"N) Lon(72°37'0"W); then running in a northerly direction for approximately 2 nm to Lat(43°56'35"N) Lon(72°37'26"W); then running in a southwesterly direction approximately 1.3 nm to Lat(43°55'48"N) Lon(72°38'54"W); then running in a southerly direction approximately 0.7 nm to Lat(43°55'8"N) Lon(72°38'48"W); then running in a westerly direction approximately 0.7 nm to Lat(43°54'55"N) Lon(72°39'49"W); returning in a southerly direction approximately 0.6 nm to the starting point at Lat(43°54'24"N) Lon(72°39'32"W). Within this area the primary operations area would be centered around our ARA facility, located at approximately Lat(43°54'47"N) Long(72°39'35"W).

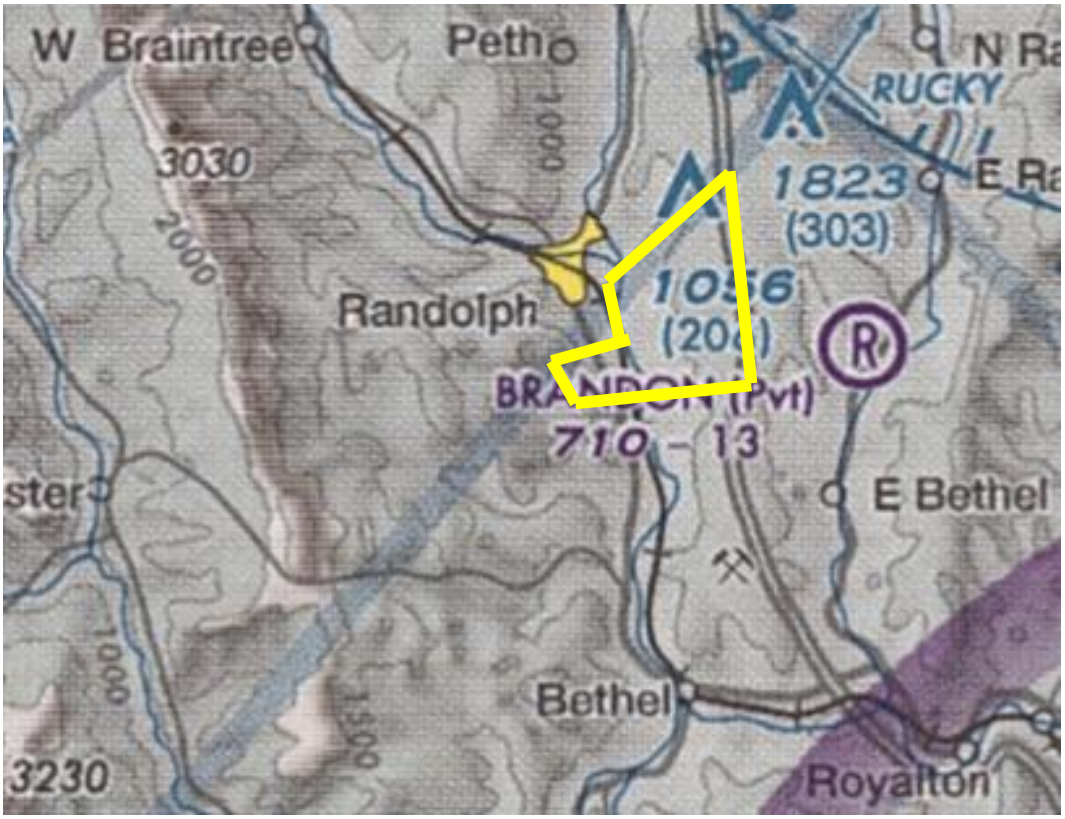

Figure 1. Map of operating area on FAA sectional map.

Vermont Operating Area

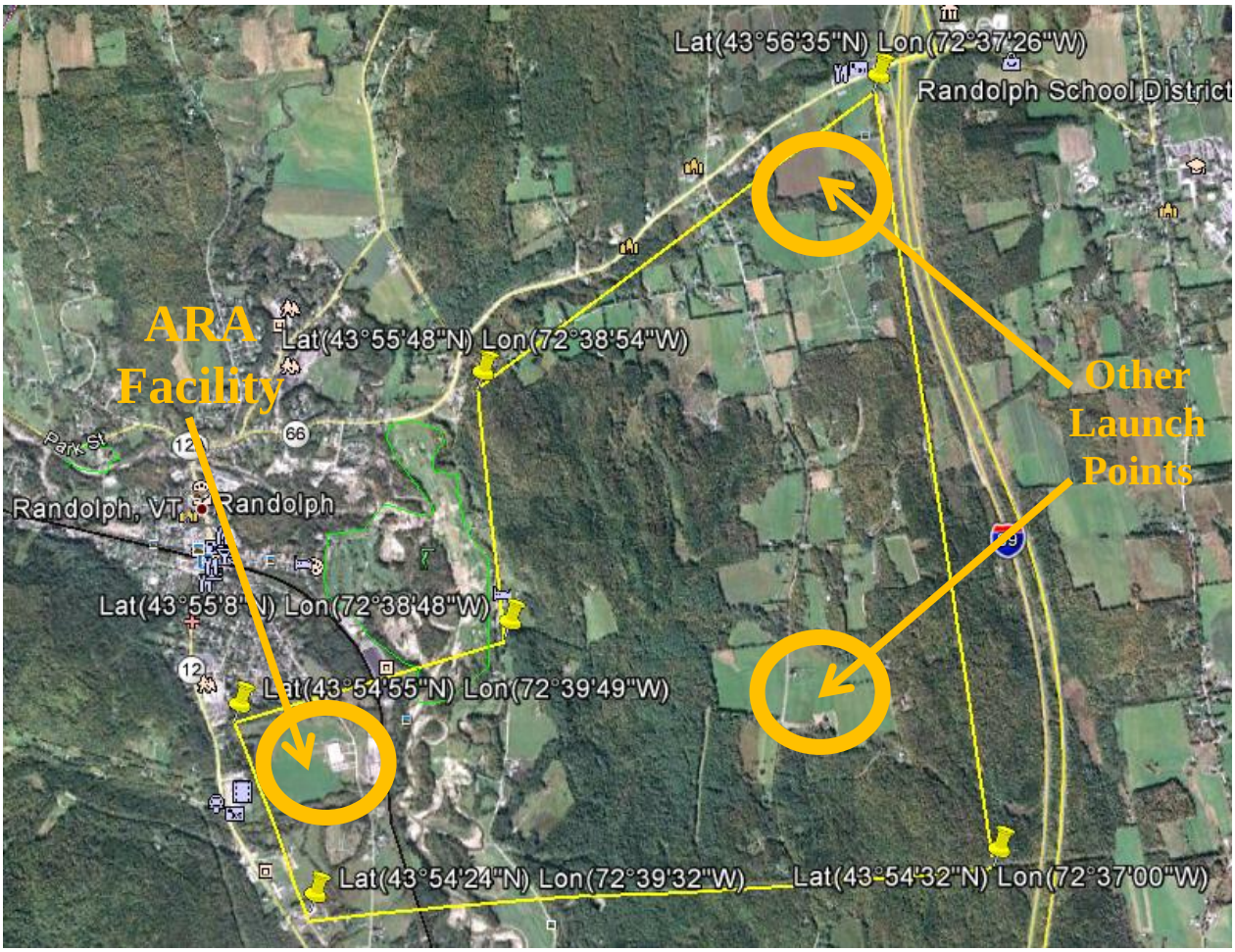

Figure 2. Map of operating area (from Google Earth), outlined in yellow, showing ARA's facility (primary launch point) and two other planned launch points within the operating area.

Florida Operating Area

The proposed Florida operating area for Nighthawk UAS operations is as follows: The northern border of the proposed operating area is established by a line starting at 30°14'25.00"N 85°31'50.00"W and moving easterly approximately 5.2 nautical miles to 30°14'25.00"N 85°255'0.00"W. From this point the eastern border is established by a southerly line approximately 2.7 nautical miles long to 30°11'45.00"N 85°25'50.00"W.From this point the southern border is established by a westerly line approximately 5.2 nautical miles long ending at 30°11'45.00"N 85°31'50.00"W. From here the western boundary line travels north approximately 2.7 nautical miles to the original starting point, 30°14'25.00"N 85°31'50.00"W. See Figure 3 and Figure 4 below. Requested operating altitude within the entire operating area would be up to a maximum of 500 ft AGL.

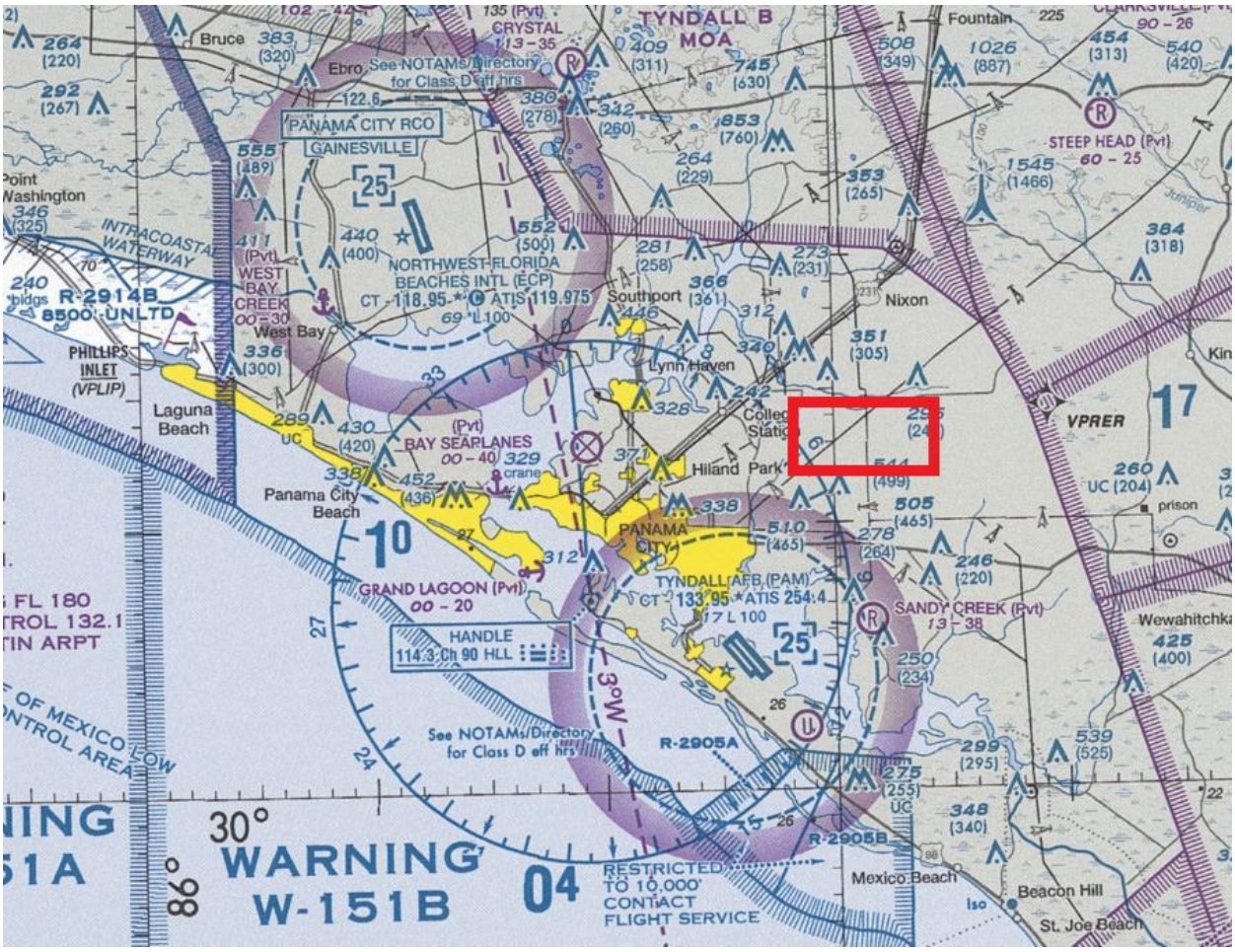

Figure 3. Map of proposed Florida operating area on FAA VFR sectional map.

Florida Operating Area

3/25/20143/25/2014

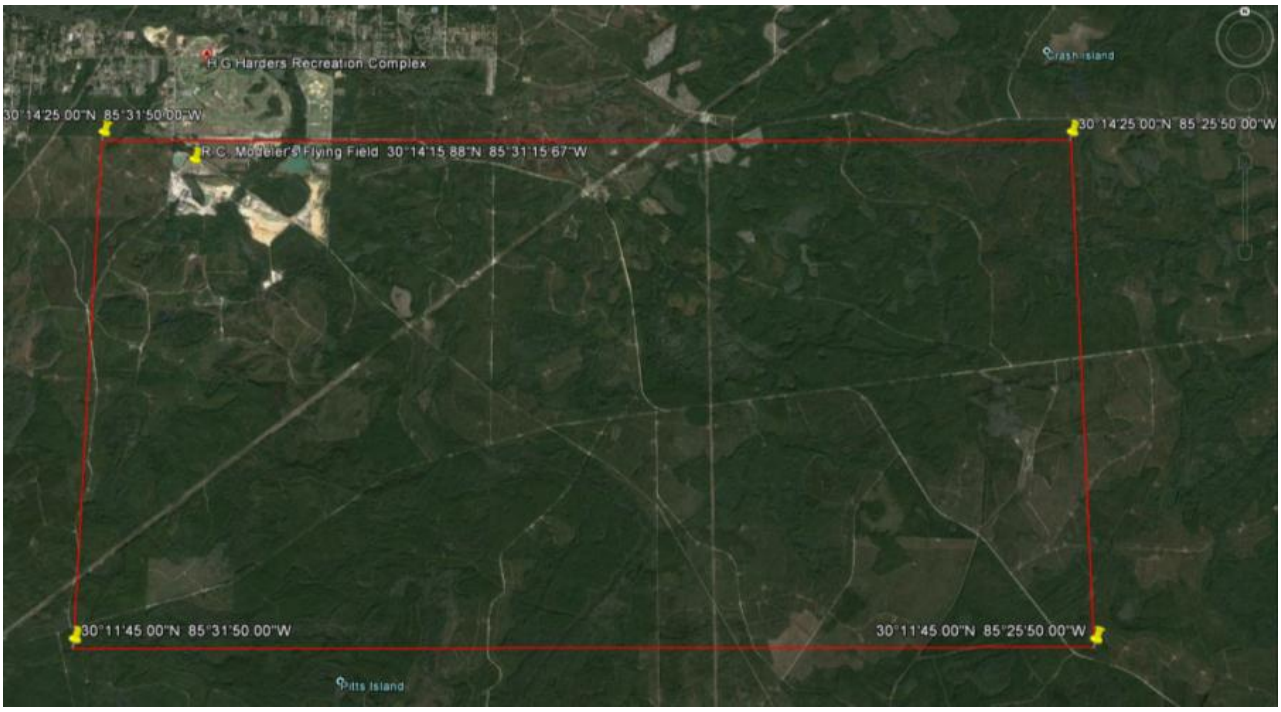

Figure 4. Map of proposed Florida operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

Virginia Operating Area

The proposed Virginia operating area for Nighthawk UAS operations is as follows. The northern border of the proposed operating area is established by a line starting at 36°52'30.00N 76°59'0.00W and moving easterly approximately 6.5 nautical miles to 36°52'30.00N 76°50'60.00"W. From this point the eastern border is established by a southerly line approximately 4 nautical miles long to 36°48'30.00N 76°50'60.00"W. From this point the southern border is established by a westerly line approximately 6.5 nautical miles long ending at 36°48'30.00"N 76°59'0.00W. From here the western boundary line travels north approximately 4 nautical miles to the original starting point, 36°52'30.00N 76°59'0.00W. See Figure 5 and Figure 6 below. Requested operating altitude within the entire operating area would be up to a maximum of 1000 ft AGL.

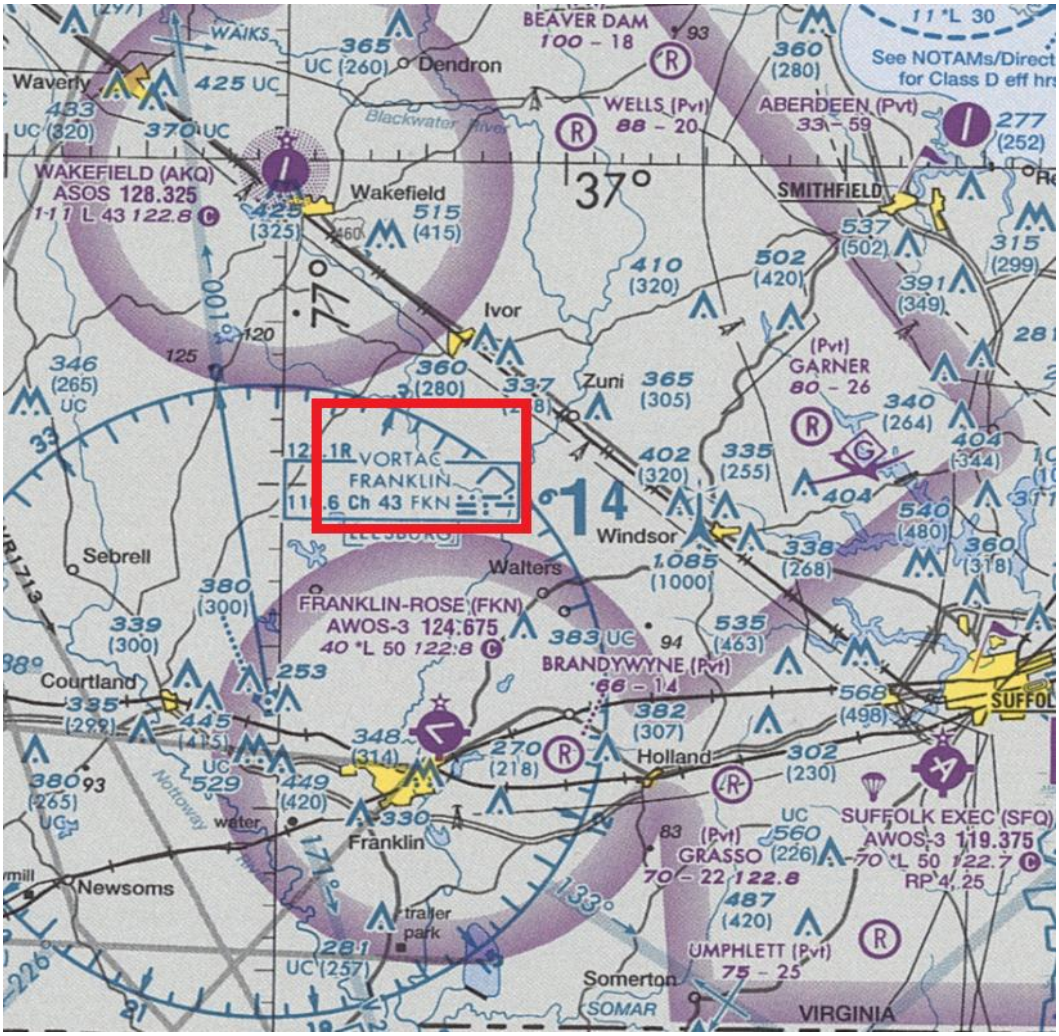

Figure 5. Map of proposed Virginia operating area on FAA VFR sectional map.

Virginia Operating Area

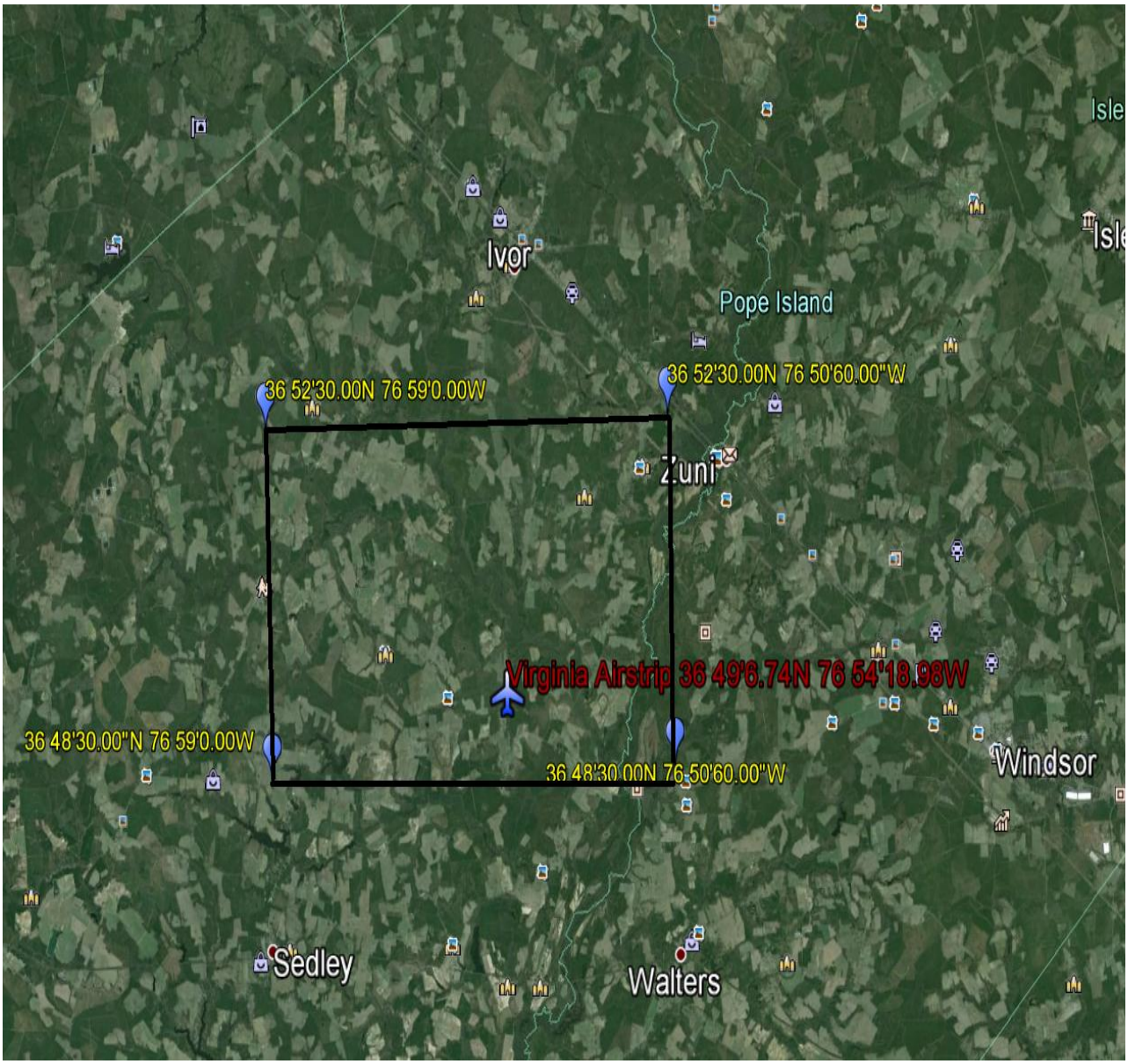

Figure 6. Map of proposed Virginia operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

Texas Operating Area

The proposed Texas operating area for Nighthawk UAS operations is as follows. The northern border of the proposed operating area is established by a line starting at 31°17'22.00"N 103°16'41.30"W and moving easterly approximately 4.5 nautical miles to 31°17'22.00"N

103°11'31.45"W. From this point the eastern border is established by a southerly line approximately 3.1 nautical miles long to 31°14'15.30"N 103°11'31.45"W. From this point the southern border is established by a westerly line approximately 4.5 nautical miles long ending at 31°14'15.30"N 103°16'41.30"W. From here the western boundary line travels north approximately 3.1 nautical miles to the original starting point, at 31°17'22.00"N 103°16'41.30"W. See Figure 7 and Figure 8 below. Requested operating altitude within the entire operating area would be up to a maximum of 1000 ft AGL.

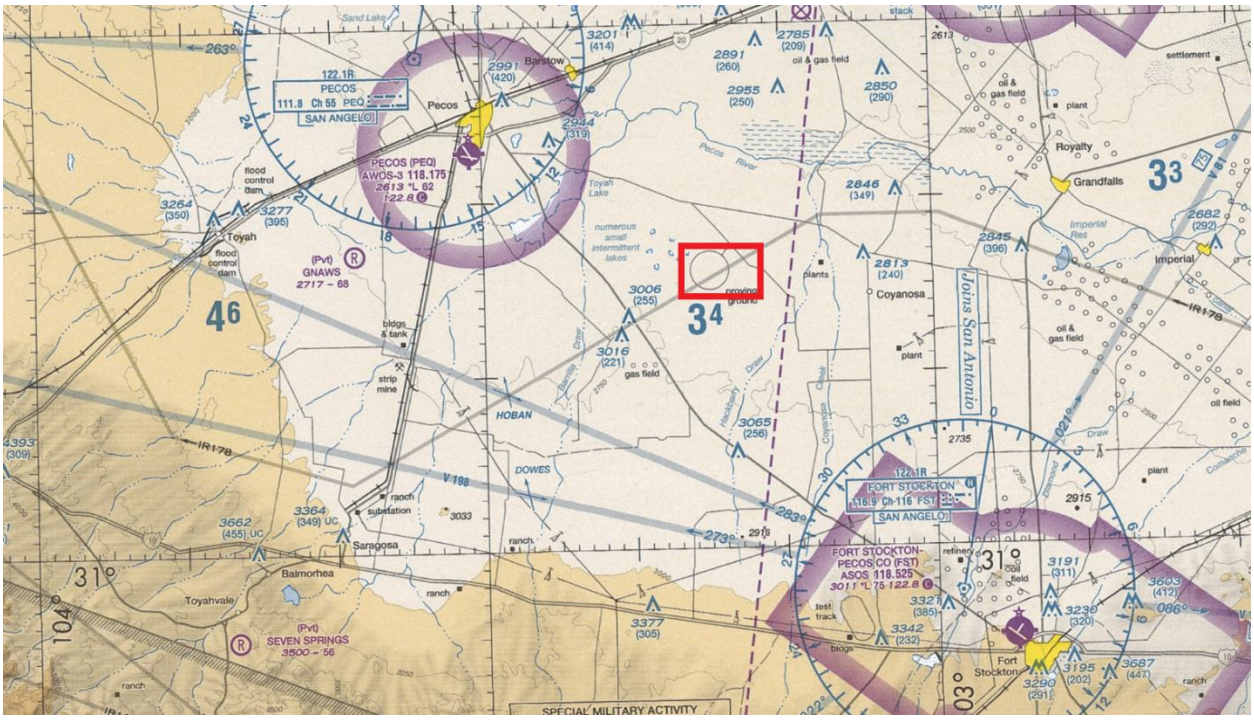

Figure 7. Map of proposed Texas operating area on FAA VFR sectional map.

Texas Operating Area

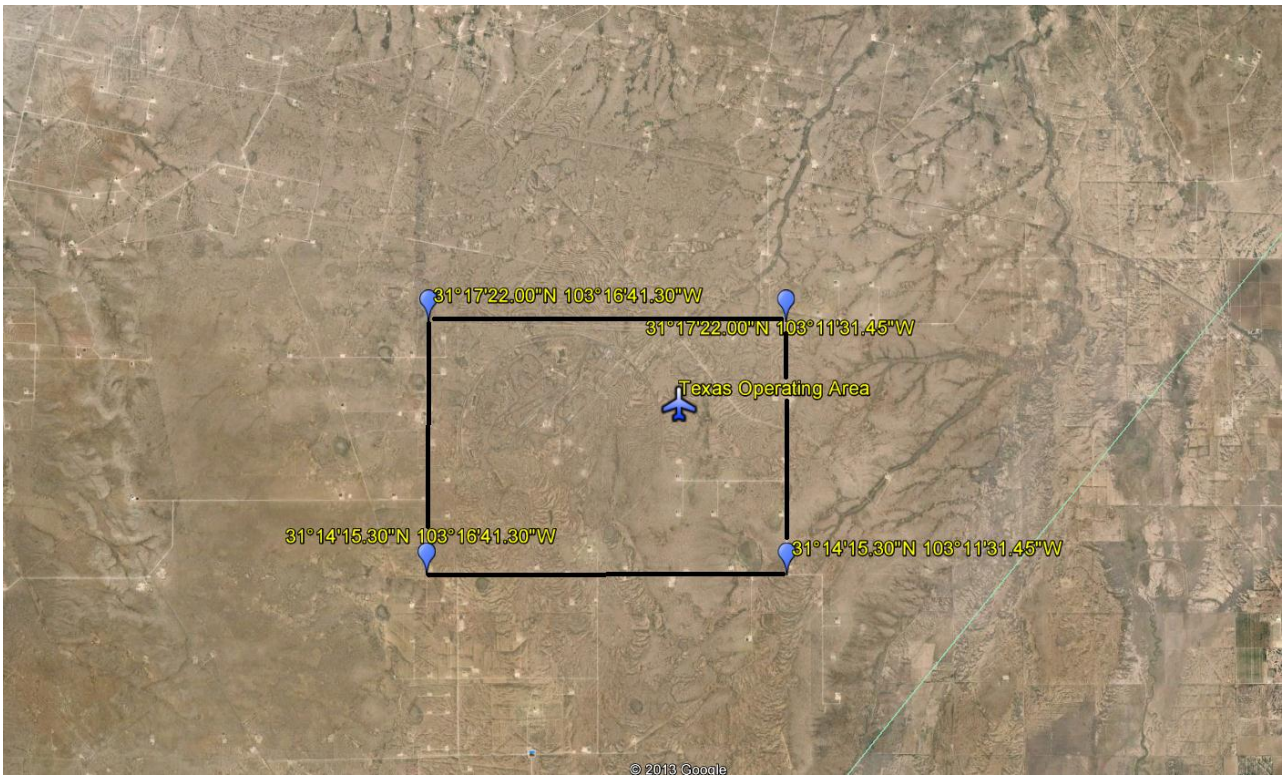

Figure 8. Map of proposed operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

c. Airspeed and altitude operating parameters, number of flight hours, number of flights, and program duration for each test flight area.

The Nighthawk UAS has a maximum airspeed of 40-45 knots, and cruise airspeed of 22-28 knots. Operating altitude within the entire operating area will be less than 1,000 ft AGL. The maximum flight endurance of the Nighthawk is approximately 70 minutes. Experimental flights will vary in duration but typically would not exceed 60 minutes. The quantity and frequency of experimental flights will be dependent on the nature of testing being done and will be coordinated with any production flight test activity.

d. Class of airspace to be used.

Class G.

e. Whether minimum fuel requirements of 14 CFR § 91.151, Fuel requirements for flight in VFR conditions, will be met.

The Nighthawk is an electrically driven UAS based on an installed battery; minimum fuel is not applicable.

f. Whether flight testing will include payload testing. If so, briefly describe the payload and its operation.

Flight testing may involve the verification of installed payload modules for the Nighthawk. The data stream for these modules is included in the data telemetry stream associated with UAS control and monitoring. The payloads for Nighthawk are electro-optical or infra-red sensor units that provide video feedback to the ground station. The ground station has the ability to steer the Nighthawk to maintain video on an area of interest. Two different payload modules are currently available, with potential for future payloads to be part of the experimental test configuration.

g. Considerations that need to be taken into account regarding payloads.

Nighthawk payloads are installed in an integral module for the UAS. The UAS provides power and data link support for transmitting data from the payload to the ground station.

h. Whether the aircraft will perform any aerobatic maneuvers as defined by § 91.303.

Aerobatic maneuvers are not part of the planned testing for the Nighthawk UAS.

i. Flight rules and weather conditions, for example, VFR and visual meteorological conditions (VMC).

Nighthawk flight testing will be conducted under VFR and VMC conditions, and will maintain line-of-sight (LOS) communication and operation of the UAS.

3. Aircraft Configuration. Attach three-view drawings or three-view dimensioned photographs of the aircraft (see § 21.193(b)(4)). Describe any ground support equipment (power carts, air carts, towing equipment, etc) required for aircraft operations. Include a description of aircraft/system performance characteristics including the following:

a. Wing span. *26.0 in*

b. Length. *24.8 in*

c. Powerplant. *AXi 2212/20 Gold Line Electric DC Brushless Motor*

d. Maximum gross takeoff weight. *2.4 lbs*

e. Fuel capacity. *N/A*

f. Payload capacity. 0.*5 lbs*

g. Maximum altitude. *37,000 ft MSL*

h. Endurance. *70 minutes maximum*

i. Maximum airspeed. *45 knots*

j. Control/data frequencies.

The Nighthawk dual-radio with analog video link configuration uses separate data up/downlink and video downlink frequencies. For up/downlink data transmittal, a frequency band with a center channel of 380 MHz and a span of 6 MHz is used. A variant of this particular communications package also supports up/downlink data transmittal at a center channel frequency of 410 MHz. Video downlink transmissions offer 10 channel selections with a center channel frequency of 1.785 GHz.

The single-radio digital data link configuration uses only one up/downlink frequency band for both data and video. There are several channels for operation of this radio link in the following frequency ranges: 2.2997-2.3133 GHz and 2.3497-2.3632 GHz.

k. Guidance and navigation control.

Nighthawk UAS incorporates an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system, complemented with the intuitive, easy-to-operate and lightweight Ground Control Station (GCS), allow operators with limited flight experience to easily plan and execute missions. The Nighthawk UAS contains a GPS receiver module, three-axis accelerometers, three-axis magnetometers, and three-axis rate gyros to support guidance and navigation control. Altitude and airspeed are provided by a pitot static sensor system. The aircraft relies on its advanced autopilot for both the pre-programmed and real-time changes to its flight path. In the event of lost link with the aircraft, the aircraft will fly a pre-programmed flight path and recovery route while attempts to re-establish link are made. If link is not re-established, the aircraft will recover autonomously in accordance with its programmed lost link procedures at a preselected lost link landing site.

Nighthawk UAS Description

The Nighthawk weighs 2 pounds, with an airframe made of carbon fiber molded for enhanced durability. It is capable of carrying a half-pound payload, with a cruise speed of 22-28 knots, and a typical operational altitude of 200-500 ft AGL. Nighthawk (shown in Figure 3) is powered by a quiet electric motor and can remain airborne for up to 70 minutes. Upon recovery, the rechargeable battery or modular plug and play imagers can quickly be swapped out and the aircraft can be re-launched within five minutes. The Nighthawk UAS disassembles into four components (fuselage, wing, payload, tail), but can be transported in a tube while fully assembled. The system is completely man-portable, offers modular multi-mission imaging sensors, and can be operated by one person, though a two-person team is optimum. The Nighthawk can be hand-launched

and, aided by GPS, can be guided to an accurate recovery via a skid-landing on the ground. The Nighthawk UAS provides a live video feed thru an RF link to the portable Ground Control Station (GCS). The GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery (same as aircraft battery), integrated Communications Box (Comms Box) with cables, and antennas. Figure 4 shows three-view schematic drawings for the Nighthawk UAS.

Figure 3. Pictures of ARA's Nighthawk UAS.

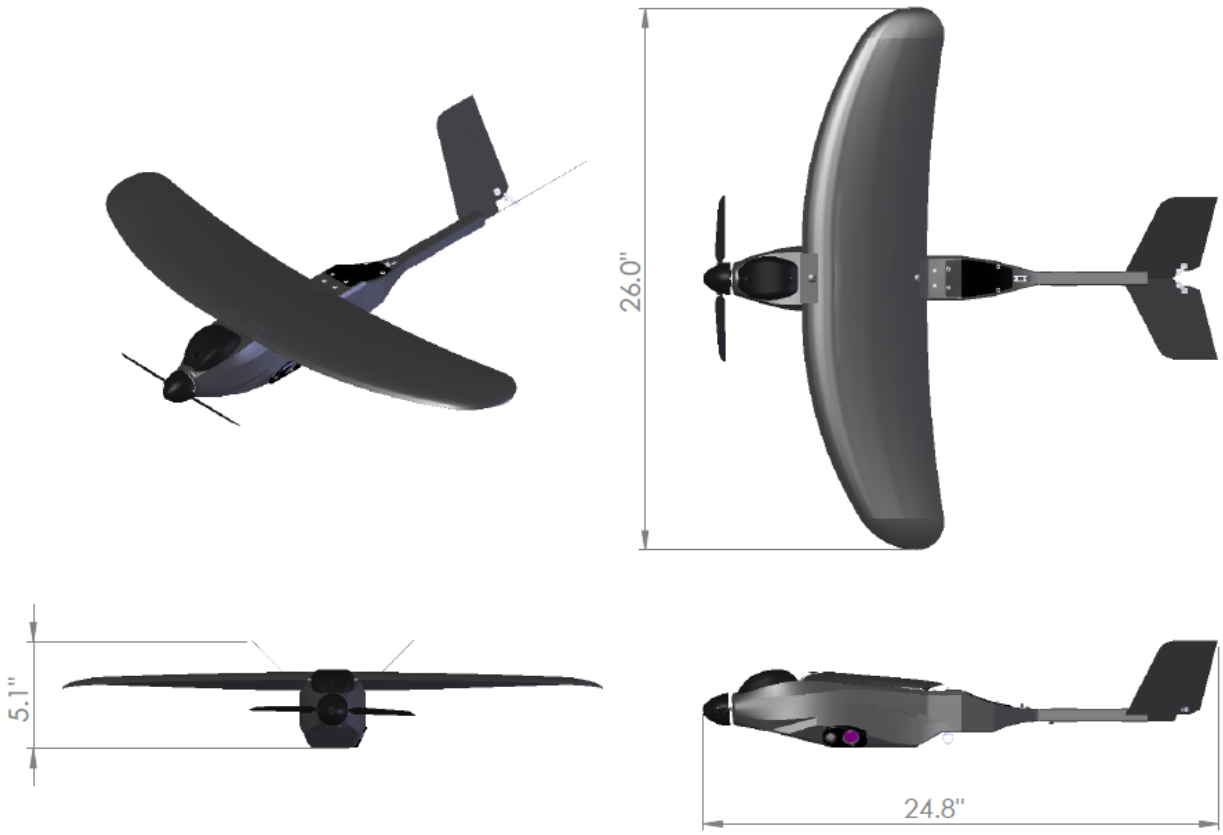

Figure 4. Schematic drawing of ARA's Nighthawk UAS showing overall dimensions.

4. Inspection and Maintenance (14 CFR part 91 – General Operating and Flight Rules, Subpart E – Maintenance, Preventive Maintenance, and Alterations).

a. Description of the Program. Describe the inspection and maintenance program that will be used to maintain the aircraft and related systems, including ground stations and/or other support systems.

The Nighthawk UAS system shall be inspected prior to each flight by completion of a pre-flight inspection. Any discrepancies noted at that time shall be repaired or corrected prior to flight. The Nighthawk UAS system will also be subject to an annual inspection. This annual inspection is similar in scope and detail to that of 14 CFR part 43 appendix D and has been submitted as part of the Safety Checklist. Please reference that document for details.

b. Required Documentation. Provide a copy of the flight manual, if applicable; current weight and balance report; and equipment list.

The Nighthawk Operations and Maintenance Manuals have been developed, and will be updated and verified as part of our R&D testing. Current weights range from approximately 1.8 to 2.0 pounds, depending on configuration. Center of gravity is held

to between 2.0 and 2.125 inches (via ballast if necessary) behind center wing leading edge until CG limits are experimentally determined.

5. Pilot Qualification (14 CFR 61.3, Requirement for certificates, ratings, and authorizations, and 14 CFR 61.5, Certificates and ratings issued under this part).

a. Pilot Qualifications. Describe the qualifications for each pilot.

All pilots need to have completed ARA training regarding operation of the Nighthawk UAS and crew resource management training. In addition, all pilots will have successfully completed private pilot ground school and an associated written exam, and will obtain a Class 2 medical certificate. For flights above 400 ft AGL, pilots will have a current Private Pilot's License.

b. Pilot Certifications. Pilots must be qualified/certificated in the appropriate category of aircraft, that is, rotorcraft, powered lift, and airplane.

ARA's primary Nighthawk UAS pilot holds a current private pilot license. ARA's primary Nighthawk UAS pilot will provide training for additional pilots who will be allowed to fly the Nighthawk under this experimental certificate in the designated area. Pilot training will include specific training regarding operation of the Nighthawk (as noted in item "c" below) and crew resource management training. In addition, all pilots will successfully complete private pilot ground school and an associated written exam. For flights above 400 ft AGL, pilots will have a current Private Pilot's License.

c. Pilot Training. Describe the internal training program to qualify pilots.

All pilots complete an ARA training program to support operating and testing of the Nighthawk UAS. This training includes the following:

- *Overview, System Setup and Teardown, Major Component Details*
- *System Operation, Software & Mission Planning*
- *Demonstration Flights*
- *Simulated Mission Instruction, Launch Procedures*
- *Field Setup*
- *Launch (Throwing) Practice*
- *Student Flights under supervision*
- *Altitude Mode operation*

Students demonstrate proficiency in the following elements as part of the training for flight certification conducted by ARA:

- *Preflight Checks – ensures users can operationally set up and check the UAS for airworthiness*
- *Launch Wizard – users can properly prepare the UAS for flight and launch*
- *GCS Preparation - users can properly use mapping and imagery for unknown areas and zone overlays*
- *Proper Mission Planning – ensure correct software execution, ensure safe flight plans are prepared, situational awareness is maintained for the flying area, identify proper launch and recovery areas*
- *Ability to edit a mission in flight – proficiency in re-tasking demonstrated*

- *Recovery Proficiency – demonstrates competency to land the UAS within specified landing zone*
- *Properly Operate Payload – demonstrates understanding capability of different modes and usage, recording payload imagery*
- *Unplanned Event Correction – handling of contingencies*
- *Range Awareness – understanding the operational concept for operating in the test range (aviate, navigate, communicate)*

Pilots will also be trained in the operation within the defined airspace for the UAS test activity, including the following:

- *Rules and responsibilities for operating near other aircraft (91.111)*
- *Right-of-Way Rules (91.113)*
- *VFR Weather Minimums (91.155)*

d. Supplemental Pilots. Describe whether supplemental pilots will be used for the operation. Describe how supplemental pilots will be used. Describe the company's internal training program for supplemental pilots. Describe company procedures and requirements for maintaining currency and conducting a flight review for supplemental pilots.

Supplemental pilots may be assigned to a flight to assist the PIC but are not required. Supplemental pilots need to have completed ARA training regarding operation of the Nighthawk UAS and crew resource management training. In addition, supplemental pilots will have successfully completed private pilot ground school and an associated written exam, and will obtain a Class 2 medical certificate.

e. Qualifications and Training of Observers. Describe the qualifications and training of observers. Observer training is required for observers to communicate to the pilot any instructions required to remain clear of conflicting traffic. Acceptable observer training as a minimum must include, but is not limited to, knowledge about the following—

(1) The rules and responsibilities described in §§ 91.111 (Operating near other aircraft), 91.113 (Right-of-way rules: Except water operations), and 91.155 (Basic VFR weather minimums);

(2) Air traffic and radio communications, including the use of approved ATC/pilot phraseology; and

(3) Appropriate sections of the *Aeronautical Information Manual*.

Observers are trained to perform their function and training includes understanding applicable aviation regulations related to see and avoid, clear of clouds and right of way rules. The primary purpose of the observers is to identify when local aviation may approach the Nighthawk flight area. Once identified, the observer will inform the pilot who will take appropriate action.

Observers are trained to understand operation of the Nighthawk and be fully briefed by the pilot prior to launch. Observers will complete ARA's crew resource management training. Observers will have a current Class 2 medical certificate.

6. **Aircraft Registration and Identification Marking (14 CFR part 45).** All UAS and OPA are required to be registered and identified with the registration number. Aircraft must be marked in accordance with part 45 or alternative marking approval issued by AIR-200.

   The Nighthawk UAS will be registered and marked with its US registration number, in accordance with part 45 or as agreed to with AIR-200.

7. **ATC Transponder and Altitude Reporting System Equipment and Use (§ 91.215**). Describe the aircraft altitude reporting system.

   Nighthawk does not include a Transponder and Altitude Reporting System.

8. **Method for See-and-Avoid (§ 91.113).** Describe in what manner, or by what means, the requirement to see-and-avoid other aircraft will be met. Describe the expected performance of the chase plane.

   The operation of the Nighthawk UAS will be within sight of the ground observer to support monitoring the aircraft for other aircraft that may be in the area. As a small, slow-moving UAS operating at low altitudes, Nighthawk does not utilize a chase aircraft to support see-and-avoid.

9. **Safety Risk Management.** Provide a safety checklist that identifies and analyzes the hazards of UAS or OPA operations described in the program letter. (See a sample safety checklist in appendix D to this order.) Additional information is available by contacting the FAA Aviation Safety Inspector.

   Refer to the Nighthawk UAS Safety Checklist.

10. **System Configuration.** Provide a description of the ground and airborne equipment used to allow direct or indirect control of the UAS or OPA.

    As described in Section 3k, the Nighthawk airborne platform incorporates an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system, complemented with the intuitive, easy-to-operate and lightweight Ground Control Station (GCS), allow operators to easily control the aircraft as well as plan and execute missions. The Nighthawk UAS contains a GPS receiver module, three-axis accelerometers, three-axis magnetometers, and three-axis rate gyros to support guidance and navigation control. Altitude and airspeed are provided by a pitot static sensor system. The portable GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery, integrated Communications Box (Comms Box) with cables, and antennas.

    A pneumatic tube launcher can be used as an alternative launching method to the commonly used hand-launch method. The tube launcher consists of: 1) a tube in which the UAS with folded wings is inserted; 2) a launching mechanism, inside the tube, to provide pneumatic thrust to launch the UAS; 3) a control pendant to provide a means to trigger the launch; and 4) a rod, inserted into the bucktooth on the nose of the UAS, that is propelled by pneumatic force used to pull the UAS out of the tube. For tube launches, the propeller of the UAS remains off until it is powered up at 100% thrust as soon as it experiences the acceleration of launch.

11. System Safety—Flight Termination and Lost Link. Describe/explain the expectation of aircraft flight if fuel is starved. Describe/explain aircraft lost link and emergency recovery procedures. Provide an explanation of the flight termination system in detail.

Low Battery Power: *The Nighthawk motor is battery powered. Battery power is monitored by the system and provides the operator alerts as the battery becomes depleted. When the battery voltage dips below a threshold value, the aircraft begins navigating to a preprogrammed recovery point. If the aircraft is not landed by the operator before the battery reaches a critical value, the aircraft lands automatically via a slow descending spiral maneuver.*

Loss of Communication in Flight: *Indications of lost or intermittent communications are identified by audible and written warnings through the GCS. Other indicators of weak uplink include reduced number of bars in the Received Signal Strength Indicator (RSSI) and a change of color of the RSSI from green to yellow to red, as indicated on the GCS. Sustained loss of signal will activate the Loss of Signal Mission, as described next.*

Loss of Signal Mission: *The Loss of Signal Mission is to return to and orbit the launch point. If there is a sustained loss of communication for greater than five minutes, the Nighthawk UAS will proceed to the primary mission landing pattern and land. Restoration of communications at any time will not impact the UAS failsafe return to home mission until otherwise instructed. The UAS will not deviate from the Loss of Signal Mission until re-tasked by the user.*

Flight Termination: *The Nighthawk UAS does not include a flight termination system. The user can command the flight to terminate at any point by commanding an immediate landing.*

12. Command and Control. Provide a description of the system and/or procedures for command and control of the UAS or OPA.

As described in Section 3k, the Nighthawk UAS utilizes a fully autonomous flight system, incorporating an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system integrate with the intuitive and easy-to-operate lightweight GCS that allows operators with limited flight experience to plan and execute missions. During autonomous missions, the pilot maintains oversight of the Nighthawk UAS and can take over direct control through the GCS at any point in time.

Prior to launching the Nighthawk UAS, the planned operational mission is loaded to the UAS via data link communications. Following launch the UAS will execute the planned mission unless the ground station operator / pilot uploads a new mission, or takes direct control of the UAS operation through input control commands. An extremely useful mission override is the "Loiter Here Now" command. By simply selecting this override and clicking on a location on the map, the UAS will divert immediately to that commanded point and begin to orbit at the default altitude. The original autonomous mission can be reactivated at any time with "Cancel Override" or GOTO a primary mission waypoint.

13. Control Stations. Provide a description of the ground/airborne stations used to control the UAS or OPA.

The Nighthawk UAS implements an intuitive, easy-to-operate, lightweight Ground Control Station (GCS). The GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery (same as aircraft battery), integrated Communications Box (Comms Box) with cables, and antennas. The GCS laptop provides a main control screen to

support the operation and monitoring of the Nighthawk UAS. This screen supports a map overlay of terrain data, depicts mission route plan information, and provides the UAS operator situational awareness of the UAS condition and flight state. The control screen also provides user controls to allow the operator to provide command inputs to the UAS to change altitude, airspeed, and heading. The GCS application on the laptop computer utilizes a graphical user interface (GUI) that includes mission planning, UAS monitors, telemetry calculations, and 2-way communication with the aircraft.

14. Control Frequencies. Provide a description/listing of the frequencies used to control the UAS or OPA.

The Nighthawk dual-radio with analog video link configuration uses separate data up/downlink and video downlink frequencies. For up/downlink data transmittal, a frequency band with a center channel of 380 MHz and a span of 6 MHz is used. A variant of this particular communications package also supports up/downlink data transmittal at a center channel frequency of 410 MHz. Video downlink transmissions offer 10 channel selections with a center channel frequency of 1.785 GHz.

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