SPEEDFEST IX ALPHA CLASS

STATEMENT OF WORK

FOR A

HIGH-SPEED SPECIAL RECON FOR INSERTION UAV

1. **SUMMARY.** Contractors are requested to demonstrate their ability to quickly design, develop and test, a high-speed portable aircraft capable of conducting special reconnaissance prior to team insertion (SRI) mission. The primary mission objective of the aircraft is the ability to be point-launched, dash to the insertion area, and quietly perform live recon. Contractors will develop and demonstrate prototype aircraft subject to the objectives of this document, and the winning design will be chosen by a qualified team of judges selected from the aerospace industry, government, and academia.

2. **REFERENCES.** Official AMA National Model Aircraft Safety Code 105. If Applicable: AMA Turbine Waiver Application 510-d, AMA Safety Regulations for Model Aircraft Powered by Gas Turbines 510-a.

3. **SCOPE.** This document includes all required objectives, Key Performance Parameters (KPP), Key System Attributes (KSA), and Measures of Performance (MOP), for the contractor to provide essential engineering, research, development, test and evaluation.

4. **DESIGN REQUIREMENTS AND CONSTRAINTS**. Aircraft not meeting the following list of requirements and constraints will not be considered for evaluation:

   4.1. Any commercially available propulsion system is allowed, including turbojets. Only factory-directed changes to the engine or control software are allowed.

   4.2. Design should be FOD resistant for engine longevity.

   4.3. If turbojets are used, design must satisfy *all* additional AMA requirements detailed in 510-a “Safety Regulations for Model Aircraft Powered by Gas Turbines”.

   4.4. Aircraft must be stable with good handling qualities. This must be demonstrated and certified by the contractor pilot before flying at the Speedfest event.

   4.5. Aircraft must have safety telemetry to monitor at least: flight system voltage, and airspeed. Voltage low warnings must be enabled.

   4.6. Control surfaces shall be linked to servos with 4-40 rods, Robart Super Ball horns. Clevis connectors must lock or be secured with tubing. Horns shall have the ball directly over the hinge line, and plates bolted on each side of the

control surfaces. Control surface under the horn plates must be solid. Control slop and flexibility must be minimal.

4.7. All servos must be mounted within a servo mount, and mechanically fastened.

4.8. All servos must be metal gear type.

4.9. Wiring, and any pneumatic harnesses must be labelled.

4.10. All servo and other electrical connections must have mechanical locks.

4.11. Flight control must be manual and under full control of the pilot only at all times. Contractors may only use the following radio systems: Futaba 2.4 GHz FASST (not FHSS) OR Jeti Duplex system with 2.4GHz primary, *and* 900MHz backup. Range / fail safe testing will also be performed at the event.

4.12. Aircraft receiver/flight control must be powered from a battery independently from all other systems and may not use a voltage regulator. The propulsion system, and any payload system may not be powered from the receiver/flight control power source.

4.13. One complete aircraft and any ground support and launch equipment except fuel and transmitter, must be protected and transportable in no more than three containers, supplied by the contractor. Internal dimensions of each container must be no more than: $54^{9}/_{16}$ in x $15^{9}/_{16}$ in x $8^{5}/_{8}$ in.

4.14. Aircraft must carry the payload system and avionics bay specs detailed in section 15.

5. DESIGN OBJECTIVES. Objectives 5.1 – 5.5 involve Key Performance Parameters used for scoring.

5.1. SRI Mission: See Section 16 for course geometry and restrictions.

Launch: Aircraft must be launched within a 6ft x 6ft designated area (based on a Mk V SOC). Teams may self-launch, hand-launch, or use a launcher. Any part of a launch apparatus may extend beyond the designated area as long as it does not touch the ground outside of the area.

Cruise: Fly 6 flags on the course.

5.1.1. Quiet Recon (QR) Sound: Fly 6 more flags while sound measurements will be taken throughout the QR part of the mission. A microphone will be located in the designated region to measure A-weighted, overall sound pressure level (OASPL). Peak-Hold setting will be used so that the measurement taken will be the highest sound level during the entire QR phase of the mission. Threshold: 78 dBA over the range 125 Hz to 20 kHz. Objective: 72 dBA over the range 125 Hz to 20 kHz.

5.1.2. Quiet Recon (QR) Identify: Located at the recon site (Section 16), a vertically mounted sign will be revealed consisting of a number of black stripes on a white background. The stripes will be at least 12 inches tall,

at least 3 inches wide, and spaced at least 3 inches apart. Judges will reveal the sign once the aircraft begins the QR phase. Teams must identify the correct number of stripes on the sign and announce it to the judges before the final QR flag.

5.1.3. Mission time: Total time between launch and the final QR flag. Threshold: 5 minutes. Objective: Fastest of competitors (per round.)

5.2. Maximum level dash airspeed. Threshold: 130kts. Objective: Highest of Competitors (up to 173kts)

5.3. Best of Show: Best of Show winner judged by spectators as well as judges. Spectators may use all aspects of contractor's display (static and flight demonstration) to vote.

5.4. Unit Cost Bid. Cost for sale of each airframe using the cost analysis guidelines of section 14. Detail must be provided sufficient for the Technical Reviewers to judge if the price is realistic. Threshold: $8,000 / plane. Objective: $5,000 / plane

5.5. Range/Loiter: Threshold: 10nm then 5 min loiter. Objective 15nm @ over 100kts airspeed then 10 min loiter.

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

6.1. Program Management Review (PMR) Contractors shall present a PMR on or prior to 30 January, 2018. The PMR shall consist of briefing slides through conceptual design of the aircraft. Slides should consist of sections for: Program management including schedule and budget, performance, aerodynamics and stability and control, propulsion, structures. Slides from this presentation must be emailed to the Speedfest email address no later than COB this date.

6.2. Critical Design Review (CDR) Contractors shall present a CDR on or prior to 20 February 2018. The CDR shall consist of briefing slides through preliminary and detailed design of the aircraft. Slides should consist of sections for: Program management including schedule and budget, performance, aerodynamics and stability and control, propulsion, structures, test and evaluation plan. Slides from this presentation must be emailed to the Speedfest email address no later than COB this date.

6.3. Speedfest Competition Safety inspection. Friday, 26 April 2019. Contractors shall present their aircraft to the Speedfest judges for safety and requirements inspection. Contractors must present proof of flight that the aircraft design has flown *prior to* Friday, 26 April 2019, in order to be allowed to compete in the event. First flight may *not* be conducted at the Speedfest site. If the deadline is not met, the aircraft will not be allowed to fly at the event, and the team's score will not count in the standings. Proof of flight must be a video showing a single flight consisting of: takeoff and a safe landing. Pilot and advisor must certify authenticity. Pilots must also disclose any handling qualities concerns.

6.4. Speedfest static and flight demonstrations. Contractors will present deliverables outlined in this document for judging.

7. TEST FACILITIES AND EQUIPMENT.

7.1. The Speedfest event is an AMA contest, and as such will be conducted under all AMA safety guidelines at the AMA-sanctioned UAFS airfield.

7.2. Speedfest will provide the test range, display tent, and judges for the event.

7.3. Contractors will be required to bring their aircraft and all associated equipment including fuel.

7.4. Contractors will be required to provide a CO_2 fire extinguisher as part of the required airplane ground equipment. The extinguisher must be with the flight team at all times while operating the engine.

8. DELIVERABLES.

8.1. Recommended minimum of two aircraft; one for flight demonstrations and one for static display and judging.

8.2. A 2 minute marketing video per guidelines and deadline on Speedfest website.

8.3. A static display. Examples of marketing information in the display include but are not limited to: a marketing brochure outlining the features and capabilities of the aircraft, a quad-chart poster (36” tall x 48” wide) for static display, legible from 6 ft. Other items that display some aspect of the aircraft.

8.4. A detailed cost analysis per guidelines in this document.

9. INTEGRATED MASTER SCHEDULE (IMS). Contractors shall develop and maintain a detailed Integrated Master Schedule incorporating all tasks and milestones necessary for completion of the project. IMS shall be continuously updated, and presented at all design reviews.

10. TECHNICAL REVIEWS. Technical reviews of the contractors work will be provided at the Speedfest event. Technical review team will consist of individuals from the aerospace industry, government, academia. Handling qualities will be scored by pilots. Reviews will be documented on scoring sheets that will be used to select the winning contractor.

11. POINTS OF CONTACT: All questions should be sent via email to SpeedfestAERO@gmail.com

12. SCORING.

The scoring system below will be used to select the winning contractor.

Objective scoring:

		KPP Score		
Objective #	**Objective**	**Threshold**	**Objective**	
5.1	SRI Mission			
5.1.1	QR Sound Level	8	15	Per
5.1.2	QR Visual ID		15	Mission
5.1.3	Mission Time	10	15	Scoring
5.2[1,2]	Max Speed	5	8	
5.3	Best of Show		3	
5.4	Unit Cost Bid	2	5	
5.5[3]	Range / Loiter	3	9	
	Subtotal Possible	**28**	**70**	

Subjective Scoring:

The following scores will be judged by the Technical Review teams outlined in this document. Scores will be averaged on the following scale:

Aircraft Design	
Fit and finish	0-5
Handling Qualities[4]	0-5
Design for intended use and future expansion.[5]	0-10
Cost bid certification	*
Subtotal Possible	**20**
Marketing	
Static display / Presentation	0-5
Video	0 **OR** 5
Subtotal Possible	**10**

NOTE: See numbered notes in section 14.

* Technical Review team will certify that the cost bid is reasonable based on detailed and convincing evidence provided by the contractors. Majority vote in the affirmative will certify. If the majority votes in the negative, the objective 5.4 score will be scored 0.

13. COST ANALYSIS

Cost Analysis must be based on the projection that the winning contractor goes on to create new production tooling as well as 100 units. Assume labor to build the aircraft would be drawn from the same individuals who built the prototypes. Final cost analysis must show unit costs for sale of individual airframes including all of the following factors:

Labor and materials for all tooling and 100 airplane systems (including any launch and recovery gear. One launch/recovery and ground station system for every 4 airplanes). Assume a fully loaded labor rate of $40/hr. *All* tooling, aircraft, and ground support materials and equipment, non-flight control radio gear, etc. needed to operate each aircraft with the exception of fuel, must be included in the bid. *Do NOT include flight transmitter, receiver, servos and associated flight control systems into cost. It is not the intent of this SOW to encourage low-quality flight control systems*. Contractors should track labor during production of the prototypes, and be able to justify projected labor man-hours in the following categories as appropriate:

- Production Tooling
- Fuselage
- Empennage
- Wing
- Finish, Paint and Graphics
- Flight control systems (servos, linkages, telemetry, electrical systems)
- Propulsion integration
- Landing gear system
- Payload system
- Launching/Recovery/Ground system

Contractors may apply projections of cost reductions for 100 aircraft using quantity discount information, as well as logarithmic learning curves for labor hours. Learning curve projected man hours at the 100^{th} unit may not be projected to drop below 50% of the lowest number of man hours documented for the final prototype actually built by the contractor. Use of machining such as a CNC shall be included at $95/hr

14. SPEEDFEST EVENT DEMONSTRATION REQUIREMENTS

When a team is granted their flight demonstration window, they must announce to the judges table, which objective(s) they will be demonstrating. They may demonstrate more than one objective on a flight.

1 For Objective 5.2, speeds will be calculated by time required to fly over a 1000 ft course, both directions (to account for wind), and the two speeds averaged. In other words: $(V_{upwind} + V_{downwind})/2$

2 Objective 5.2 must be completed before Saturday of Speedfest. Speed trials will not be allowed after Friday, 27 April. If not done at Speedfest site, advisor must certify it was done in accordance with above.

3 Objective 5.5 range may be completed before Speedfest if the team wishes, and the range/loiter witnessed and certified by the advisor. 15 Speedfest figure-8 laps (30 flags) will be counted as 10nm of distance. 23 laps (46 flags) will be counted as 15 nm. Teams need not demonstrate the full range and loiter capability if they obtain pre-approval to test range and loiter with a partial fuel load and ballast, and can demonstrate with a full fuel load they could perform the required objectives.

4 Pilots will provide a score for their teams' plane based on a C-H scale but with 5 being the high score, and 0 being low score.

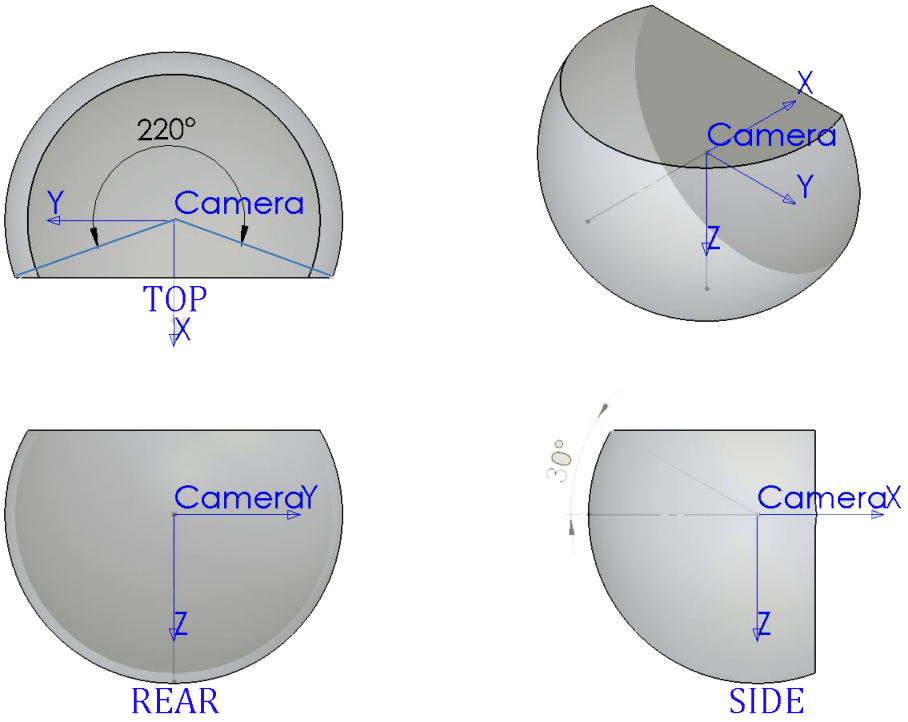
5 Judges will inspect the aircraft and review the material provided at the event in order to assess how well the aircraft is designed for the contest, as well as the potential for future growth of capabilities.

15. PAYLOAD AND AVIONICS BAY SPECIFICATIONS

Payload

The required payload is a camera system capable of imaging and identifying the specified targets at least within a field of view defined by the curved part of the truncated sphere in the drawing. The sphere is truncated by a plane defined by the -110° to 110° forward azimuth, and another plane intersecting the 30° polar, relative to the aircraft's body-fixed frame.

The view of the camera must be completely unobstructed even intermittently, by propellers or other objects.



Avionics Bay

Aircraft flight receiver must be placed within an avionics bay that has room to fit a box that is at least:

- 6 inches along the longitudinal axis
- 4 inches wide
- 5 inches tall

This is to allow the mounting of a specified autopilot system and additional payload at a later date by the customer. As such, the avionics bay should be RF transparent in order to allow the mounting of a gps receiver.

It is also desired that the avionics bay is ahead of the aircraft cg. and be directly adjacent to the bottom of the aircraft in order to allow the later integration of a small

payload drop system. Designs that accommodate these requests for future expansion will receive added consideration in the subjective scoring category.

16. COURSE

The course consists of pylons spaced 1000 ft apart. Aircraft must perform figure-8 patterns with turns away from the safety line. High-speed aircraft may not fly within the East fence line except during takeoff and landing. The East fence line is approximately 250 ft away from the location of the microphone and the sign.