SPEEDFEST XVI ALPHA CLASS
STATEMENT OF WORK
for a new aircraft type:
Max Speed Range Anytime Racer

1. **SUMMARY.** A new class of racing aircraft is proposed that has a maximized speed range and will be capable of racing day or night. This mission will focus on both maximizing *and minimizing* pylon racing speed on an electric-powered aircraft that has high visibility both in day and night. Contractors will develop and compete prototype aircraft subject to the objectives of this document, and the designs will also be scored by a qualified team of judges selected from the aerospace industry, government, and academia.

2. **REFERENCES.** Official AMA National Model Aircraft Safety Code 105.

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. Teams must produce an aircraft optimized for the specified missions, and an assembly tool kit with any tools needed to assemble aircraft. Judges will consider performance, cost, assembly simplicity, weight, and any other relevant factors to the design of the overall system.

   4.2. The aircraft propulsion system must be electric, powered by standard LiPo batteries (4.2V/cell charge, 3.7V nominal). *HV LiPo or LiHV batteries are prohibited. Batteries must be charged at the standard Lipo setting or the team will be disqualified. Battery charge may be spot checked.*

   4.3. Propulsion battery must be no more than 6S, and a maximum energy capacity of 40 W-hr calculated by (3.7 * nS * mah /1000)

   4.4. Teams must design a removeable shunt that includes an anti-spark connector such as a Jeti AFC 4mm. Connection should be possible between battery and ESC with or without the shunt. This will also allow the same shunt to be used on multiple aircraft.

4.5. Any aircraft lighting system may be powered by the flight battery but must not draw power or signal from the receiver or the ESC BEC. A separate independent voltage regulator is allowed for lighting power. Connection to the battery must be upstream of both the Rx and ESC. Aircraft lighting on/off options must be easily selectable prior to launch but may not be controlled through the receiver.

4.6. Wingspan is limited to 1.5 m.

4.7. Aircraft must have safety telemetry to monitor at least: aircraft receiver voltage, and airspeed. Voltage low warnings must be enabled for both receiver and transmitter.

4.8. Aircraft may use roll-off-ground (ROG) or hand launch with no additional type of energy assist.

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

4.10. Control surfaces (CS) shall be linked to servos securely. CS horns shall have the horn pivot hole over the hinge line and must be securely fixed to the control surface. Surface bonding alone is not acceptable. The horn must be structurally integrated into the surface. CS under the horn must be solid (not hollow or foam).

Prohibited control linkages:

- Any type of set-screw adjustable linkages.
- IDS, LDS, or RDS types or similar internal control surface drive.

Clevis connectors must lock or be secured with tubing. Control slop and flexibility must be minimal.

4.11. All servos must be metal gear type and must be mounted within a servo mount or frame, and mechanically fastened.

4.12. All servo and other flight control electrical connections must have mechanical locks.

4.13. No part of the aircraft may be intentionally jettisoned.

4.14. Flight control must always be manual. No autopilots are allowed for flight control, however gyros for stability augmentation are permitted. Futaba 2.4 GHz FASST (not FHSS) or Jeti Duplex system with 2.4GHz primary are preferred. Range / fail safe testing will also be performed at the event.

4.15. Teams are required to develop a night racing “flag” for each of the Flagmen to indicate when the aircraft has crossed a pylon. These flags must be easily seen when raised and lowered in darkness from at least 400 ft away and may be any geometry. Day and night pylons will be provided and placed by Speedfest organizers.

5. DESIGN OBJECTIVES.

Objectives 5.1 – 5.4 involve Key Performance Parameters used for scoring.

5.1. Max Speed Range Racing (MSRR) mission: Consists of two racing phases in the following order. Both phases are conducted on a figure-8 course with flags spaced 600 ft.

5.1.1. Slow Racing Phase (SRP): Time begins upon reaching first flag, and aircraft must complete 1 full lap (3 flags) at which point SRP time ends. Maximum SRP time is 90 sec. Aircraft must turn before or immediately upon reaching each flag. SRP timer pauses while aircraft is turning. Timer starts again upon aircraft established approximately parallel to pylon line again or upon flag drop, whichever occurs last. Climbing during SRP may not be used as a strategy to increase SRP time or to dive going into the next phase. Violation of SRP in turn or climb may result in DQ of a mission score.

5.1.2. Fast Racing Phase (FRP): This phase begins immediately after the slow racing phase is complete (3rd flag) at which point the FRP timer starts. No dive entry. Aircraft must complete 10 full laps (21 flags) at which point the FRP timer stops

SCORE = n * SRP time / FRP time

(n is scale for points. Setting n=100 gives 75 pts if SRP=90s and FRP=120s. See score sensitivity excel)

- *Scores will only be calculated using times that were awarded during a single complete MSRR mission. In other words, times may not be claimed for best SRP and best FRP that happened on different missions.*

5.2. Night Qualification Score (NQS): Aircraft achieve an NQS by completing a full MSRR mission during Nautical Twilight (NT) or darker. NT will be calculated for the specific day any qualification is attempted. NQS must be achieved before Friday of Speedfest as NQS attempts will not be allowed at any time during the Speedfest event window. Teams should give particular attention to both day and night visibility in order to be able to maintain good scoring potential and aircraft survivability. Threshold: NT MSRR score = xxxx, Objective: NT MSRR score = yyyy.

5.3. Unit Cost Bid. Cost for sale of each airframe using the cost analysis guidelines of section 13. Unit costs will not be revealed until event day. Detail must be provided sufficient for the judges to determine if the price is realistic. Threshold: $3,250 / aircraft Objective: $2,750 / aircraft

5.4. Marketing to industry experts: Teams will develop both on-site and online marketing materials to market justify their aircraft design to expert judges selected from industry. There will be two sets of judges who are typically not the same people: “Expert Judges” are the individuals who judge the online

website and video, and “Industry Judges” are the individuals who are on site for Speedfest and judge fit and finish, design justification, and cost bid.

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

6.1. Preliminary Design Review (PDR) The PDR in this context can be considered the project “kickoff” review. Contractors shall present a PDR on or prior to **Thursday, January 28.** The PDR 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.

6.2. Critical Design Review (CDR) Contractors shall present a CDR on or prior to **Thursday, February 18.** 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.

6.3. Speedfest Competition Safety inspection. Contractors shall present their aircraft to the Speedfest judges for safety and requirements inspection.

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

6.5. Contractors must present proof of flight that the aircraft design has flown *prior to* Speedfest, in order to be allowed to compete in the event. First flight may *not* be conducted at Speedfest. If the deadline is not met, the aircraft will not be allowed to fly at the event (including Friday), and the team’s score will not count in the standings. Pilot and advisor must certify authenticity. Pilots must also disclose any handling qualities concerns to the judges.

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 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 an exhibit tent for static display and presentations to the judges and public. Installation and rental of the exhibit tent will be coordinated with the Speedfest contacts.

8. DELIVERABLES.

8.1. Recommended minimum of two aircraft; one for flight competition and one for static display and judging. One of the teams’ aircraft will also serve as

an award to India Class “Best Build” and “Team Spirit” awards. Teams may also develop an on-site marketing display for spectators as well as to justify design decisions to Industry Judges. Past examples include poster boards, brochures, display parts, etc.

8.2. A 2 minute marketing video (Due Monday of Speedfest week by 1700)

8.3. An online marketing/sales display website for the online expert judging. Details in section 14.

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. **PERIOD OF PERFORMANCE (PoP).** Total PoP for this SOW is 15 weeks.

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	MSRR		SCORE
5.2	NQS	15	20
5.3	Unit Cost Bid	5	10

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 (Industry Judged)	
Fit and finish	0-5
Handling Qualities[1]	0-5

Design Justification	0-5
Subtotal Possible	**15**
Marketing (Expert Judged)	
Online Marketing Display[2]	0-5
Video[2]	0-5
Judges Choice[3]	0 *or* 3 (Winner only)
Subtotal Possible	**13**

NOTE: See numbered notes in section 14.

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. Assume a fully loaded labor rate of $40/hr. *All* tooling, aircraft, propulsion, 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 flight control and communication 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
Flight control structural/mechanical (control surfaces, linkages, wipers, etc.)
Flight control electrical system integration (servos, rx, telemetry)
Propulsion integration
Landing gear system
Finish, Paint and Graphics
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 100th 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 which includes setup and actual machine time. Laser cutting and 3D printing if used, are only charged based on the labor hours for setup and post-processing at the $40 rate.

14. SPEEDFEST EVENT DEMONSTRATION REQUIREMENTS

1 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

2 The competitors will develop a web page and 2-minute video for marketing and sales of the aircraft. The web page and video will be the means by which a panel of external judges make their decision about the winning design. The video may be no longer than 2:00 minutes. Video may be a downloadable file, but if video is hosted by a streaming service, it is the teams' responsibility to confirm the video and audio are playable and not silenced due to copyright. Due Monday of Speedfest week by 1700.

3 Judges will include experts who could be in the market for a plane of this class, as well as representatives from the aircraft industry. They may use any reasonable criteria in their judgement, but they will be asked to consider the primary mission in the SOW. Examples include, but are not limited to: performance, novelty of design, fit and finish, simplicity and reliability, transportability, "sexiness", perceived cost of operation. This all-or-nothing category will come down to the simple majority of the judges as to which aircraft they would prefer.