SPEEDFEST XII ALPHA CLASS

STATEMENT OF WORK

FOR A

Rocket-Plane Racer

1. **SUMMARY.** Contractors are requested to demonstrate their ability to quickly design, develop and test, a new combination rocket-electric powered aircraft optimized for speed and efficiency. The aircraft must not only demonstrate top speed, efficiency, and pylon-racing capability, but it also must be reliable, durable and cost effective.

   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 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:

Electric Propulsion System

4.1. The propulsion system must be electric with a 5S Lipo battery or smaller.

4.2. Battery capacity is fixed at tech-in, and the same capacity battery must be used for all flights.

4.3. All current to the ESC must pass through a single 40-amp fuse (Mouser #: 504-ATC-40) which will be provided to the team when they enter the field ready to fly. For multi-motor aircraft, *all* propulsion current must go through the same fuse.

4.4. The fuse must serve as the arming shunt to the esc, and the top face of the fuse showing the current rating must be external to the OML and easily removable by hand with no tools. It must be at least 3 inches away from the closest point of the propeller arc. To install the fuse it is required that the operator simply push it into the aircraft using fingers. Removal should also be simple using only fingers.

4.5. Aircraft receiver/flight control/servos must be powered from a battery *independently* from both propulsion systems and rocket ignition current, and

may *not* use a BEC (voltage regulator). The receiver battery must have a minimum capacity of 650 mah.

Rocket Propulsion System

4.6. Rocket propulsion may consist of any combination of motors for a total impulse to not exceed 80 N-s. The impulse used to determine qualification must come from NAR certification, or manufacturers documentation. Motors must be retail available, not custom, and impulse not modified from the qualification.

4.7. Rocket motors may not be jettisoned from aircraft per AMA Safety Code.

4.8. Different motors may be used for different missions as long as the aircraft configuration does not change.

4.9. Rocket launch must be at an angle to the ground not exceeding 60 deg, and laterally oriented at least 90 deg from any spectator area.

General

4.10. Aircraft configuration may not change between different missions. e.g. wings or other aircraft components of differing geometry cannot be used or omitted for different missions. The intent of this rule is that the same aircraft must be capable of all missions. Competing with different aircraft optimized for specific missions is prohibited. This does not prohibit the use of spares if parts become damaged, or multiple aircraft for efficient use of competition time. It simply requires that the designs used are the same for all flights.

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

4.12. Pitot/Static ports Must be at least 6 inches away from any surface *laterally*. If pitot tip is aft of the prop plane, the pitot must be at least 1 prop diameter lateral from the prop tip. Pitot speed and telemetry will be verified by judges prior to each flight. The intent of the rule is to prevent any team from measuring a higher speed due to pitot placement.

4.13. Aircraft may use ground roll or unassisted launch sled for launching. Additionally, if a rocket is not fired during launch, hand-launching may be used. For rocket launch with ground roll, rocket exhaust may not impinge on the ground/runway at any time.

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

4.15. Control surfaces shall be linked to servos securely, without set-screw type linkages. Clevis connectors must lock or be secured with tubing. Horns shall have the clevis pivot directly over the hinge line and must be securely fixed to the control surface. Surface bonding alone is not acceptable. Control surface under the horn must be solid (not hollow or foam). Control slop and flexibility must be minimal.

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

4.17. All servos must be metal gear type.

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

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

4.20. 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.

4.21. No part of the aircraft may be jettisoned.

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

5.1. Rocketplane Racing:

5.1.1. Pylons

Rocket-glide phase
- Time starts on visible rocket ignition.
- Time ends when electric propulsion first used.
- Aircraft must follow the pylon course during the glide
- Aircraft must not land before the pylon phase.

Electric-pylon phase
- Time starts at first flag. Score based on flag count within the time set by the rocket-glide phase
- Rocket-glide time is only valid for the current Pylons mission.

5.1.2. Max Speed
- Time starts at first motion of aircraft (hand launch or ROG).
- Score is based on top airspeed recorded within 10 s.
- If rocket-assist used, aircraft must be headed between NE to SE (directions away from airfield) during burn, or DQ.
- Aircraft must accelerate in figure-8 pattern. No pattern size limit other than pilot and judge ability to see unaided.
- Teams must have some recording of airspeed. Can be electronic, photographic, etc.
- Aircraft must land with at most minor damage for score to count.

5.2. Endurance / Flight Demonstration:
- Must fly for at least 4 min on same battery pack type used in 5.1.
- Flight demo should include some classical aerobatic maneuvers, and demonstrate unique aspects of the plane.
- Teams may narrate on the sound system during the flight to highlight the aircraft and the team to the spectators.

5.3. 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: $3,000 / plane. Objective: $2,000 / plane. Bid should include costs for at least 10 rocket launches.

5.4. Marketing to industry experts: Teams will develop online marketing materials consisting of a video and informational website to market their aircraft to expert judges selected from the RC aircraft field and industry.

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

6.1. Preliminary Design Review (PDR) Contractors shall present a PDR on or prior to TBD, 2023. 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. 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 TBD February 2023. 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, April 2023. 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, April 2023, 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.

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. An online marketing/sales display for the online 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. **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.

Objective scoring:

5.1.1	Pylons	Based on place	1st	15
			2nd	10
			3rd	5
			4th	0
5.1.2	Max Speed	Based on place	1st	15
			2nd	10
			3rd	5
			4th	0

The best score during the competition for each mission is retained for scoring. To be awarded any points, the mission must be completed with a non-zero score. e.g. a team cannot place second with a DQ mission, or a score of zero.

		Threshold	**Objective**
5.2	Endurance / Flight Demo	0	5
5.3	Unit Cost bid	2	5

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[1]	0-5
Design optimization	0-5
Cost bid certification	*
Subtotal Possible	**15**
5.4 Marketing (Expert Judged)	
Online Marketing Display[2]	0-5
Video	0-5
Judges Choice[3]	0 *or* 5 (Winner only)
Subtotal Possible	**15**

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 5.3 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. 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

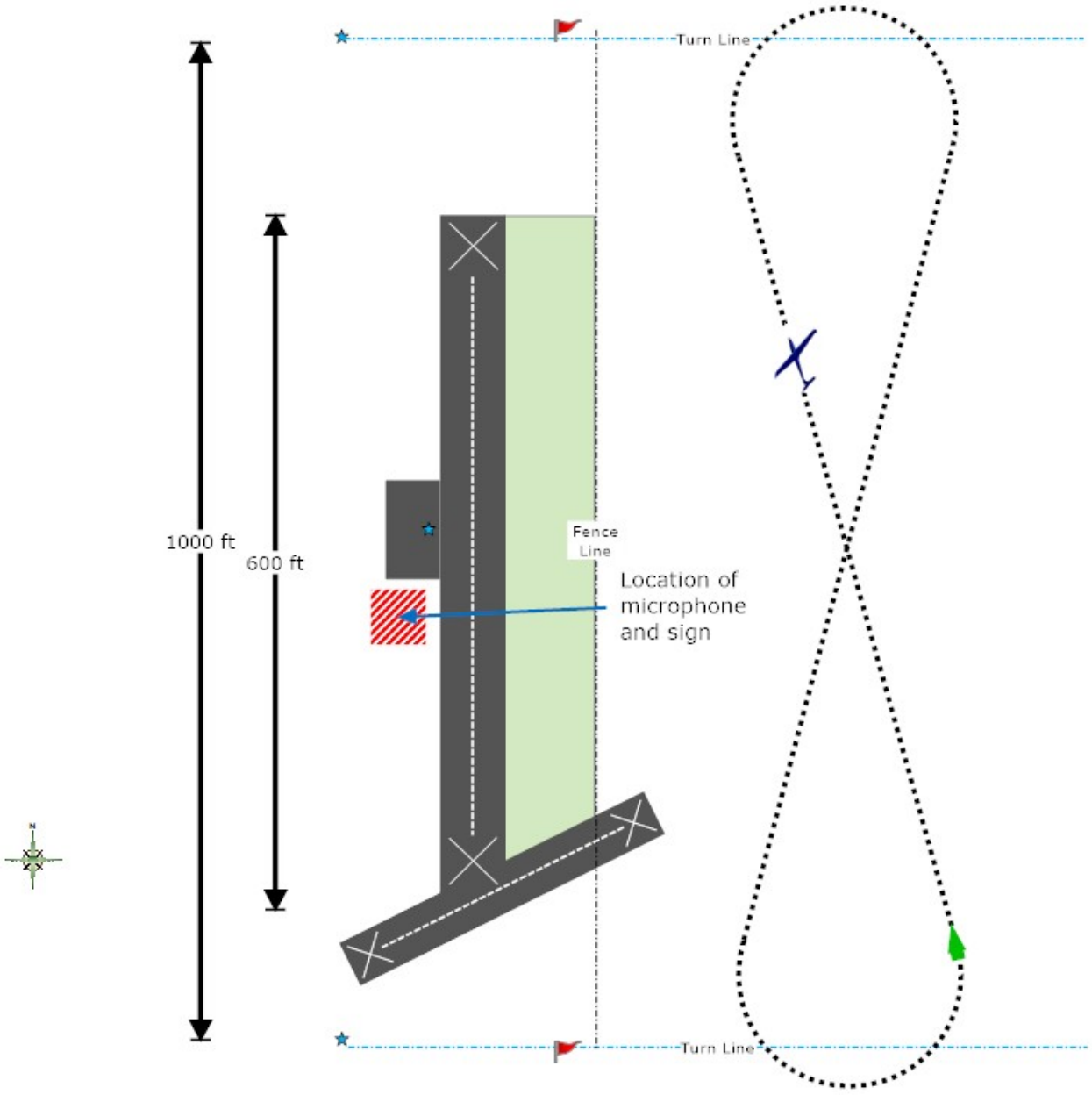
1 Pilots will provide a score for their teams' plane based on a C-H scale but with 5 being the high score, and 0 being low score

2 The competitors will develop a web page for marketing and sales of the aircraft. This web page will be the means by which a panel of external judges make their decision about the winning design. Due date will be TBD.

3 Judges will include expert RC pilots who could be in the market for a plane of this class, as well as representatives from the RC aircraft industry. They may use any reasonable criteria in their judgement. 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 to own.

15. 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.


Turn Line
1000 ft
600 ft
Fence Line
Location of microphone and sign
Turn Line