SPEEDFEST VI ALPHA CLASS

STATEMENT OF WORK

FOR A

TURBINE-POWERED REMOTELY-PILOTED SPORT JET / TRAINER

1. **SUMMARY.** There is a need for a remotely piloted (RP) sport jet that may also be used as a training aircraft for the new generation of small turbine engines. The aircraft developed under this program will be a platform for pilots to safely train to receive their AMA Turbine Waiver, and then allow continued use as an aerobatic sport jet. As such, the aircraft should be safe and easy for pilots transitioning to turbine aircraft, forgiving in handling qualities (both pre and post stall), robust, and simple to service, maintain, and operate. 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, academia, and experienced RP turbine operators.

2. **REFERENCES.** AMA Turbine Waiver Application 510-d, AMA Safety Regulations for Model Aircraft Powered by Gas Turbines 510-a, 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. The aircraft must be of novel design

   4.2. The aircraft must be designed around, and include an unmodified Kingtech 45 Turbine engine. (Only factory-directed changes to the engine or control software are allowed.)

   4.3. Wingspan must be equal to or less than 53 inches, to allow shipping as a single assembled (flight configuration) unit.

   4.4. Design must satisfy *all* AMA requirements detailed in 510-a “Safety Regulations for Model Aircraft Powered by Gas Turbines”

   4.5. Minimum dry (no fuel) weight for the training jet requirement of this SOW must be 12 lb (Per AMA 510-a) There is no minimum weight restriction for the Sport Jet configuration. Removable ballast of any secure type (including a

removable smoke system) is allowed to meet this requirement as long as the aircraft may perform as a sport jet with ballast removed.

4.6. Aircraft must have safety telemetry to monitor at least flight system voltage and airspeed at all times. Warnings must include at least airspeed low, and voltage low.

4.7. Design structural load limit for aggressive maneuvering: Instantaneous C_{Lmax} at full level flight speed with 1.5 Factor of Safety (FOS). Trainer configuration. Contractor pilot must certify that a full-pull maneuver at maximum level speed has been accomplished safely prior to the Speedfest event. Video evidence will be required.

4.8. 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.

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

4.10. All servos must be metal gear type.

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

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

4.13. Any pneumatic systems used must have pressure gages in the airplane.

4.14. Turbine and electrical retract / brake systems must be powered independently from receiver.

4.15. Radio systems must be 2.4 GHz Spread Spectrum. Range / fail safe testing will be performed at the event.

5. DESIGN OBJECTIVES.

Objectives 5.1 – 5.10 involve Key Performance Parameters

Remaining objectives involve Key System Attributes

All objectives must be met in the Trainer configuration unless otherwise noted.

5.1. Ease of operation: Threshold: Unpack to flight ready in 20 min. Objective: Unpack to flight ready in 10 minutes. Batteries and fuel must not be in the airplane to begin. Any pneumatic systems may not be charged. “Flight Ready” means ready to taxi for takeoff. Time does *not* include any preflight checklists prior to takeoff.

5.2. Static Margin Threshold: minimum 20%, Objective: minimum 20% with minimal stability or trim shift with fuel burn

5.3. Ability to operate on a grass or hard surface runway. Runway length (both types) Threshold: 400 ft, Objective: 200 ft.

5.4. Crosswind Requirement, threshold runway. Threshold: 5kt. Objective 10kt.

5.5. Endurance. Threshold: 3 min @ WOT Objective: 5 min @ WOT

5.6. Number of figure-8 pylons @ 900 ft in 60 seconds (Sport Jet configuration): Threshold:10 flags. Objective: largest of competitors.

5.7. Maximize ratio of maximum to minimum airspeeds. Threshold: 2.5, Objective: highest of competitors. (Max. allowable speed 170 kts)

5.8. Maximum level flight airspeed. Threshold: 100kts. Objective: 130kts

5.9. Precision Aerobatics. Threshold: Demonstrate a horizontal figure-8 with turns away from the spectators, a Cuban 8, and an Immelmann turn in trainer configuration. Objective: Demonstrate Threshold for trainer configuration. "Best of Show" in Sport Jet configuration. Integrate threshold maneuvers into a flight routine to music and/or narration. Add additional aerobatic maneuvers such as humpty-bump with ½ roll, rolling turn, etc. Best of Show score judged by spectators as well as judges.

5.10. Unit Cost Bid. Cost for sale of each airframe using the cost analysis guidelines of section 14. Unit costs will not be revealed until event day. Detail must be provided sufficient for the Technical Reviewers to judge if the price is realistic. Threshold: $10,000 / plane Objective: Lowest certified bidder

5.11. FOD-safe belly landing capability in case of landing gear retract failure on grass runway. Minimize dust and debris ingestion.

5.12. Minimal pitch moment change with thrust over entire envelope

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

6.1. Program Management Review (PMR) Contractors shall present a PMR on or prior to 27 January 2016. 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.

6.2. Critical Design Review (CDR) Contractors shall present a CDR on or prior to 17 February 2016. 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. Friday, 22 April. 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.

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.

7.5. Contractors will be required to provide a CO_2 fire extinguisher as part of the required airplane ground equipment.

8. DELIVERABLES.

8.1. Recommended minimum of two aircraft; one for flight demonstrations and one for static display and judging. One of the aircraft shall be in university-themed graphics and colors. The other may be contractor's discretion.

8.2. A 2 minute marketing video

8.3. A static display. Examples of marketing information in the display include: a marketing brochure outlining the features and capabilities of the aircraft. or A quad-chart poster (36" tall x 48" wide) for static display, legible from 6 ft (minimum 32 pt Calibri font). Other items that display some aspect of the aircraft.

8.4. A detailed cost analysis per guidelines in this document, with a unit cost bid to be revealed at the Speedfest event.

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, and experienced pilots with AMA

Turbine Waivers. Reviews will be documented on scoring sheets that will be used to select the winning contractor.

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

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

13. SCORING.

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

Objective scoring:

		KPP Score	
Objective #	**Objective**	**Threshold**	**Objective**
5.1	Ease of Operation	2	8
5.2	Static Margin	1	2
5.3	Runway	2	8
5.4	Crosswind	1	2
5.5	Endurance	1	2
5.6	Figure 8 pylon laps	2	5
5.7	Max Speed ratio	2	8
5.8	Max Speed	1	2
5.9	Precision Aerobatics	2	10
5.10	Unit Cost Bid	2	8
	Subtotal Possible	**16**	**55**

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	0-10
Design for intended use	0-10
Cost bid certification	*
Subtotal Possible	**25**
Display	

Static display	0-15
Video	0-5
Subtotal Possible	**20**

* 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 5.10 score will be scored 0.

14. 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 RTF units. 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 airframes. Assume a fully loaded labor rate of $20/hr. *All* tooling, aircraft, and ground support materials and equipment, radio gear, etc. needed to operate each aircraft with the exception of fuel, must be included in the bid. Contractors should track labor during production of the prototypes, and be able to justify projected labor man-hours in the following categories:

Production Tooling

Fuselage

Empennage

Wing

Finish, Paint and Graphics

Flight control systems (servos, linkages, telemetry, wiring harness, electrical systems)

Propulsion integration

Landing gear system

Contractors may apply projections of cost reductions for 100 aircraft using quantity discount information, as well as learning curves for labor hours. Use of machining such as a CNC shall be included at $95/hr

15. 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.

The following is a list of the acceptable methods for demonstrating objectives:

5.1	Ease of Operation	**Event Day**
5.2	Static Margin	Prior Via Calculation. Submitted via email
5.3	Runway	**Event Day**. Hard surface only
5.4	Crosswind	Prior Via Calculation submitted via email
5.5	Endurance	Static test at WOT. Prior, or at event.
5.6	Figure 8 pylon laps	**Event Day**
5.7	Max Speed ratio	**Event Day**
5.8	Max Speed	**Event Day**
5.9	Precision Aerobatics	**Event Day**
5.10	Unit Cost Bid	**Event Day (In Tent)**

For Objectives 5.7 and 5.8, Speeds will be calculated by flying over the 900 ft course, both directions (to account for wind), and the two speeds averaged. In other words: $(V_{upwind} + V_{downwind})/2$

Max Speed for objective 5.7 and for 5.8 will be measured on the same speed run. Calculation will be as follows:

$$\frac{900\ [ft] * 0.592\ [\frac{knots}{fps}]}{0.5\left(Tfast_{upwind} + Tfast_{downwind}\right)[s]}$$

Objective 5.8 will be measured as follows:

$$\frac{Tslow_{upwind} + Tslow_{downwind}}{Tfast_{upwind} + Tfast_{downwind}}$$

The slow speed runs do not have to be done on the same flight as the high speed runs. But slow speed runs must be done in both directions immediately after each other, on the same flight. The same is true for the high speed runs.