SPEEDFEST XIII ALPHA CLASS

STATEMENT OF WORK

FOR PROJECT FALSETTO

(FAst **L**oitering **S**t**E**al**T**h **T**arget dr**O**ne)

1. **SUMMARY.** There is a need for an advanced turbine-powered loitering target drone to train US defense personnel in the identification, tracking, and elimination of small, low-cost, fast moving and low observable UAS threats. Presently, such a drone does not exist, but is a critical need in order to stay ahead of threats as they develop. The aircraft developed under this program must be low-cost, easy to operate, reliable, and have a low radar cross section (RCS). 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.** 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:

Design Considerations relating to CONOP

4.1. The aircraft must be designed to evade Doppler radar, primarily from the frontal perspective, with additional consideration for loitering CONOP. For the purposes of this exercise, Ka band Doppler radar will be used at approximately 34.7 GHz.

4.2. The aircraft must include an unmodified Xicoy X95 Light turbine engine as the propulsion system. (Only factory-directed changes to the engine or control software are allowed.)

4.3. Design should be FOD resistant on landing for engine longevity.

4.4. Aircraft must have an avionics bay large enough for flight control/receiver system as well as a navigation system consisting of Cube Orange autopilot, RMLIEC NB20 radio system and antenna, RFD900x Modem, and antenna, Here2 GPS system. (Externally mounted GPS antenna) (Navigation system not required for demonstration at Speedfest, but aircraft must be provisioned for all components in their appropriate configuration including placement of GPS and antennas for low RCS)

4.5. Aircraft must have a forward payload bay capable of carrying a 2 inch diameter low-carbon steel rod payload, cut to length for at least 3 lb (approx. 3.5 inches)

4.6. Aircraft must be designed for both RATO launch and bungee launch. RATO launch capability need not be demonstrated prior to Speedfest, however if only designs are provided, the details in the documentation must be sufficient for judges to evaluate. Bungee launch will be accomplished with a bungee system capable of 11 kJ and 62 lb of initial force. Details of the bungee system will be provided to teams. Teams must design the bungee ramp and if restraint is needed on takeoff due to thrust, a release system. It is desirable that the same hardware use for bungee launch be used for RATO, although it is not disqualifying.

4.7. Aircraft must be packed within an unmodified Pelican BX255. Launch ramp system must also be designed to fit within the same type of case. The cases must be unmodified with the exception of the addition of removeable foam restraints. The fit and design of the restraints must be deemed by the judges sufficient to allow transportation without shifting or damage.

General

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

4.9. Aircraft must be stable with good handling qualities, and minimal pitch moment change with thrust over entire envelope

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

4.11. 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.

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

4.13. All servos must be metal gear type.

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

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

4.16. Turbine and any launch system must be powered independently from receiver.

4.17. 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.

5. DESIGN OBJECTIVES.

Objectives 5.1 – 5.7 involve Key Performance Parameters used for scoring.

5.1. Rapid Deployment: Threshold: Unpack aircraft and launcher ramp to flight ready in 10 minutes using a team of no more than 3. Objective: Unpack to flight ready in 5 minutes. Fueling aircraft time not included. "Flight Ready" means ready to launch except fueling and bungee tensioning. The scoring of Objective 5.1 will be done head-to-head at the contest. One attempt only. Flight controls must work and safety inspection conducted otherwise no points awarded.

5.2. Range / Endurance.

Design: minimum 22nm + 15 min loiter (verified via flight test data presented to industry judges prior to contest)

Demonstrated: Given 2lb of fuel: Threshold: 2 min loiter, then 10 flags Objective: 4 min loiter then most flags. (Aircraft must land undamaged to score. Flags are not counted during loiter)

5.3. Maximum Airspeed. Threshold: 100kts. Objective: Highest of Competitors. Airspeed measured as average of flight between both pylons in both directions. Northern leg must be completed first and then southern leg after a turn to the east (right). Altitude must be as low as terrain avoidance allows. Pilot must fly to the initiation point at a speed of no more than 80kt. Altitude may not be used for speed gain. (some gain/loss in altitude due to handling is acceptable, but no significant advantage may be gained) Must be complete within 30 seconds from initiation of run.

5.4. Evade: The Doppler radar gun will be sighted continuously at the airplane as soon as the aircraft has begun the initial speed pass at the radar and conducted during the Maximum Airspeed mission. Detect Zone A will be defined by the judge using a sight line of no more than 15 degrees. Points are awarded based on the detect zone reached before the aircraft speed is detected by the radar for each deploy run. Zones are identified by passage of pylon flag, Zone C: 0 pts, Zone B: 4 pts, Zone A: 8pts.

5.5. Precision Maneuvering. Threshold: Demonstrate a horizontal figure-8 with turns away from the spectators, a Cuban 8, and an Immelmann turn. Objective: Add more aggressive maneuvers that show the capabilities of the airplane. *At no time may a maneuver direct the aircraft towards the safety line*. This mission need be done only once, and can be flown in the same flight as Evade and/or max airspeed.

5.6. 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. Costs must include launch ramp and restraints, however these may be divided by 3 since the intent is to ship 1 launch system with every 3 aircraft. Detail must be provided sufficient for the Technical Reviewers to judge if the price is realistic. Threshold: $20,000 / airframe. Objective: $15,500 / airframe

5.7. Marketing to industry / govt. experts: Teams will develop online marketing materials consisting of a video and informational website to market their aircraft to expert judges selected from industry and government.

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

6.1. Program Management Review (PMR) Contractors shall present a PMR on or prior to date. 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 date. 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. date. 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 the Speedfest site. 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. Proof of flight must be a video showing a single flight

consisting of: takeoff, all three 5.6 Threshold maneuvers, and a safe landing. 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.

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.

8.2. A 2 minute marketing video

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

8.4. A detailed cost analysis per guidelines in this document including a detailed RCS design justification.

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	Rapid Deployment	2	4
5.2	Range / Endurance	4	8
5.3	Max Airspeed	2	4
5.4	Evade	4	8
5.5	Precision Maneuver	2	4
5.6	Unit Cost Bid	4	8
	Subtotal Possible	**18**	**36**

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 Justification	0-5
Subtotal Possible	**15**
Marketing (Expert Judged)	
Online Marketing Display[2]	0-5
Video	0-5
Judges Choice[3]	0 *or* 4 (Winner only)
Subtotal Possible	**14**

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

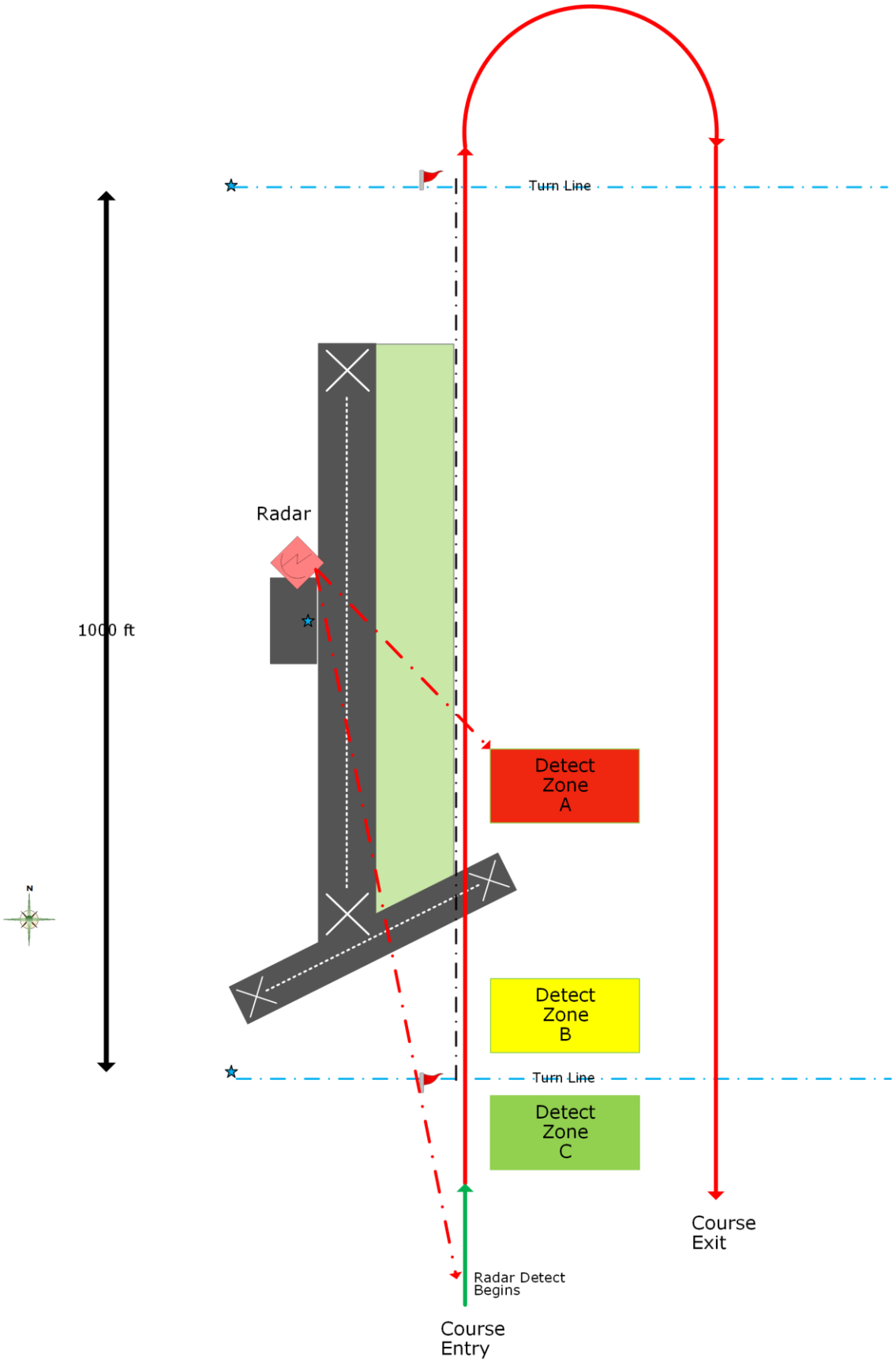
Contractors may apply projections of cost reductions for 100 aircraft using quantity discount information, as well as logarithmic learning curves for labor hours. Learning curve projected man hours at the 100th unit may not be projected to drop below 50% of the lowest number of man hours documented for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

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 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. 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.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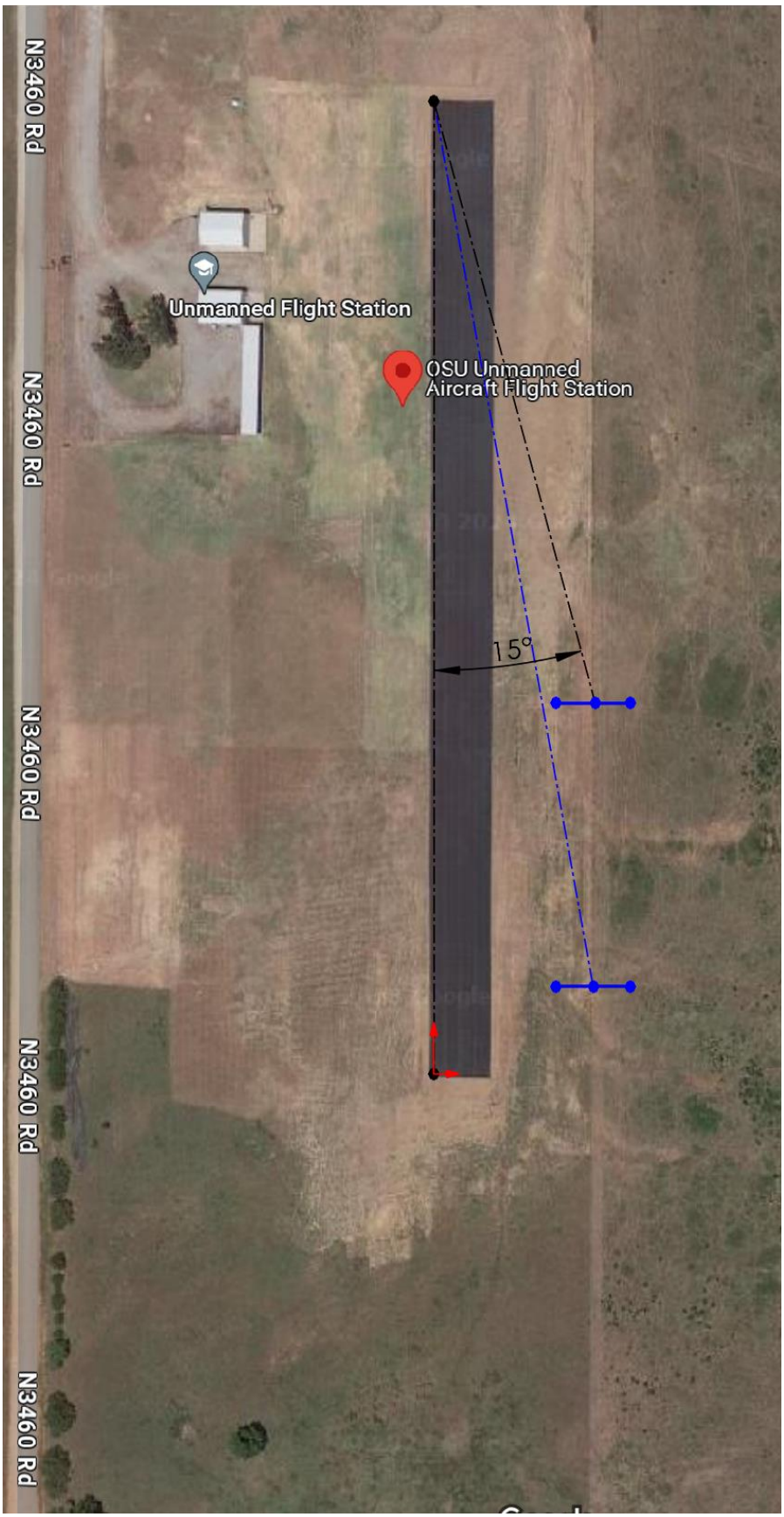
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