FA8620-26-R-2500 — VOLUMES I & II

UNCLASSIFIED

PROPOSAL IN RESPONSE TO

ADVANCED SMALL UNMANNED AIRCRAFT SYSTEM (ASUAS)

Request for Proposal FA8620-26-R-2500

Offeror: FlyNow Aerosystems, Inc.
QX-250 Advanced Small UAS
CAGE 9XQ21 · Houston, TX

Volume I — Technical | **Volume II** — Reliability, Safety & Airworthiness
Volume III — Cost/Price (summary) | **Volume IV** — Contract Documentation

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VOLUME I — TECHNICAL

Executive Summary 1.1

FlyNow Aerosystems, Inc. offers the **QX-250** Advanced Small UAS in direct response to FA8620-26-R-2500 and the Air Vehicle System Specification, PRF ASUAS-AV-1001. The QX-250 is a Quad-X electric VTOL reconnaissance air vehicle developed through a complete, tool-verified digital thread — reliability and system-performance simulation first (MADe, Simcenter Amesim), then requirements, functions and logical architecture, mechanical design (NX), and electrical design (Capital), all materialized in Teamcenter. Of the 85 verifiable air-vehicle requirements in PRF ASUAS-AV-1001, the QX-250 is **compliant today against 58 (68%)**, with the remainder provisioned in the design and closed by analysis, build, or qualification test as summarized in the compliance matrix (1.4).

The design is **reliability-led**: the MADe analysis found the four-rotor baseline has 24 order-1 single-points-of-failure, which drove a dual energy source and dual flight controller (sections 3.4.1.2 and 3.4.2.2) and yields a predicted mission reliability of **R = 0.99998** against the 0.9995 allocation, and a loss-of-thrust rate of **1.85×10^{-4}/hr** against the 2×10^{-4} allocation (Volume II). The QX-250 meets the GTW **Objective** (0.65 kg vs 0.70 kg), flies with a **3.83:1** thrust-to-weight margin verified in a full 6-DOF simulation at the as-built mass, and offers meaningful Trade-Space growth in endurance, operational radius, an IR payload, and a six-rotor redundancy option.

System Description 1.2

The air vehicle is a 250 mm Quad-X: a 3K carbon-fiber airframe (≥4 mm arms), four 2306-class brushless motors driven by a 4-in-1 45 A DShot600 ESC, 5-inch tri-blade propellers, an F7 flight controller (MPU-6000 IMU at 8 kHz, DPS310 barometer), and dual 4S 1100 mAh energy sources (2200 mAh installed, OR-ed via PWR1) with a second flight controller for redundancy. The mechanical model is checked into Teamcenter as the QX250_v3_final 53-component NX assembly; the electrical architecture and logical BOM are authored in Capital and Teamcenter; and the requirements, functions and logical architecture (56 requirements, nine functions, a ten-block logical architecture) are live in Teamcenter with derive links.

Compliance Summary 1.3

5	53	20	7	85
Meets Objective	Compliant	Compliant (planned)	Partial + plan	Total requirements

Table 1-1. Compliance Rollup by Specification Section

Section	Title	Reqts	Compliant	Planned	Partial
3.1	Performance and Physical Characteristics	25	22	3	0
3.2	Mission Payload	6	1	4	1

3.3	Propulsion System	6	6	0	0
3.4	Vehicle Subsystems	13	8	3	2
3.5	Ground Control Station and Human Systems	5	3	2	0
3.6	Autonomy and Flight Modes	5	2	3	0
3.7	Recorded Information	3	2	1	0
3.8	Product Support	9	8	1	0
3.9	Climatic and Environmental Conditions	4	2	1	1
3.10	Architecture and Security	4	1	0	3
3.11	Utility Attributes	5	3	2	0

Requirements Compliance Matrix 1.4

The following matrix responds to every verifiable requirement of PRF ASUAS-AV-1001 (Section 3) and cross-references the offeror's verification approach to Section 4 (VCRM). Status legend:

Meets Objective Compliant Compliant (planned) Partial — closure plan

SS Para	Requirement	QX-250 Compliance Approach	Status	Evidence
3.1.2.1	Hover Endurance	8.0 min hover at the as-built 0.65 kg GTW on the dual 4S 1100 mAh energy system (2200 mAh installed; the ≥1500 mAh usable of REQ-PWR-005 is the **system total** across the two OR-ed packs, not per-pack). Objective 20 min via the extended-energy option, App. C.	Compliant	RFLP REQ-PERF-002; MADe Nominal Sortie; 6-DOF v3 @0.65 kg
3.1.2.2	Mission Endurance	Completes the 10.5-min App. A reference sortie with ≥20% reserve retained.	Compliant	MADe “QX-250 Nominal Sortie” (7 phases)
3.1.2.3	Operational Radius	~2.0 km C2/video radius on the 2.4 GHz link (Threshold); 5 km Objective via the directional-antenna option.	Compliant	Link budget; RFLP IF set
3.1.2.4	Dash Speed	60 km/h (32 kt) level dash — exceeds the 30 kt Threshold.	Compliant	RFLP REQ-PERF-003
3.1.2.5	Cruise Speed	15 kt sustained transit cruise with payload imaging.	Compliant	Performance analysis
3.1.2.6	Rate of Climb	>3 m/s vertical climb retained on the 3.83:1 thrust margin at the as-built 0.65 kg vs 3 m/s required.	Compliant	Amesim 6-DOF v3; performance analysis
3.1.2.7	Hover Ceiling (OGE)	OGE hover to high density altitude on the 3.83:1 thrust margin (Objective).	Meets Objective	Amesim 6-DOF v3; performance analysis
3.1.2.8	Thrust-to-Weight Ratio	3.83:1 static thrust-to-weight at the as-built 0.65 kg GTW, flight-verified in the 6-DOF model, vs 2:1 required — large gust-rejection margin (peak 43° tilt recovered).	Compliant	RFLP REQ-PERF-001; Amesim 6-DOF v3 (T/W 3.83)

3.1.2.9	Wind and Gust Tolerance	Position hold in 15.5 kt (8 m/s) steady wind (Threshold); 20 kt Objective under evaluation.	**Compliant**	RFLP REQ-PERF-004
3.1.2.10	Vertical Launch and Recovery	Inherent VTOL: unassisted vertical launch and precision landing, no launch/recovery gear.	**Compliant**	Functional F-set; RFLP REQ-SYS-002
3.1.2.11.1	Stabilized Flight Modes	Self-leveling (Angle), position-hold (GNSS) and Acro modes with bumpless transitions.	**Compliant**	RFLP REQ-SYS-004 / CTRL set
3.1.2.11.2	GPS-Denied Attitude Hold	Auto-reverts to attitude hold on GNSS loss with unambiguous operator cueing.	**Compliant**	RFLP REQ-CTRL set
3.1.2.11.3	Operator Skill Level Handling	Self-level mode + student-fault tolerance sized to a minimally-trained operator.	**Compliant**	RFLP REQ-SYS-004
3.1.2.11.4	Loss of Control Resistance	Dual flight control + deterministic contingencies; rotor loss → controlled descent (see 3.3.5).	**Compliant**	MADe RBD; RFLP REQ-CTRL
3.1.2.12	Acoustic Signature	~62 dBA at 100 m predicted for the 5-in rotor set; to be confirmed by MIL-STD-1474E measurement.	**Compliant (planned)**	Acoustic analysis (to be tested)
3.1.3.1	Gross Takeoff Weight	GTW ~0.65 kg incl. energy source and Standard Payload — beats the 0.70 kg Objective.	**Meets Objective**	NX mass properties; RFLP REQ-SYS-006
3.1.3.2	Transport Configuration	Air vehicle + GCS + consumables stow in a single man-portable case.	**Compliant**	Design / transport concept
3.1.3.3	Rapid Assembly	Tool-less arm/prop assembly to ready-to-launch in <2 min.	**Compliant**	RFLP REQ-STR; design
3.1.3.4	Configuration	Symmetric Quad-X, 250 mm motor-to-motor diagonal; realized as the QX250_v3_final 53-component NX assembly on the parametric datum.	**Compliant**	NX QX250_v3_final (53 comp.); RFLP REQ-STR-001
3.1.3.5	Design Service Life	Carbon airframe sized to ≥500 h / 2000 cycles; substantiated by durability analysis and test.	**Compliant (planned)**	MADe MTTF; structural analysis (planned)
3.1.3.6	Structural Load Factors	-2/+4 G limit envelope, ultimate = 1.5× limit; confirmed by NX FEA and static test.	**Compliant (planned)**	NX; structural analysis (planned)
3.1.3.7	Materials, Processes, and Corrosion	3K carbon-fiber arms ≥4 mm; corrosion-tolerant materials and HAZMAT program.	**Compliant**	NX; RFLP REQ-STR-002
3.1.3.8	Drop Survivability	Survives 1.5 m drop onto each face without primary-structure fracture; realized as-built by the LandingLeg (STR-002) landing gear.	**Compliant**	RFLP REQ-STR-002; NX landing gear (analysis→physical)
3.1.3.9	Structural Dynamics	First bending mode ≥80 Hz, decoupled from the control bandwidth.	**Compliant**	RFLP REQ-STR-007 (analysis)
3.1.3.10	Propeller Clearance and Frangibility	≥5 mm prop tip clearance; impact-tolerant frangible propellers.	**Compliant**	NX; RFLP REQ-STR-006

3.2.1	Standard Payload	100 g Standard-Payload provision with mechanical/electrical/data interfaces.	Compliant	RFLP REQ-SYS-005
3.2.2	Electro-Optical Sensor	Payload bay provisioned; production stabilized EO zoom gimbal to be integrated to meet 300 m recognition.	Partial — closure plan	Integration plan
3.2.3	Infrared Sensor (Growth)	IR channel offered as the App. C growth payload with SWaP-C provisioning.	Compliant (planned)	Trade study (App. C)
3.2.4	Gimbal Stabilization	2-axis stabilized gimbal, ≤150 µrad jitter by analysis.	Compliant (planned)	Payload analysis (planned)
3.2.5	Target Geo-Location	GNSS + gimbal geo-pointing, ≤50 m CE90 by error-budget analysis.	Compliant (planned)	TLE analysis (planned)
3.2.6	Imagery Metadata	MISB ST 0601 KLV metadata embedded in the payload stream.	Compliant (planned)	Payload SW plan
3.3.1	Electric Propulsion	Four independent BLDC / 4-in-1 ESC / propeller channels, DShot600 digital command.	Compliant	Capital electrical architecture
3.3.2	Per-Channel Current Capacity	45 A continuous / burst per channel 4-in-1 ESC.	Compliant	RFLP REQ-PWR-002; Capital
3.3.3	Propellers	5043 tri-blade set, 2×CW + 2×CCW, tool-less swap.	Compliant	NX; RFLP REQ-STR
3.3.4	Energy Reserve	≥20% usable energy reserve retained at end of the App. A sortie.	Compliant	MADe Nominal Sortie
3.3.5	Single-Rotor Failure Response	Failed-channel detection → controlled descent/termination; hexa-rotor growth removes the 24 order-1 SPOFs (App. C).	Compliant	MADe FTA (24 order-1 cut sets)
3.3.6	Propulsion Health Monitoring	Per-channel current + vibration-signature health monitoring (PHM).	Compliant	RFLP REQ-REL-006
3.4.1.1	Energy Source	Two 4S LiPo packs, 12.0-16.8 V, 1100 mAh each (2200 mAh installed), OR-ed via PWR1 — ≥1500 mAh usable at the system level.	Compliant	RFLP REQ-PWR-001/005; Capital LBOM v3
3.4.1.2	Battery Redundancy	Two independent energy sources in a 1-of-2 group, OR-ed via PWR1 — right-sized to 2×1100 mAh so dual redundancy fits under the 0.70 kg cap (dual 1500 mAh → ~0.74 kg **violated** REQ-REG-001/SYS-006): a traceable reliability↔regulatory trade.	Compliant	MADe RBD; Capital LBOM v3 (QX-BT2)
3.4.1.3	Regulated Avionics Power	Regulated 5.0 V ±5%, ≥2 A BEC isolated from propulsion transients.	Compliant	RFLP REQ-PWR-003
3.4.1.4	Reverse-Polarity and Over-Current Protection	Reverse-polarity + propulsion-bus over-current protection.	Compliant	RFLP REQ-PWR-006
3.4.1.5	Battery Management and Thermal Runaway	Cell-level BMS (OV/UV/imbalance) with thermal-runaway containment design.	Compliant (planned)	RFLP REQ-REL-002 (containment planned)

3.4.2.1	Inertial Sensing	F7 FC, MPU-6000 IMU at 8 kHz, DPS310 baro; 25 Hz closed-loop bandwidth.	Compliant	RFLP REQ-CTRL-001 / PERF-006
3.4.2.2	Flight Control Redundancy	Dual-redundant flight control (Rev-2), standby assumes control with no operator action.	Compliant	MADe RBD; Capital LBOM v2 (QX-U1B)
3.4.2.3	Arming Interlocks	Arm only on link + IMU cal + idle throttle + attitude within 25°.	Compliant	RFLP REQ-CTRL-005
3.4.3	Navigation Subsystem	GNSS-aided nav ≤3 m CEP via the integrated GNSS module.	Compliant (planned)	Nav integration plan
3.4.4	Command and Control (C2) Data Link	2.4 GHz frequency-agile C2 baseline; FIPS 140-3 encryption added on the production link.	Partial — closure plan	Crypto integration plan
3.4.5	Payload Data Link	Digital video/metadata downlink, ≤200 ms end-to-end by analysis.	Compliant (planned)	Datalink analysis (planned)
3.4.6	Lost-Link Behavior	Lost-link >1 s → return-to-home; auto-resume on link restore.	Compliant	RFLP REQ-SYS-007
3.4.7	Lighting	Visible arming indicator present; NVIS/covert light to be added per MIL-STD-3009.	Partial — closure plan	RFLP REQ-REG-002
3.5.1	Human Engineering	GCS human-engineered to MIL-STD-1472 for a dismounted operator.	Compliant (planned)	HE plan
3.5.2	Control Station Configuration	Single handheld GCS <1.5 kg, glove-operable.	Compliant	GCS design
3.5.3	Displays	Sunlight-readable map (MIL-STD-2525) + live video + health.	Compliant (planned)	GCS SW plan
3.5.4	Single-Operator Operation	Full single-operator plan/launch/employ/recover.	Compliant	CONOPS; design
3.5.5	Setup and Teardown Time	GCS transport-to-operational in <2 min.	Compliant	Design
3.6.1	Automatic Takeoff and Landing	Automatic takeoff and precision auto-land.	Compliant (planned)	Autonomy plan
3.6.2	Waypoint Navigation	≥20-waypoint routes with loiter/orbit/POI patterns.	Compliant (planned)	Autonomy plan
3.6.3	Return-to-Home	Commanded/automatic return-to-home and land.	Compliant	RFLP REQ-SYS-007
3.6.4	Geofencing	Operator lateral/vertical geofence enforcement.	Compliant (planned)	Autonomy plan
3.6.6	Contingency Behaviors	Deterministic contingencies: lost-link, low-energy, GNSS-loss, rotor-loss.	Compliant	MADe; RFLP REQ-CTRL
3.7.1	Flight Data Recording	Flight state / commands / energy / link logged ≥10 Hz for the full sortie.	Compliant	RFLP REQ-CTRL-006
3.7.2	Imagery and Metadata Recording	Payload imagery + MISB metadata recorded and exportable.	Compliant (planned)	Payload SW plan

3.7.3	Built-In Test and Health Data	Initiated + continuous BIT across propulsion/power/FC/nav/links.	**Compliant**	RFLP REQ-CTRL; PHM
3.8.1	Operational Availability (Ao)	Ao ≥0.90 by RAM analysis; all 51 verification objects PASS in the native Teamcenter V&V thread.	**Compliant**	MADe RAM prediction; TC native V&V 51/51 PASS
3.8.2	Mission Reliability (Rm)	Mission reliability R(10.5 min) = 0.99998 predicted vs 0.9995 required.	**Meets Objective**	MADe RBD (dual redundancy)
3.8.3	Loss-of-Thrust Probability	Loss-of-thrust 1.85×10^{-4}/hr predicted vs 2×10^{-4} allocation.	**Meets Objective**	MADe Fault Tree top event
3.8.4	Mean Time Between Failures (MTBF)	System MTTF ~4,673 h vs 250 h MTBF allocation.	**Meets Objective**	MADe RAM (redundant config)
3.8.5	Mean Time To Repair (MTTR)	Operator-level MTTR <30 min via tool-less LRU replacement.	**Compliant**	Maintenance concept
3.8.6	Diagnostics	BIT to 95% detection / 90% isolation with low false-alarm rate.	**Compliant (planned)**	Diagnostics plan
3.8.7	Two-Level Maintenance	Two-level maintenance; arms/motors/props/energy/avionics are tool-less LRUs.	**Compliant**	Maintenance concept
3.8.8	Turn-Around Time	<5 min turn-around incl. energy-source swap.	**Compliant**	Design
3.8.9	Nameplates and Product Marking	MIL-STD-130 identification marking on AV and LRUs.	**Compliant**	Marking plan
3.9.1	Natural Climate	-10 to +45 °C operating (Threshold); -20/+49 °C Objective under qualification.	**Compliant**	RFLP REQ-ENV-001
3.9.2	Precipitation and Blowing Particulates	Aeroshell (ENV-002) realizes splash/light-precip protection as-built; full MIL-STD-810 sand/dust/blowing-rain still to be qualified.	**Partial — closure plan**	RFLP REQ-ENV-002; NX aeroshell (analysis→physical)
3.9.3	Induced Environment	Soft-mounted avionics isolate propulsion vibration from the IMU.	**Compliant**	RFLP REQ-ENV-003 / STR-004
3.9.4	Electromagnetic Environmental Effects (E3)	MIL-STD-461/464 EMC/E3 qualification.	**Compliant (planned)**	EMC plan
3.10.1	Modular Open Systems Approach	Open modular architecture in place; STANAG 4586 UCS interface to be implemented for interoperability.	**Partial — closure plan**	Open-architecture plan
3.10.2	Cybersecurity	RMF authorization and FIPS 140-3 crypto delivered on the production configuration.	**Partial — closure plan**	Cyber/RMF plan
3.10.3	Supply Chain / Blue UAS	Production BOM built to the DIU Blue UAS / NDAA §848 baseline (dev article uses COTS FPV parts).	**Partial — closure plan**	Blue UAS BOM plan
3.10.4	Computing Resources and SWaP-C Margin	≥25% spare compute/memory/power on the F7 avionics at delivery.	**Compliant**	SWaP-C budget

3.11.1	Transportability	Man-portable; carried by a single dismounted operator with combat load.	Compliant	Transport concept
3.11.2	System Safety	MIL-STD-882E system-safety FMECA complete; risks documented and mitigated.	Compliant	FMECA_MIL-STD-882E_QX250.pdf
3.11.3	Airworthiness Certification	Airworthiness per MIL-HDBK-516 tailored for light UAS / STANAG 4703.	Compliant (planned)	Airworthiness plan
3.11.4	Spectrum Supportability	DD-1494 spectrum supportability for the areas of operation.	Compliant (planned)	Spectrum plan
3.11.5	Frangibility and Ground Safety	Frangible props + 0.65 kg low kinetic energy — low ground-injury probability.	Compliant	MADe; design

Trade Space Responses 1.5

Per Section L, the offeror's proposed values for the Appendix C Trade-Space requirements are:

Paragraph	Attribute	Threshold	FlyNow Proposed
3.1.2.1 / 3.1.2.2	Endurance	8 min hover / 10.5 min sortie	Baseline 8 min hover / 10.5 min sortie; **extended-energy option** proposed toward the 20 min Objective.
3.1.2.3	Operational Radius	2.0 km	Baseline ~2 km; **directional-antenna option** proposed toward the 5 km Objective.
3.2.3	Infrared Sensor	Not required (EO only)	EO baseline; **uncooled IR channel** offered as SWaP-C-provisioned growth.
3.3.5	Rotor Redundancy	Quad-X (controlled descent on rotor loss)	Quad-X baseline (controlled descent on rotor loss); **Hexa-X option** offered to remove all 24 order-1 SPOFs.

VOLUME II — RELIABILITY, SAFETY & AIRWORTHINESS

Reliability Program & Predictions 2.1

The QX-250 reliability case is built in MADe as a RAM prediction, a Fault-Tree Analysis of the "Loss of Thrust" top event, and a FMECA to MIL-STD-1629A and MIL-STD-882E. The single propulsion channel predicts $\lambda \leq 185$ failures/10^6 h and R(1 h) ≥ 0.9998. The MADe analysis identified 24 order-1 single-points-of-failure in the baseline quad — the direct driver of the redundancy architecture. Adding a second energy source and second flight controller (two 1-of-2 parallel groups) raises predicted mission reliability to **R(10.5 min) = 0.99998** (allocation 0.9995) at a system MTTF of ~4,673 h, and reduces the loss-of-thrust top event to **1.85×10^{-4}/hr** (allocation 2×10^{-4}).

Table 2-1. Reliability & Safety Compliance (traceable to PRF ASUAS-AV-1001 Appendix B)

Parameter	Predicted / Achieved	Basis
Single propulsion channel λ	≤ 185 failures / 10^6 h	MADe RAM prediction (single Battery→FC/ESC→Motor→Prop channel).
Single-channel R(1 h)	≥ 0.9998	MADe RAM; maps to 3.8.4 MTBF allocation.
Loss-of-Thrust top event	$\leq 2 \times 10^{-4}$ / flight hour	MADe Fault Tree top event predicted at 1.85×10^{-4} (3.8.3).
Single-points-of-failure (baseline quad)	24, all order-1	MADe FTA cut sets — a quad cannot fly on three rotors; drives 3.3.5 and APPENDIX C.
Highest-importance item	Energy source (FV ≈ 7.7%)	MADe FTA importance ranking; drives the dual-source requirement 3.4.1.2.
Redundant-configuration R(10.5 min)	≥ 0.9995 required; 0.99998 predicted	Dual energy source + dual flight controller (3.4.1.2, 3.4.2.2); maps to 3.8.2.
Redundant-configuration MTTF	≈ 4,673 h predicted	MADe RBD with two 1-of-2 parallel groups (battery, flight control).
System-safety risk (loss of thrust)	Catastrophic; residual mitigated	MIL-STD-882E FMECA; baseline Frequent×Catastrophic (RAC 1A) reduced by redundancy & inspection (3.11.2).

System Safety 2.2

A MIL-STD-882E system-safety FMECA is complete. The baseline loss-of-thrust hazard is Frequent×Catastrophic (RAC 1A); redundancy and pre-flight inspection reduce residual risk, and all Serious/High residual risks are presented for Government acceptance. The six-rotor growth option (Appendix C) eliminates the order-1 cut sets entirely and is offered as a risk-reduction trade.

Airworthiness Approach 2.3

Airworthiness is substantiated per AFPD 62-6 / AFI 62-601 using MIL-HDBK-516 criteria tailored for light UAS and consistent with STANAG 4703, with the structural, propulsion, and flight-control substantiation drawn from the digital-thread artifacts (NX structural model, MADe safety case, Amesim flight-dynamics study).

VOLUME III — COST / PRICE (SUMMARY)

Fully-burdened pricing is provided for all CLINs and options of Section B. The summary below is a **notional Rough-Order-of-Magnitude** for this demonstration and is not an offer.

CLIN	Supply / Service	Qty	Unit
0001	EMD Air Vehicle System — design, develop, and qualify the ASUAS air vehicle and GCS per PRF ASUAS-AV-1001	1	Lot
0002	EMD Qualification Test & Verification (ground and flight) per Section 4 of PRF ASUAS-AV-1001	1	Lot
0003	System Safety, Reliability & Airworthiness data package (FMECA, FTA, RAM, airworthiness substantiation)	1	Lot
0004	Data (CDRLs per Exhibit A)	1	Lot
1001	Production Option I — Low-Rate Initial Production air vehicle systems	100	Each
1002	Production Option II — Full-Rate Production air vehicle systems	500	Each
1003	Contractor Logistics Support & spares (per option year)	1	Lot

ROM basis: unit recurring cost is driven by the COTS-derived propulsion and avionics set; the redundant electronics add modest cost while materially improving reliability (the MADe trade showed the redundant configuration is *both* cheaper in expected sustainment and more reliable than the single-string baseline).

VOLUME IV — CONTRACT DOCUMENTATION

The offeror acknowledges the SF 1449, all solicitation amendments, and Section L representations and certifications, and confirms the CDRL deliverables of Exhibit A will be provided per the referenced DIDs. The offeror asserts compliance with the DIU Blue UAS / NDAA FY2020 §848 supply-chain requirements for the production configuration.