Attachment 1

Statement of Work (SOW)

Rescue Operations Support Unmanned Aircraft System (ROS UAS) Development Program

Phase 0 - Technology Demonstration
Phase 1 - System Concept Definition
Phase 2 - System Development and Demonstration

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The University of Texas at Austin
Department of Aerospace Engineering and Engineering Mechanics
Boeing Aircraft System Integration Laboratory (BASIL)

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1 Introduction

The purpose of this SOW is to define the systems engineering tasks associated with concept definition, system development, and flight demonstration of a Rescue Operations Support Unmanned Aircraft System (ROS UAS).

1.1 Vision Statement

Provide continuous 24 hours per day, seven days per week (24/7), unmanned aircraft system capabilities for search, surveillance, and precision airborne drop package delivery in support of Austin Fire Department rescue operations with minimal basing requirements.

1.2 Mission Description

The ROS UAS supports Austin Fire Department (AFD) rescue operations by locating and identifying people that need assistance and rescue after natural disasters. By surveilling an area of interest, it locates stranded people, identifies distressed persons, and delivers a medical supplies kit by precision aerial drop. The location of the homes with stranded people, an assessment of distress, and any other intelligence that is gathered, is transmitted to AFD to assist planning of rescue team activities.

1.3 Mission Scenario

There has been flooding around the Austin metropolitan area. AFD has received reports of water rapidly rising above the level of homes in some areas. Wanting to know if they need to deploy their rescue teams and where to deploy them, AFD sends several ROS UAS to search for people in need of assistance.

Houses in the area of interest are surrounded by water. Unable to escape the rapidly rising water, people have moved to the roofs of their houses.

Some people are uninjured and content to wait for the water to subside. The ROS UAS identifies and maps their locations and transmits the data to the AFD command center.

A few people are in distress and may be unconscious or injured, needing immediate medical assistance. In addition to transmitting the location data to the AFD command center, the ROS UAS performs a precision aerial drop payload (ADP) delivery containing a medical supply kit.

1.4 Scope

This Research and Development (R&D) contract initiates concept definition, development, flight demonstration, and validation of ROS UAS capabilities for search, surveillance and precision Airborne Drop Package (ADP) delivery in support of AFD rescue operations.

The ROS UAS may be capable of performing other missions including, but not limited to: support of student aerial robotic competitions, commercial UAS research and development, UAS flight training and other UAS flight and Concept of Operations (ConOps) related research.

The ROS UAS may also have capabilities for follow-on commercial use including aerial photography, agricultural surveys and operations, and small package delivery.

The customer is especially interested in system autonomy capabilities that minimize low-level human interactions, reduce operator workload, and maximize public safety and time available for human tactical and strategic decision-making.

2 Applicable Documents

Top-level applicable documents by number, title, and date are contained in Section J of the RFP. The document versions specified in Section J take precedence over the generic references (without revision letters) cited in this SOW.

- Capabilities Description Document (CDD)
- Aircraft Design Standards Manual
- Demonstration Mission Requirements
- Data Item Descriptions (DIDs)
- Phase 0 Review and Documentation Evaluation Criteria
- Phase 1 Review and Documentation Evaluation Criteria
- Phase 2 Review and Documentation Evaluation Criteria

3 General Requirements

This section describes general requirements for performance of this effort.

3.1 Non-Personal Services

The Customer neither supervises Contractor employees nor controls the method by which the Contractor performs the required tasks. The Customer does not assign tasks to, or prepare work schedules for Contractor employees. It is the Contractor's responsibility to manage its employees and guard against any actions that are, or perceived to be, personal services. It is the Contractor's responsibility to notify the Contracting Officer (CO) immediately if Contractor believes that any actions constitute, or are perceived to constitute personal services.

3.2 Business Relations

The Contractor shall successfully integrate and coordinate all activity needed to execute the requirements. The Contractor shall manage timeliness, completeness, and quality of problem identification. The Contractor shall provide corrective action plans, proposal submittals, timely identification of issues, and effective management of team members. The Contractor shall seek to ensure Customer satisfaction and professional and ethical behavior of all Contractor staff.

3.3 Contract Management and Administration

The following subsections specify requirements for contract management and administration.

3.3.1 Contract Management

The Contractor shall establish clear organizational lines of authority and responsibility to ensure effective management of the resources assigned to the contract.

3.3.2 Contract Administration

The Contractor shall establish processes and assign appropriate resources to administer the contract. The Contractor shall respond to customer requests for contractual actions in a timely fashion. The Contractor shall have a single Point of Contact (POC) between the Customer and Contractor personnel assigned to support the contract. The Contractor shall assign work and maintain proper and accurate timekeeping records of personnel assigned to work on the contract. The Contractor shall not deviate from the contracted SOW. Contractor comments such as, "The Contracting Officer Technical Representative (COTR) or Program Manager told me to do it" are not acceptable. Contractual changes can only be authorized by the CO.

3.4 Contractor Personnel, Disciplines, and Specialties

The Contractor shall accomplish work by employing and utilizing qualified personnel with appropriate combinations of education, training, and experience. The Contractor shall match personnel skills to the work or task with a minimum of under/over employment of resources.

3.5 Organizational Interfaces

Contractor IPT organizations shall show named persons responsible for Customer program office interface to the levels shown in Table 3.5. The Contractor may assign Tier 4 personnel as desired if supported by team personnel availability. Multiple organizational assignments may be required due to a limited number of Contractor personnel.

Table 3.5 – Organizational Interfaces

Tier	Position Title	Responsibilities
1	Program Manager	Overall product, manufacturing, performance, test, and quality. Specific responsibility for strategy, planning, tasking, schedule performance, and requirements and product quality review.
2	Chief Engineer	Overall product definition and technical quality. Reports to program manager. Responsible for technical tasking, schedule, performance, technical quality review.
2	Systems Engineering	Requirements definition and tracking, risk management, and overall system documentation. Also responsible for mass properties and ConOps.
3	Mass Properties	Definition, coordination, tracking, and documentation of AV mass and c.g. Reports to or may be performed by SE Lead.
3	ConOps	Overall ConOps definition, documentation, simulation, test, and execution. Reports to or may be performed by SE Lead.
2	Mission Systems	Definition, coordination, tracking, documentation of retained & expendable payloads, including sensors, sensor comms, comms antennae, external suspension and release equipment, ADP, and mission systems installation.
2	Air Vehicle	Overall responsibility for AV configuration, aerodynamics, propulsion, performance, avionics, and airframe integration
3	Air Vehicle Configuration	Definition, coordination, tracking, documentation of AV configuration geometry, volume, and internal arrangement
3	Aerodynamics	Estimation, coordination, tracking, documentation of aero performance. Includes wing and empennage design.
3	Propulsion System	Definition, coordination, tracking, documentation of propulsion system. Includes propeller/motor sizing and performance estimates.
3	AV Performance	Estimation, coordination, tracking, documentation of Air Vehicle performance.
3	Avionics Systems Integration	Definition, coordination, documentation of AV electrical systems, including power, flight control system (e.g., autopilot, pitots, servos, RC comms), and Mission Systems interface. Includes performance estimation.
2	Mission Control System (MCS)	Definition, integration, simulation, and test of ground-based MCS, including aircraft and sensor control. Executes ground control of CDV & TDV flights.
2	Mission Support & Logistics	Mission support and logistics planning and execution, including maintenance, spares, transportation.
2	Manufacturing	TDV manufacturing plan definition, AV build, system integration and test.
2	T&E	Independent product test and validation, T&E product quality review, Test and Flight Readiness Reviews.

4 Execution Requirements

4.1 Program Summary

The ROS UAS technology demonstration program consists of competitive Structural Technology Demonstration during Phase 0, System Concept Definition during Phase 1, followed by System Concept Development, Fly-off Demonstration, and System Performance Validation in Phase 2. The program demonstrates a subscale Technology Demonstration Vehicle (TDV), while other elements of the system are representative of operational elements.

4.1.1 Phase 0 – Technology Demonstration (TD) Summary

A contract award following a successful proposal evaluation initiates the TD Phase. This phase focuses on structural testing of a surrogate wing to Design Ultimate Load (DUL), which results in destruction of the wing. During TD, the Contractor performs the following activities:

- Surrogate Wing Test Readiness Review (TRR)
- Surrogate Wing DUL Structural Test
- Surrogate Wing Test Results Review (TResR)

4.1.2 Phase 1 – System Concept Definition (CD) Summary

The CD Phase focuses on development and selection of the initial system design concept, which is developed further in Phase 2. Phase 1 culminates in selection of up to two Contractors and system concepts for development in Phase 2. During CD, the Contractor performs System Engineering design activities, simulation, Milestone Reviews, and documentation activities including:

- CONOPS Simulation
- System Requirements Review (SRR)
- Conceptual Design Review (CoDR)
- Phase 1 Documentation Preparation

Customer evaluation of CoDR presentations and Phase 1 Documentation results in down-select to a maximum of two Contractors and proposed system concepts for Phase 2 System Development and Demonstration (SDD). Equipment proposed by selected Contractors is procured as CFE so that it is available for hardware design evaluation, proposed modification and system integration at Phase 2 contract start.

4.1.3 Phase 2 - System Development and Demonstration (SDD) Summary

The SDD Phase completes design, build, and integration of the concept, and culminates in a Fly-off demonstration. During SDD the Contractor performs aircraft design trade studies, System Engineering Milestone Reviews, wing fabrication, system integration, ground and flight testing, and documentation activities including:

- Phase 2 Kickoff Review
- CONOPS Simulation
- CDV Flight Testing
- Preliminary Design Review (PDR)
- Propulsion Testing
- Critical Design Review (CDR)
- Wing fabrication and assembly
- Wing Proof Testing
- System Integration Review (SIR)
- TDV Operational Test & Evaluation (TDV OTE)
- TDV Competitive Flyoff Demonstration
- System Design Review (SDR)
- Phase 2 Documentation Preparation

The Customer evaluates Competitive Flyoff results, SDR presentations, and substantiating Phase 2 Documentation to select a winning system concept.

4.2 Systems Engineering

This section describes expectations for program execution using rigorous Systems Engineering processes and standards.

4.2.1 System Engineering Milestone Reviews

We use standard System Engineering Milestone Reviews to evaluate Contractor progress and performance. Authorization to begin the next set of tasks is dependent on successful review completion. Table 4.2.1 provides a summary of objectives for each review.

Table 4.2.1 – System Engineering Milestone Reviews

Milestone Review	Review Objective
System Requirements Review (SRR)	Does Contractor understand the requirements and have a viable program plan and schedule? (Program Readiness)
Conceptual Design Review (CoDR)	Is Contractor initial concept selection viable and supported by trade studies? (Preliminary Design readiness)
Preliminary Design Review (PDR)	Does Contractor have a viable preliminary design including rationale and plan for detail design? (Detail Design Readiness)
Critical Design Review (CDR)	Does Contractor have a viable detailed design and engineering rationale and manufacturing plan? (Manufacturing Readiness, focused on wing and empennage)
System Integration Review (SIR)	Does Contractor understand subsystem design and integration requirements and have a viable system integration definition, plan, and schedule (System Installation Readiness with focus on fuselage)
Test Readiness Review (TRR)	Is article ready/safe to test and does Contractor know what to test, how to test it, and why? (Test Readiness)
Flight Readiness Review (FRR)	Is vehicle ready/safe to fly and does Contractor know what tests to fly, how to fly them, and why? (Flight Readiness)
Test Results Review (TResR)	Present test results and conclusions in sufficient detail for results to be independently verified. (Test Verification)
System Design Review (SDR)	Has Contractor successfully completed and documented required tasks? (Exit Readiness)

4.2.2 System Engineering Design Process and Documentation

All work shall be performed using documented Contractor SE processes that conform to these Customer standards and/or formats:

1. Customer defined and Contractor derived requirements analysis, flow-down, compliance, and verification methodology shall be documented in a System Requirements Document (SRD) in Customer defined format.

2. Contractor decision making documentation including rationale shall be in Customer defined format. Decision documentation shall address programmatic, ConOps, risk, test and evaluation, and system/subsystem design decisions through organizational Level 3 including Contractor decisions/selections reflected in Customer presentations and reviews.

3. Concept of Operations (ConOps) development/rationale and validation shall be presented for review in Contractor format. ConOps speeds, altitudes and maneuvers shall be included in decision documentation (described in item 2 of this section).

4. Mass property estimation shall be documented using a Customer specified mass property format including mass, locations and margins/contingencies and maintained in Excel spreadsheet format. Definition shall include, at a minimum, individual component mass (lbm) and fuselage station (FS) location (inches) and meet minimum format and fidelity requirements by program phase as defined in the Data Item Descriptions document, DID 1.

5. External configuration geometry including propulsion envelope, landing gear and external payloads shall be developed and analyzed using Vehicle Sketch Pad (VSP) or any UT supported CAD system (Solidworks preferred). Geometry models shall be substantiated by copies of supplier provided planform and side view drawings or photos used to define geometry. Internal configuration definition may use any UT supported CAD system (Solidworks preferred). Required substantiation, VSP and/or CAD drawings and charts shall be pasted into PPt or MS Word for presentation or submittal.

6. Wing FEM structural analysis shall be checked by hand calculations and/or other validated tools/methods.

7. Air vehicle performance analysis shall be performed using SAVE methods. SAVE input cells shall be documented to provide input parameter definition and rationale. Other supporting analysis tools used shall be industry standard (e.g. XFLR5 and DATCOM).

8. Risk assessment, tracking and mitigation shall be documented in Contractor format. Risk based decision making shall be included in decision documentation (described in item 2 of this section).

9. Program planning, scheduling, task assignment and tracking shall be documented in Contractor format. Program level decisions and selections shall be included in decision documentation (described in item 2 of this section).

10. Customer technical/program reviews are evaluated to Customer defined entry and exit criteria. Contractor presentation/review materials shall be in PowerPoint format supplemented by other materials in Contractor defined format. The PowerPoint file shall be submitted at least 15 minutes before the starting time of the review.

11. Contractor documentation shall be prepared in accordance with (IAW) formats defined in RFP Section F, Contract Data Requirements List (CDRL).

12. Contractors shall develop and maintain a System Configuration Description Document (SCDD) for each vehicle concept, as appropriate for the level of current development. The SCDD shall document system concepts sufficiently to communicate required details across the team and to the Customer. It shall be formatted and contain the information as described in the Data Item Descriptions document, DID 2.

13. Air vehicle level trade studies shall be defined, analyzed, documented by and trace directly to live SAVE spreadsheets. Non-SAVE based trades shall be documented in Contractor format.

14. Proposed flights shall be supported by rigorous systems engineering test and evaluation planning. Flight Readiness Reviews (FRRs) shall be conducted IAW flight envelope expansion phases and address, at a minimum, the following envelope expansion phases: (1) First flight through manual control handling qualities evaluation, (2) Autopilot operation and gains development through Operational Test and Evaluation (OTE), and (3) Engineering Flight Testing. Each FRR phase shall include SAVE predictions for the proposed flights, up-to-data mass property weight and balance predictions vs. actuals down to individual components, and include flight test data analysis and lessons learned from prior flights. EFT analysis shall use customer provided tools and methods, supplemented by contractor tools and methods. Flight test planning shall be in MS compatible Contractor format.

15. Flight test data recording/calibration and analysis shall use customer furnished Excel methods for SAVE aero-propulsion and air vehicle performance validation.

16. Flight performance validation shall address, as an objective, takeoff ground roll and liftoff speed, flap up/down stall speeds, reconciled climb and cruise specific excess power (P_s), surveillance endurance factor (EF) and glide performance. Flight validated SAVE input parameters shall include, as an objective, zero-lift drag coefficient (C_{D0} with externally mounted equipment and expendable stores), Oswald wing efficiency (e) and propeller efficiency (η_p).

4.2.3 Design Standards

POD, PSC, and TDV baselines shall be designed IAW requirements for performance and design margin provided in the Aircraft Design Standards Manual. In addition, the RTF Baseline shall incorporate design margins defined in the Aircraft Design Standards Manual.

4.2.4 Mass Properties Documentation Standards

Air vehicle mass properties shall be defined as described in the Data Item Descriptions document, DID 1. At a minimum, the mass property statements document mass property estimates and rationale for the following useful load (UL) items: internal and external retained and expendable payloads, proposed primary and secondary power batteries, miscellaneous UL items. The mass property statements also document empty weight items, including: installed propulsion, mission required avionics and systems (including air data and autopilot subsystems except for the as-delivered RTF vehicle), alighting gear, airframe components (fuselage plus nacelle, wing and empennage) and required weight growth margins.

4.3 Phase 0 – Technology Demonstration

The following tasks are included in Phase 0.

4.3.1 Wing Structural Technology Demonstration

The Wing Structural Technology Demonstration develops key wing structural technologies and experience needed for successful execution of subsequent program phases.

4.3.2 CLIN 001 - Surrogate Wing Structural Demonstration

The objective of the Surrogate Wing Structural Demonstration is to build a wing using technologies envisioned for the TDV and test it to observe and analyze wing structural failure mechanisms. The TResR summarizes the test results and provides supporting structural analysis. Successful completion of this test provides experience applicable to Phase 2 wing structural design activities.

4.3.2.1 Surrogate Wing Structural Demonstration Task Description

The Contractor shall build and test a surrogate wing to structural failure. The surrogate wing shall be built using a Customer provided kit and tested in the ASFL. A wing static load test to failure is conducted to establish the Design Ultimate Load (DUL). Structural performance predictions shall be completed prior to testing. A TRR shall be performed prior to testing. Test setup and execution shall be supported by all Contractor team members. The Contractor shall present a TResR briefing which summarizes the test results for critical review, in accordance with the due date published on Canvas. Data completeness and quality shall be sufficient to support independent Customer assessment of test performance.

Deliverables:

A001.1 – Surrogate Wing TRR Presentation
A001.2 – Surrogate Wing TResR Presentation

4.3.2.2 Surrogate Wing Structural Demonstration Information Provided

- Test Requirements
- Test Descriptions – Including test rig description, load application process plan, data collection plan
- Test results - Including loads analysis, structure performance predictions, identification of failure mechanisms, comparisons to previous test results
- Lessons Learned

4.3.2.3 Surrogate Wing Structural Demonstration Evaluation Criteria

TRR and TResR briefings are evaluated using the criteria provided in the Phase 0 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.4 Phase 1 – System Concept Definition

The following tasks are included in Phase 1.

4.4.1 Conceptual Design

The objective of Conceptual Design is to develop a feasible concept that meets the mission capabilities described in the Concept Development Document (CDD).

4.4.1.1 Conceptual Design Task Description

Contractors shall conceptually develop and propose complete system concepts including Concepts of Operation (ConOps), sensor payloads, vehicle subsystem and expendable payload integration concepts, a preferred Ready to Fly (RTF) vehicle, and proposed Technology Demonstrator Vehicle (TDV), with rationale and supporting management approaches, plans and schedules for Phase 2.

System concepts shall be designed to provide the capabilities defined in the Capability Development Document (CDD). System operational effectiveness shall be evaluated using methods defined in the CDD.

Contractor proposed mission design wind conditions (sustained, gust and takeoff/landing cross winds) shall be defined and provided with substantiating rationale and mission risk assessment.

ConOps, sensor payloads, and ADP payloads shall be developed concurrent with air vehicle concepts to maximize demonstration objectives and competition score within cost, schedule and risk constraints.

ConOps simulation results, including flight operation under design wind conditions, shall be presented for ConOps alternatives at the SRR and for the POD at the CoDR.

Contractor preferred air vehicle selection, based on engineering evaluation of TBD candidate Commercial off the Shelf (COTS) concepts, shall be substantiated by SAVE System Effectiveness assessments. The COTS concepts shall be based on evaluation of ready-to-fly (RTF) and/or almost-ready-to-fly (ARF) air vehicles, both of which are referred to as RTF. Air vehicles that

have been flight demonstrated by previous Contractors within the last 5 years shall be excluded from consideration.

Alternative vehicle concepts assessments shall include SAVE models for the as delivered RTF vehicle showing consistent SAVE Option 1 and 2 airframe and airframe component weight estimates. Consistent Option 1 and 2 SAVE models shall be developed for RTF Baseline designs. RTF Baseline designs are model-based and represent RTF vehicles with required ConOps payloads, primary and secondary power, design and operational margins and systems and avionics. RTF Baseline designs are not expected to meet full mission endurance requirements.

Alternative concept assessments shall include development of geometric models using Vehicle Sketch Pad (VSP) or SolidWorks and SAVE Option 1 and 2 sizing and mission performance analysis for each candidate configuration. Geometric models shall be accurate representations of the concepts studied, consistent with data availability, and include significant relevant external features to include propulsion envelope, landing gear, sensors and expendable stores.

Proposed TDV Point of Departure (POD) concepts shall be defined using Option 3 SAVE and VSP or Solidworks geometry models with required ConOps payloads, required primary and secondary power for full mission endurance with design and operational margins and required systems and avionics. Proposed TDVs shall use commercially available rechargeable batteries.

A TDV Preferred System Concept (PSC) with an improved mission design wing planform (and empennage, if required) shall be proposed based on SAVE Option 3 based sizing/performance analysis. The TDV shall be represented by a VSP or Solidworks model that accurately reflects the SAVE Option 3 based-geometry. SAVE-based TDV trades shall address, at a minimum, (1) wing thickness-to-chord, taper, and aspect ratio, (2) wing loading, (3) horizontal and vertical tail volume coefficient requirements, (4) air vehicle power-to-weight ratio required to meet consistent takeoff and in-flight performance requirements and (5) battery fraction required to meet consistent overall mission definition and endurance requirements including margins.

Contractor concepts shall employ Customer defined communications, command and control (C3), avionics, autopilots, air data system, operator vehicle interface (OVI), ground control systems and ADP payloads. Separate communication payloads shall provide line of sight (LOS) vehicle control and sensor/air data system transmission. C3 payloads shall include required electronics and antenna installations for unobstructed LOS. Sensor and C3 payload and other required equipment weight, volume, and power and secondary power battery size, weight and volume shall be estimated and documented.

4.4.2 CLIN 101 - System Requirements Review (SRR)

The objective of SRR is to ensure system design and development requirements are completed and documented. The review allows the Customer to assess the Contractor's program approach and progress, and provide feedback. Successful completion ensures that the Contractor understands system requirements and is ready to proceed to initial system design.

4.4.2.1 SRR Task Description

The Contractor shall present an SRR briefing for critical review, IAW the due date published in Canvas. Topics to be reviewed include current system design status, review trade study results, and review system requirements definition. Information completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor requirements definition.

Deliverables:

A101.1 – SRR Presentation
A101.2 – System Requirements Document (SRD)

4.4.2.2 SRR Information Provided

- System Architecture – System Architecture is defined to the major subsystem level.
- Requirements Development – Requirements are complete and preliminary interfaces are defined. Preliminary verification approaches are identified.
- Trade Studies – The results of any trade studies completed to validate the design approach are presented to include system effectiveness and cost trades.
- RTF air vehicle candidates – List with top level verification of ability to meet requirements
- Technology Readiness – Key technologies identified, assessed, and maturation plans developed (as needed).
- Risk Identification – Technical risks identified and initial mitigation plan in place.
- Updated program schedule to include testing and analysis timelines with feasible path to flight test program within established schedule metrics.

4.4.2.3 SRR Evaluation Criteria

SRR briefings are evaluated using the criteria provided in the Phase 1 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.4.3 CLIN 102 - Conceptual Design Review (CoDR)

The CoDR objective is to determine feasibility of the Contractor's system design and that it is consistent with program goals. The Contractor presents the system conceptual baseline, review results of any trade studies completed, and review the system-level specification. The review forms the basis for deriving the preliminary design, allows the Customer to assess the Contractor's program approach and progress, and provides an opportunity for feedback. Successful completion of CoDR provides confidence that maturity of overall system Point of Departure (POD) design is sufficient to support preliminary design activities.

4.4.3.1 CoDR Task Description

The Contractor shall present a CoDR briefing for critical review, IAW the due date published on Canvas. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and performance.

Deliverables:

A102.1 – CoDR Presentation
A102.2 – Initial System Configuration Description Document (SCDD)

4.4.3.2 CoDR Information Provided

- System requirements status
- Description of key system concept attributes to include physical and functional characteristics that enhance operational effectiveness, mission suitability and support and logistics to successfully execute the mission, meet demonstration requirements and maximize Systems Effectiveness as described in CDD Section 6.1.
- Definition of contractor initial ConOps and rationale for derived speed, altitude and maneuver requirements and simulation lessons learned.
- Air Vehicle Kit (RTF/ARF) Candidate Concept Descriptions and Comparisons
- Air Vehicle Kit (RTF/ARF) Concept Selection Process and rationale
- Description of the selected Air Vehicle Kit and estimated performance to show why the vehicle is the "best" concept to meet mission requirements. Provide vehicle mass properties including "fuel" (batteries), propulsion, subsystems, center-of-gravity, and SAVE sizing options 1 and 2 estimated performance for the as-delivered air vehicle kit.
- Description of the ADP design, mounting location and rationale.
- Definition and rationale for video sensors, video datalink equipment, and sensor gimbals (if needed), to be selected from an inventory of Customer Furnished Equipment (CFE), procured as COTS equipment, or Contractor built.
- Air Vehicle Baseline Description with required equipment and Useful Load (UL).
- Description of the proposed candidate TDV POD air vehicle with SAVE Option 3-based rationale and estimated performance. The objective is to demonstrate Contractor understanding and capabilities for Phase 2 TDV development.
- Comparison of the Air Vehicle Kit, Air Vehicle Baseline, and POD including payloads, propulsion, "fuel" and secondary power, subsystems, mass properties, center-of-gravity and SAVE sizing option 3 estimated performance compared to the proposed baseline.
- Approaches to minimize the ground operational and logistics footprint for storage, refueling, maintenance, safety, and launch and recovery operations.

4.4.3.3 CoDR Evaluation Criteria

CoDR briefings are evaluated using the criteria provided in the Phase 1 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides

that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.4.4 CLIN 103 – Phase 1 Documentation Preparation

The objective of this task is to provide Phase 1 documentation demonstrating rigorous systems engineering design and analysis processes. This documentation provides a comprehensive overview of all of the work completed in Phase 1.

4.4.4.1 Phase 1 Documentation Task Description

The Contractor shall prepare comprehensive documentation, which summarizes the concept developed during Phase 1, IAW the due date published on Canvas. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and performance. Format and content shall be IAW the description provided in the Data Item Descriptions, DID 3.

Deliverable: A103 – Phase 1 Documentation

4.4.4.2 Phase 1 Documentation Information Provided

- Updated CoDR Presentation – Incorporates feedback provided during the CoDR
- System Concept Description Document (SCDD)
- Procurement List - Items needed for development of the concept in Phase 2
- System Requirements Document (SRD) update
- Decision Documentation

4.4.4.3 Phase 1 Documentation Evaluation Criteria

Phase 1 Documentation evaluation uses the criteria provided in the Phase 1 Review and Documentation Evaluation Criteria document.

4.5 Phase 2 – System Development and Demonstration

The following tasks are included in Phase 2.

4.5.1 System Development

The objective of System Development is to develop the selected concept so that it meets the mission capabilities described in the Concept Development Document (CDD).

4.5.1.1 System Development Task Description

The TDV shall be developed as a complete stand-alone air vehicle with all sensors and equipment required to meet mission capabilities as defined in the Capability Development Document (CDD).

Phase 2 TDV trades shall employ formalized SAVE Option 3 trade study optimization methods and trace directly to the SAVE spreadsheet runs used.

The Contractor shall perform detailed weight and geometry measurements of the as-delivered RTF vehicle and all equipment items scheduled for integration. The RTF vehicle shall be assessed for modifications required for systems. RTF mass and geometry shall be recorded using a Customer provided Air Vehicle Mass and Geometry Datasheet template.

Air vehicle mass properties shall be developed for all PSC configurations, describing airframe, alighting gear, air vehicle systems and useful load items. Geometric and SAVE models shall be updated to reflect the validated mass and geometry.

Autopilot and flight test instrumentation equipment shall be CFE COTS. Both systems shall be installed to meet customer specified requirements for robust control station connectivity and real time flight data acquisition and transmission. Autopilot air and ground control shall be ArduPilot and/or other customer selected equipment. Flight test instrumentation shall be based on EagleTree or ArduPilot. Contractors shall be responsible for installation and operation of subsystems to customer standards of performance, safety and interference free operation. Minimum required real-time flight test data acquisition parameters include UTC time, indicated airspeed and pressure altitude, GPS speed and altitude, battery pack voltage and amps, outside air temperature (OAT), motor RPM, and battery temperature. All data shall be processed in standard English units.

4.5.2 CLIN 201 – Phase 2 Kickoff Review

The objective of the Kickoff Review is to communicate to the Customer your team plan, including organizational approach, schedule, and rationale following merger with non-selected team personnel. The review allows the Customer to assess readiness of the Contractor's plans

for execution and provide feedback. Successful completion of the Kickoff Review provides confidence that the program plan supports the program objectives. Following a successful Kickoff Review, the Contractor is approved to proceed to preliminary design.

4.5.2.1 Kickoff Review Task Description

A Phase 2 Kickoff Review shall be presented IAW the due date scheduled on Canvas. Topics to be reviewed include team organization, organizational interface compliance, and overall program planning and schedule for the newly merged team. Customer feedback covers organizational concepts and program planning.

Deliverable: A201 – Kickoff Review Presentation

4.5.2.2 Kickoff Review Information Provided

- Organizational concept
- Overall program schedule
- SE Management Plan
- ConOps Development Plan
- Control Station Development Plan
- Design Development Plan
- TDV Fabrication and Integration Plan
- Test and Evaluation Plan
- Support and Logistics Plan

4.5.2.3 Kickoff Review Evaluation Criteria

Kickoff Review briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.3 CLIN 202 – CDV Flight Testing

The primary objective of CDV Flight Testing is to develop the Contractor's ConOps. Secondary objectives are to enable Ground Crew training and maintain flight readiness of the CDV for use as a backup for the Flyoff Demonstration.

4.5.3.1 CDV Flight Testing Task Description

ConOps Development Vehicle (CDV) flight testing shall evaluate takeoff and landing characteristics and handling qualities. Autopilot and Operational test and evaluation shall support ConOps development and operator training. Engineering Flight Testing (EFT) shall

compare the CDV to prior flight performance documentation. TRRs shall be completed prior to each of the three initial flight test increments.

The CDV shall be maintained in flyable condition through completion of the Mission Capability Demonstration Flyoff.

CDV flight testing shall be conducted at the Austin Radio Control Association (ARCA) model aircraft flying field described at austinrc.org. Safety requirements are described in the Demonstration Safety Requirements.

Deliverables:

A202.1 – CDV First Flight Readiness Review Presentation
A202.2 – CDV Autopilot Flight Readiness Review Presentation
A202.3 – CDV OTE Flight Readiness Review Presentation

4.5.3.1.1 CDV Flight Testing Information Provided

- CDV First Flight Readiness Review
- CDV Autopilot Flight Readiness Review
- CDV OTE Flight Readiness Review
- ConOps development and mission rehearsal Lessons Learned

4.5.3.2 CDV Flight Testing Evaluation Criteria

FRR briefings are evaluated using the criteria provided in the Phase 2 Review and Documention Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.4 CLIN 203 – Preliminary Design Review (PDR)

The objective of PDR is to determine if the design maturity of the Preferred System Concept (PSC) is consistent with ROS UAS program goals. The review allows the Customer to assess the feasibility of the design to complete a meaningful flight test program within program schedule constraints and provide feedback. Successful completion of the PDR provides confidence that maturity of overall PSC design is sufficient to support detailed design activities.

4.5.4.1 PDR Task Description

The Contractor shall present a PDR briefing for critical review, IAW the due date published on Canvas. Information to be presented includes the system preliminary design baseline with closure around documented requirements, updated program risks, and updated program schedule through completion of the flight test program. The System Configuration Description

Document (SCDD) reflects the current configuration. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and performance.

Deliverables:

A203.1 – PDR Presentation
A203.2 – SCDD Update

4.5.4.2 PDR Information Provided

- Requirements Development – Interface and requirements are complete. Initial verification statements are complete and external interfaces are documented.
- Preliminary design for all 5 system elements is complete to the subsystem/configuration item level, requirements are traceable to system-level requirements, and the design closes around documented requirements and performance achieves threshold-objective values, and meets size, weight, power and cooling (SWaP-C) constraints.
- Risk Management – Risks must include all design risks
- Technology Maturation - Desired technology maturation can be achieved via planned development within program schedule. Test plans define objectives and expected results that validate design proof-of-concept.
- Updated program schedule

4.5.4.3 PDR Evaluation Criteria

PDR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced. The SCDD shall describe the current system configuration.

4.5.5 CLIN 204 – Propulsion System Testing

The objective of Propulsion System Testing is to verify propulsion system installed performance in terms of overall efficiency and thrust.

4.5.5.1 Propulsion System Testing Task Description

A battery-electric propulsion system representative of that proposed for the TDV shall be tested in the ASE Low Speed Wind Tunnel, IAW the due date published on Canvas. Various motor and propeller combinations shall be tested to verify analytical predictions and enable selection of the most optimal configuration. A TRR shall be completed prior to testing. Propulsion System test results shall be summarized at the CDR.

Deliverables: A204 – Propulsion System TRR Presentation

4.5.5.2 Propulsion System Testing Information Provided

- Pre-test performance predictions
- Performance characteristics for various candidate motor/propeller combinations
- Preferred propulsion system configuration and performance

4.5.5.3 Propulsion System Testing Evaluation Criteria

TRR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.6 CLIN 205 – Critical Design Review (CDR)

The objective of CDR is to determine if the design maturity of the Preferred System Concept (PSC) is consistent with ROS UAS program goals. The review allows the Customer to assess the feasibility of the design to complete a meaningful flight test program within program schedule constraints and provide feedback. Successful completion of the CDR provides confidence that maturity of overall PSC design is sufficient to proceed to manufacturing.

4.5.6.1 CDR Task Description

The Contractor shall present a CDR briefing for critical review, IAW the due date published on Canvas. Information to be presented includes the system detailed design baseline with closure around documented requirements, updated program risks, and updated program schedule through completion of the flight test program. The review shall focus on wing and empennage design, but cover the entire system. The System Configuration Description Document (SCDD) is updated to reflect the current configuration. Manufacturing drawings and instructions shall be complete and reflected in the Manufacturing Plan. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and performance.

Deliverables:

A205.1 – CDR Presentation
A205.2 – SCDD Update
A205.3 – Manufacturing Plan

4.5.6.2 CDR Information Provided

- Updated system requirements, flowdown, and compliance

- ConOps have been updated using simulation and CDV flight test experiences
- Detailed design for all five system elements is complete to the subsystem/configuration item level, requirements are traceable to system-level requirements, and the design closes around documented requirements and performance achieves threshold-objective values, and meets size, weight, power and cooling (SWaP-C) constraints
- Wing proof test planning update
- Mass properties update – detailed breakdown
- Performance update – including System Effectiveness
- Risk Management – Risk management plans updated to reflect testing results
- Updated SCDD
- Completed manufacturing drawings and instructions
- Updated program schedule

4.5.6.3 CDR Evaluation Criteria

CDR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced. The SCDD shall describe the current system configuration. The Manufacturing plan shall adequately describe manufacturing processes.

4.5.7 CLIN 206 – Wing Proof Testing

The objective of the Wing Proof Testing is to ensure that the wing can safely carry the expected loads during the flight demonstration. The TRR allows the Customer to assess the feasibility of the design to complete proof load testing and carry the ultimate load. Successful completion of Wing Proof Testing provides confidence that wing strength is sufficient to support flight demonstration activities.

4.5.7.1 Wing Proof Testing Task Description

- The TDV wing shall be proof tested to 115% of Design Limit Load (DLL) by performing a ground static load proof test, IAW the due date published on Canvas. This establishes a Contractor defined safe operational envelope in terms of gross weight and speed for Contractor defined steady state and gust wind conditions. A TRR shall be completed prior to testing. Test results shall be reported at SIR.

Deliverables: A206 – Wing Proof Testing TRR Presentation

4.5.7.2 Wing Proof Testing Information Provided

- Pre-test structural analysis to define Design Ultimate Load
- Wing Proof TRR
- Definition of safe operational envelope as function of aircraft gross weight, speed, and steady state and gust wind conditions

4.5.7.3 Wing Proof Testing Evaluation Criteria

Wing Proof TRR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.8 CLIN 207 – System Integration Review (SIR)

The objective of the SIR is to verify that all systems are integrated in accordance with manufacturing plan. The review allows the Customer to assess if the Contractor understands subsystem design and integration requirements and has a viable system integration definition, plan, and schedule. Successful completion of the SIR provides confidence that maturity of overall PSC design is sufficient to proceed to flight test preparation.

4.5.8.1 SIR Task Description

The Contractor shall present an SIR briefing for critical review, IAW the due date published on Canvas. This informal review focuses on viability of the fuselage subsystem integration, but cover the entire system. After the briefing, the SIR shall continue in the BASIL with an inspection of the aircraft. The System Configuration Description Document (SCDD) is updated to reflect the current configuration. Data completeness and quality shall be sufficient to support Customer assessment of the technical viability of Contractor's integrated product.

Deliverables:

A207.1 – SIR Presentation
A207.2 – SCDD Update

4.5.8.2 SIR Expectations

- All manufacturing activities completed for wings and empennage
- Wing proof test completed successfully
- All systems installed in TDV fuselage, wing, and empennage
- Demonstrate that all systems are working or discuss corrective actions
- SCDD updated

4.5.8.3 SIR Evaluation Criteria

SIR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced. The SCDD shall describe the current system configuration.

4.5.9 CLIN 208 – TDV Operational Test and Evaluation (TDV OTE)

The objective of TDV OTE is to verify that the system design meets the system requirements by performing flight testing. Successful completion of OTE clears the path toward the Mission Capability Flyoff Demonstration.

4.5.9.1 TDV OTE Task Description

TDV OTE flight testing shall evaluate takeoff and landing characteristics, manual in-flight handling qualities, autopilot functionality, sensor performance, communications datalinks, ADP performance, and ground control system operation. TRRs shall be completed prior to TDV first flight and beginning of the OTE flight series. ConOps effectiveness shall be evaluated and updated as needed.

Limited engineering flight testing (EFT) shall be completed to enable evaluation of System Effectiveness MOEs. The Endurance Factor (EF) shall be evaluated during a Customer validated demonstration. The EF demonstration shall last for a minimum of 5 minutes and provide flight test measurements of battery power consumed and lift plus thrust and drag estimates.

TDV flight testing shall be conducted at the Austin Radio Control Association (ARCA) model aircraft flying field described at austinrc.org. Safety requirements are described in the Demonstration Safety Requirements document.

Deliverables:

A208.1 – TDV FFRR Presentation
A208.2 – TDV OTE FRR Presentation

4.5.9.2 TDV OTE Information Expectations

- SIR completed and Critical Action Items closed
- Ground testing completed, including functional and integrated systems testing
- TDV First Flight Readiness Review completed
- TDV OTE Flight Readiness Review completed
- Limited EFT completed

4.5.9.3 TDV OTE Evaluation Criteria

FRR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.10 CLIN 209 – TDV Competitive Flyoff Demonstration

The Flyoff Demonstration supports five UAS mission objectives: rapid deployment, search, surveillance, precision airborne drop package delivery, and mapping. The demonstration exercises ground and in-flight segments, which are limited to a total maximum elapsed time of forty (40) minutes.

4.5.10.1 TDV Competitive Flyoff Demonstration Task Description

The ROS UAS shall be demonstrated in a simulated rescue mission. For the purposes of this technology demonstration, the system shall be stored, deployed, and operated from a single site, with a single flight and ground operations crew supporting the entire mission.

The TDV shall be the primary flight vehicle for the Technology Demonstration Flyoff. The CDV air vehicle shall be maintained in flight ready condition and serve as a back-up air vehicle unless damage is sustained that, in the customer's opinion, makes it non-viable.

It is expected that viable solutions require only one aircraft to perform the demonstration. However, system concepts involving more than one aircraft are allowed if only one is moving at any given time (in the air or on the ground) and a flyable backup is available for each vehicle.

Manual control is permitted for takeoffs and landings, otherwise all air vehicle flight control commands shall be through the CFE autopilot.

Deliverable: A209 – Flyoff Documentation

4.5.10.2 TDV Competitive Flyoff Demonstration Expectations

The Competitive Flyoff Demonstration shall be conducted IAW the mission and safety requirements defined in the "ROS UAS Demonstration Mission Requirements" document.

4.5.10.3 TDV Competitive Flyoff Demonstration Evaluation Criteria

A Customer review team observes each flight demonstration and assesses performance based on Contractor provided flight test data. A panel of experts selected by the Customer then

evaluates Contractor performance and products based on requirements in this section and the Performance Attribute TPMs and MOEs defined in CDD Section 5.

4.5.11 CLIN 210 – System Design Review (SDR)

The objective of the SDR is to verify that the Contractor's system design consistent with the ROS UAS program goals and meets the performance and system effectiveness requirements described in the Capabilities Development Document (CDD). Successful completion of the SDR provides confidence that the ROS UAV design meets the program objectives and clears the path to Phase 2 completion (exit readiness).

4.5.11.1 SDR Task Description

The Contractor shall present an SDR briefing focused on system performance verification and validation, IAW the due date published on Canvas. The Contractor shall present an overview of program management processes, system requirements, system design, demonstrated performance, and lessons learned. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and verify that performance meets requirements.

Deliverable: A210 – SDR Presentation

4.5.11.2 SDR Expectations

- Project Management Approach
- System Concept Overview
- System Requirements, Flowdown, and Compliance Summary
- System Functional Description
- System Physical Description and Performance
- Design Methods and Trade Studies
- Fabrication and Integration Approach
- Ground Test and Evaluation Summary
- Flight Test and Evaluation Summary
- Performance Validation
- Risk Management Approach
- Lessons Learned

4.5.11.3 SDR Evaluation Criteria

SDR briefings are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document. Briefings shall be limited to the number of slides

that can be presented in the allocated time and/or used in support of the customer directed question and answer (Q&A) session. Time limits are strictly enforced.

4.5.12 CLIN 211 – Phase 2 Documentation Preparation

The objective of this task is to provide documentation of rigorous systems engineering design and analysis processes used in Phase 2. This documentation provides a comprehensive overview of all of the work completed in Phase 2. Format and content shall be IAW the description provided in Data Item Descriptions, DID 4.

4.5.12.1 Phase 2 Documentation Task Description

The Contractor shall prepare comprehensive documentation, which summarizes the concept developed during Phase 2, IAW the due date published on Canvas. Data completeness and quality shall be sufficient to support independent Customer assessment of the technical viability of the Contractor designs and performance.

Deliverable: A211 – Phase 2 Documentation

4.5.12.2 Phase 2 Documentation Information Provided

- SDR Report
  - Describes all material presented in SDR and additional information not presented due to time constraints

- Supporting Data
  - SDR Presentation
  - Decision Documentation
  - Requirements Documentation (SRD)
  - Risk Assessment
  - Mass and Geometry Summary Datasheets
  - RTF and TDV VSP and/or SolidWorks Models
  - Trade Study Substantiation
  - RTF and TDV SAVE Models
  - Ground Test Data, Analysis and Results
  - Flight Test Data, Analysis and Results

4.5.12.3 Phase 2 Documentation Evaluation Criteria

Phase 2 Documentation are evaluated using the criteria provided in the Phase 2 Review and Documentation Evaluation Criteria document.