Attachment J-03

NASA ARMSTRONG FLIGHT RESEARCH CENTER

TASK ORDER 2

STATEMENT OF WORK

FOR THE UNMANNED AIRCRAFT SYSTEMS (UAS) INTEGRATION IN THE NATIONAL AIRSPACE SYSTEM (NAS) PROJECT LIVE, VIRTUAL, CONSTRUCTIVE- DISTRIBUTED ENVIRONMENT (LVC-DE) CONNECTION DEVELOPMENT

RFP No.: NND15548481R

27 May 2015

I. Objectives/Summary

The first objective of this NASA UAS Integration in the NAS (UAS-NAS) Project task is to develop a Live, Virtual, Constructive - Distributed Environment (LVC-DE) connection. The proposer (FAA UAS Test Sites) will compete for this task. Each test site will purchase necessary equipment, perform the connection to a NASA defined LVC Interface Control Document (ICD) and LVC Software Design Description (Reference 1 and 2), work with NASA to develop and sign all required agreements, and develop best practices for making an LVC-DE connection with partners. Test sites will also be asked to demonstrate the prototype LVC-DE connection by leveraging components developed under the second objective of this task.

The second objective of this NASA UAS-NAS task is to implement testing of state of the art Detect and Avoid (DAA) technologies that may be used to enable extended operations in class D, E, and G airspaces. The DAA technologies to be tested will be selected based on applicability to two different ConOps highlighting needs relative to terminal airspace (class D) and other airspaces that a UAS user will perform operations (class E and G). NASA must have the ability to acquire associated test data in real-time through the LVC-DE.

II. References

1. Live Virtual Constructive (LVC) Interface Control Document (ICD) for the LVC Gateway, Flight Test 3, LVC ICD-03 Release: Rev B (Attachment J-04)
2. LVC, Software Design Description, LVC SWDD-03, Release: Rev B (Attachment J-07)
3. Information Technology Security Management Plan Template (Attachment J-05)
4. RTCA Special Committee (SC)-228 Terms of Reference (TOR) (Attachment J-08)

III. Objective 1 Description

The FAA Designated Test Site Operator shall develop a Live, Virtual, Constructive- Distributed Environment (LVC-DE) connection. The test site shall purchase necessary equipment, perform the connection to a NASA defined Interface Control Document (ICD) ICD (reference 1), work with NASA to develop and sign all required agreements, and develop best practices for making an LVC-DE connection with partners.

The Test Site Operator shall demonstrate the LVC-DE connection by leveraging components developed under the second objective within this acquisition.

The Test Site Operator shall consider the following technical tasks when developing the technical plan, schedule, total costs, payment milestones, estimated man-hours, and procurements required,

1. Procure hardware to host the LVC-DE Gateway at the FAA Test Site(s) necessary to meet LVC-DE ICD (reference 1).
2. Sign Software Usage Agreement (attachment 2) for access to the core LVC-DE and supporting software.

3. Obtain NASA Authority to Operate (ATO), through the IT Security Plan (reference 3), on the NASA LVC-DE network in order to complete the connection between NASA and the FAA test site.
4. Utilize the existing LVC-DE Gateway ICD (reference 1) to develop a connection from the UAS-NAS LVC-DE to the existing UAS Test Site technologies.
5. Identify gaps in the LVC-DE Gateway ICD ICD (reference 1) that prevents connection of proposed technologies and propose design ICD modifications for implementation by NASA personnel.
6. Install and configure the LVC-DE instantiation at the UAS Test Site.
7. Conduct local and distributed connection testing between the FAA Test Site and the UAS-NAS LVC-DE hub. The intention is that data would be streamed to/from NASA and could initiate from a UAS Ground Control Station (GCS), flight simulator, DAA technologies, C2 technologies, range equipment, or other UAS P2 MOPS relevant technologies.

The objectives above are not necessarily to be considered sequential in nature. Usage agreements and ATO shall be in place immediately after task order award. The ATO process is not able to be pre-specified for reference by a test site. The process is a NASA security related process that is evaluated on a customer-to-customer basis, and can take a significant amount of time. Procurement and installation tasks will likely be performed simultaneous to agreement and ATO development tasks.

Although the requirements above will give NASA and the test site the ability to share data, the connection will not necessarily work for all data shared. The connection is specific to the planned data that will be streamed, and hardware leveraged to conduct the initial local and distributed testing. Thus the cost of the connection will be balanced against the services provided in the following Phase 2 Minimum Operational Performance Standard (MOPS) DAA related objective 2 proposal – RTCA SC-228 TOR (Reference 4).

IV. Objective 2 Description

The FAA Designated Test Site Operator shall demonstrate their ability to test DAA technologies with the capability to adequately provide a safety case for the two Concept of Operations (ConOps) below. It is expected that a single DAA technology is not at the required maturity level to meet the intent of both ConOps. After the description of each ConOps, an example technology set is described that could meet the intent of the ConOps. It is not required that the proposer uses this example technology set to meet the intent of the ConOps. All solutions will be evaluated and scored against the solicitations evaluation criteria. Solutions should leverage DAA technologies that do not include chase aircraft or ground observers.

The Test Site Operator shall consider the following technical tasks when developing the technical plan, schedule, total costs, payment milestones, estimated man-hours, and procurements required:

1. Proof of DAA hardware availability including descriptions of hardware certification standards and if the equipment is commercial off-the-shelf (COTS).

2. Description of DAA system architecture, and prior testing on the system proving a minimum of NASA test readiness level (TRL) 5.
3. Description of DAA sensor characteristics and applicability to associated ConOps. Sensor characteristics include: angular resolution, range, and range rate, update rate, scan rate, track update rate or search update rate, search volume, covariance errors, altitude resolution, cross-section detection, and other time space position indicators as appropriate.
4. Description of known aspects of the associated DAA architecture beyond the sensor including visibility and weather restrictions, track classification method, DAA algorithms with adaptability to well clear definitions, etc. NASA will use information to support technical evaluation including TRL Level.
5. A brief Test Plan and concept will demonstrate the approach the test site will take to characterize sensor performance and DAA architecture of components in support of a MOPS, through a series encounter runs described in the test plan.

ConOps1 – An aircraft will utilize a Class D airport for take-off to perform a given beyond visual line of sight (BVLOS) mission in class E airspace. The DAA capability is not expected to provide the capability for the aircraft to perform surface operations. The DAA technology is expected to be capable of providing sufficient means of safety for the aircraft to safely transition into Class E and G airspaces. The DAA system must provide all detection and track data to the pilot and UAS Ground Control Station (GCS). The DAA system must be capable of handling DAA functions for all cooperative and non-cooperative aircraft operating with a wide range of aircraft speeds, and function against necessary relative encounter speeds and geometries.

ConOps1 Example technology: 3-D Ground Based Radar, or acoustic sensors, with data integrated into a UAS GCS

ConOps2 – An aircraft will be required to take-off from class G or E airspace with ability to perform a beyond visual line of sight (BVLOS) mission. The aircraft will be capable of operating up to 10,000 feet mean sea level (MSL) for an extended period of time. The system must be capable of continually performing necessary DAA functions for both cooperative and non-cooperative aircraft operating with a range of aircraft speeds, and function against necessary relative encounter speeds and geometries. The DAA sensor must be onboard the aircraft and provide intruder data to a central processing unit onboard the aircraft with the ability to communicate intruder information to the pilot and UAS GCS. The system may have the capability to perform automated maneuvers, but must also comply with existing rules for communication with the FAA Air Traffic Control (ATC) system.

ConOps2 Example technology: Example technologies for ConOps2 would include EO/IR systems, LIDAR, acoustic, or airborne radar systems operating per ITU-R M.2204.

Descriptions of the DAA concept including partners are of primary importance. The proposer will be responsible to perform DAA testing specific ConOps including pairwise encounters to demonstrate the technical performance of the sensor as part of the DAA architecture. The proposer will be the primary party responsible for developing and executing their Test Plan (including intruder aircraft), and responsible for safety of all test operations. The proposer shall

be required to provide sufficient evidence, including schedules and payment milestones, that all activities can be completed prior to September 30, 2016.

The proposer is also asked to discuss any defined uses of a Phase 1 MOPS related terrestrial communication system to implement the communication component for the aircraft and overall DAA system under test.

The Test Plan for the proposed activity shall include discussion on data that will be streamed via the LVC-DE connection with NASA. It shall also include evidence that the proposer understands the testing needs of a system that can be used to prove safety and overall feasibility of the various ConOps described. The Test Plan shall also include evidence that assets necessary to accomplish the test plan are preliminarily identified and will be available within reason. The Test plan shall also include preliminary identification of test areas and associated airports that will be used in the test.

It is expected that the proposer will acknowledge and briefly discuss their plans to fly and perform their expected subset of system testing during the month of April 2016 for the Initial Safe National UAS integration Campaign/Initiative.

V. Place of Performance

Support will primarily be provided at the Test Site Operator facilities and the NASA Armstrong Flight Research Center, though the needs of some tasks will require travel. All travel in support of this requirement shall comply with FAR 31.205-46 and the Federal Travel Regulations.

VI. Period of Performance

The period of performance for this requirement will be 2 years from the date of task order award.

VII. DELIVERABLES/MILESTONES

Deliverable Titles	Deliverable Instructions	Deliverable Due Date
Joint Kick-off Meeting	meeting (virtual or at Test Site) to discuss all initiatives, deliverables, and technologies	**Sept 2015**
Proof of Hardware purchases	Documentation of equipment to be installed for LVC-DE connection	**Dec 2015**
Software Usage Agreement	Final signed software usage agreement necessary for connection to LVC	**June 2016**
Authority to Operate (ATO)	Final signed ATO necessary for connection to LVC	**July 2016**
LVC-DE ICD Gap Assessment	Description of deficiencies or necessary changes to NASA ICD to allow for more efficient connections, and to document final configuration ICD	**Sept 2016**
Final DAA Architecture Diagram	Final components that will be leveraged within the DAA system. Describing all components and	**Dec 2015**

and Description, ConOps1 and ConOps2	integration schemes. Likely two deliverables if both ConOps are implemented	
Final DAA Flight Test Plan	Including encounter geometries, data collection plan, details of COA	**Jan 2016**
Initial Safe National UAS Integration Initiative Testing	Initial Testing of DAA system during the timeframe of an independent NASA initiative.	**April 2016**
Final LVC-DE Connection and DAA Demonstration	Final Demonstration of all LVC-DE and DAA components, likely a multiple week period. Live flight data will be passed to NASA from the vehicle system through the LVC	**July-Aug 2016**
DAA data and analysis report	Final report documenting all DAA data collected and overall performance and analysis of the systems capabilities	**Sept 2016**