Task Order Total Cost (Total Estimated Cost + Total Max Fee): $11,892,586.85

IV&V SUPPORT
STATEMENT OF WORK (SOW)

Task Order No. 4 / Mod No.10
Task Monitor (TM): Lisa Downs

Contract SOW Reference:

Section 1.6 – Contract Management
Section 3.2 - Directed Projects
Section 3.3 – Capability Development (CD)
Section 3.4 – Project Management Support
Section 3.5 – Technical Quality and Excellence (TQE)
Section 3.6 – Software Assurance Tools (SWAT) Support

1. SCOPE

The contractor shall perform IV&V Support functions consistent with the contract SOW. Specific tasks are identified in Section 3. The requirements include all work in TO-4 previous mods.

2. PERIOD OF PERFORMANCE

The period during which the work for this task shall be performed is from May 11, 2017 through September 30, 2021.

3. TASK DESCRIPTION

3.1. **Management:** Contractor shall perform management related activities, as specified in Section 1.6, *Contract Management*, of the contract SOW.

3.2. **SAS Program Engineer Staff**: Program work experiences slowdowns primarily due to project delays or other unexpected events that cannot be predicted. There are also cases where work can spike requiring more resources to complete tasks within required deadlines. The Program maintains a steady backlog of support work in numerous areas that would enable more effective accomplishment of the Program's goals and objectives. The work is across the technical spectrum of what is accomplished, from IV&V to S&MA support to JSTAR simulation to Capability Development efforts. Initial planning would be a level of effort for this staff. Subsequent planning as work opportunities arise would be coordinated across the offices with the champion team. Skill sets required include the following:

3.2.1. Broad knowledge of IV&V, S&MA, and Systems engineering including Information Assurance, simulation, cyber security, and NIST cyber security framework applicable to both flight and ground systems.

3.2.2. Capability to step in, learn quickly, and provide meaningful results in short periods of time.

3.2.3. Flexibility and excellent communication.

Deliverables would be coordinated depending on the specific work need. Capability Development efforts or other assigned work would be the backfill for periods of time where no office is requiring additional support. Given that this is a LOE requirement the current request shall be for 3 WYE.

3.3. **Technical Quality & Excellence:** The Contractor shall provide support for the Technical Quality & Excellence (TQ&E) activities and initiatives.

3.3.1. **Technical Consulting:** The Contractor shall maintain understanding and prioritization of challenges faced by IVVO. The Contractor shall provide technical expertise and support as necessary to deliver solutions to those challenges (e.g., support IV&V projects in determining correct objectives and the methods for reaching those objectives; assessing the quality and consistency of IV&V analysis results; updating IV&V processes and catalog of methods; and infusion of IVVO initiatives and Capability Development (CD) solutions into IV&V projects, etc.). The Contractor shall develop project plans to characterize the nature of specific challenges, recommend solutions, identify goals, and estimate schedule and resource needs to accomplish the goals. The Contractor shall collaborate with IV&V projects, groups, or individuals as necessary in developing the plans. The plans shall be approved by the TQ&E Group Lead. The Contractor shall implement solutions identified in project plans and manage schedule and resources to ensure goals are met effectively and efficiently.

3.3.2. **IVVO Initiatives Advancement:** The Contractor shall collaborate with the TQ&E Group Lead, IV&V Group Lead, and IVVO Lead to identify the highest priority initiatives to focus on and address during the period of performance. The Contractor shall be responsible for identifying an initiative lead or set of leads in TQ&E, responsible for the identification of the goals and objectives for each initiative. The contractor initiative lead(s) shall lead the development of a plan to satisfy the goals and objectives of each of the initiatives. The plans shall be approved by the Government prior to execution. The Contractor shall provide

technical guidance to support implementation of solutions related to the initiatives.

3.3.3. **Knowledge Management:** The Contractor shall identify best practices occurring on IV&V projects. The Contractor shall develop and implement plans to ensure that those best practices are understood and leveraged by all appropriate IV&V projects. The plans shall be approved by the TQ&E Group Lead. The Contractor shall coordinate knowledge sharing events (e.g., technical discussions, workshops, etc.) to facilitate knowledge transfer within the IV&V community. The contractor shall encourage, collect, evaluate, mature, and disseminate lessons learned and success stories from IV&V projects to support communication of IV&V value to Program stakeholders. The Contractor shall engage with IV&V Strategic Communications Office (SCO) as appropriate to coordinate knowledge management activities.

Skill sets required: Personnel (e.g., senior engineers, subject matter experts (SMEs), etc.) with deep knowledge of the IV&V Program's technologies, methods, and approach for providing assurance will be required. The TQ&E team should possess knowledge of a broad range of technical domains relevant to advancing the IV&V Program's technical capabilities. Anticipating 5.0 WYE support in FY21.

3.4. **Support to Software Assurance Tools (SWAT):** The contractor shall advance the IV&V Program tooling capabilities by supporting the SWAT initiatives identified below. Reference documents are available on ECM.

3.4.1. Provide functionality and data validation and verification for COTS tool upgrades. For instance, support DOORS upgrades, Polyspace upgrades, Confluence/JIRA, etc.

3.4.2. Provide user testing of tools developed in house by SWAT. This effort would include requirements identification, prototype and other release testing, verification of project specific customizations, and data validation/verification. Examples that may require these efforts during this period of performance would be ATS and any potential additional releases, COMPASS updates, Risk Manager updates, potential development of an Assurance Case tool, potential development of an Effort Estimation Tool, and other tools or initiatives that may evolve in the implementation of the broader DMA vision/approach.

3.4.3. Support regularly scheduled group and/or project coordination tag-ups in order to better understand the current tool support requirements and upcoming IV&V project milestones that may impact SWAT plans or priorities(Iteration varies by project-a half hour meeting that occurs monthly to quarterly).

3.4.4. Provide support for Static Code Analysis Working Group activities to aid SWAT in defining, improving, and outreaching process improvements in the area of static code analysis.

3.4.5. The contractor shall provide backup support for hardware and software installation and maintenance on classified systems located at the IV&&V Facility.

3.5. Capability Development

The Contractor shall advance the IV&V Program by executing the Capability Development (CD) initiatives identified below.

3.5.1. Autonomous Software Systems (Period of Performance: 4/29/2020 – 6/30/2021)

3.5.1.1. Scope

Perform research that focuses on developing approaches and tools required to assure safety-critical autonomous software systems. These autonomous systems (vs. automated) may include components for executing actions and making decisions and are able to reason about the operating environment and the system itself.

3.5.1.2. Requirements

- Conduct a study across NASA and other appropriate government agencies and industry to **identify/determine the state-of-the-practice** of autonomous software systems from a safety and mission assurance perspective.
- Conduct a study to **identify/determine approaches and tools that are being used** at NASA and other appropriate government agencies and industry to assure the safety-critical intelligent autonomous software systems.
- Review and assess NASA IV&V processes, tools, and methods and **recommend changes required** (new methods required, updates to existing methods, new tools, etc.) to assure safety-critical autonomous software systems, such as those systems being developed for Gateway.
- Recommend **efficient and effective way(s) to develop/advance** NASA IV&V processes, tools, and methods required to assure safety-critical autonomous software systems (Government will issue follow-on initiative(s) to develop approaches/tools as required).
- Recommend **efficient and effective way(s) to institutionalize** the new/revised NASA IV&V processes, tools, and methods required to assure safety-critical autonomous software systems.

3.5.1.3. Deliverables

3.5.1.3.1. **Project Plan** – The Project Plan describes the approach for performing this Capability Development (CD) initiative. The Project Plan will be brief, but shall include, at a minimum, the following items: overall strategy for conducting the research, planned tasking, including anticipated duration of tasks, deliverables, and milestones. Due Date: No later than 30 calendar days after the start of this initiative. (Delivered in FY20)

3.5.1.3.2. **Tech Discussion** – Conduct training and/or tech discussions on the outcomes from this initiative for IV&V Program personnel. Due Date: As required (anticipating 1-2 events).

3.5.1.3.3. **NASA IV&V Processes, Tools, and Methods Change Recommendations** – The report describes the recommend changes required in NASA IV&V processes, tools, and methods to assure safety-critical autonomous software systems. Due Date: As identified in the Project Plan.

3.5.1.3.4. **Quarterly Progress Report** – The report describes activities performed, results/outcome achieved per the stated requirements, and challenges/risks. Due Date: Quarterly.

3.5.1.3.5. **Final Summary Report** – The report summarizes the research in sufficient detail to comprehensively explain the results. The report shall include all activities performed, results/outcomes, and recommendations. Due Date: Prior to end of this initiative.

3.5.2. **Machine Learning – (Period of Performance: 4/29/2020 – 12/31/2020)**

3.5.2.1. **Scope**

Perform research that focuses on the application of machine learning to determine how to automate and/or support IV&V analysis activities. The NASA IV&V Program has access to over 25 years of knowledge/information based upon performing IV&V on NASA missions. This information includes thousands of analyzed requirements across several NASA projects from different NASA centers, IV&V issues, risks, assurance cases, catalog of methods and the methods/approaches used to identify a specific issue on a project, etc. Through the application of machine learning, this historical data may help the IV&V Program to discover ways to enhance IV&V effectiveness and efficiency, and to advance its IV&V capabilities.

3.5.2.2. **Requirements**

- In collaboration with the Government, conduct a study to identify the appropriate information available from the IV&V historical data for possible application of machine learning.
- Review current NASA IV&V processes, tools, methods and best practices in performing IV&V.

- This research will utilize results from a previous Deep Learning feasibility initiative, specifically the exploration of ATS data relative to requirements and IV&V analysis.
- Recommend a technical roadmap for the application of machine learning to enhance IV&V effectiveness and efficiency, and to advance IV&V capabilities (Government will issue follow-on initiative(s) to develop approaches/tools as required).

3.5.2.3. **Deliverables**

3.5.2.3.1. **Project Plan** – The Project Plan describes the approach for performing this Capability Development (CD) initiative. The Project Plan will be brief, but shall include, at a minimum, the following items: overall strategy for conducting the research, planned tasking, including anticipated duration of tasks, deliverables, and milestones. Due Date: No later than 30 calendar days after the start of this initiative. (Delivered in FY20)

3.5.2.3.2. **Tech Discussion** – Conduct training and/or tech discussions on the outcomes from this initiative for IV&V Program personnel. Due Date: As required (anticipating 1-2 events).

3.5.2.3.3. **Machine Learning Technical Roadmap** – This technical roadmap describes the application of machine learning to enhance IV&V effectiveness and efficiency, and to advance IV&V capabilities. Due Date: Prior to end of this initiative.

3.5.2.3.4. **Quarterly Progress Report** – The report describes activities performed, results/outcome achieved per the stated requirements, and challenges/risks. Due Date: Quarterly.

3.5.3. **IV&V Project Effort Estimation and Risk Assessment – (Period of Performance: 8/1/2020 – 9/30/2021)**

3.5.3.1. **Scope**

IV&V project planning requires reliable estimates of software size, complexity, and testability, early in the project lifecycle for IV&V project scoping and effort estimation. This CD initiative focuses on developing and improving IV&V project effort estimation and risk assessment metrics based on the early lifecycle information. Anticipating 0.25 WYE support.

3.5.3.2. **Requirements**

- The contractor shall **support** this CD initiative being performed under a separate contract vehicle (grant).
- The contractor shall collaborate with the Government task monitor and the principal investigator of the grant as needed and ensure relevant aspects of CD solutions have been properly integrated into IV&V practices and processes.

3.5.3.3. **Deliverables**

3.5.3.3.1. **MPSR inputs** – Provide status of activities and notable accomplishments in the Monthly Progress Status Report (MPSR).

3.6. Directed Project

3.6.1. **Background**: NASA's IV&V Program is entering into working relationships with NASA projects and other agencies that require IV&V and SSO work to be performed within a classified environment. Therefore, the IV&V Program is constructing an area within the IV&V facility to allow classified work to be performed. Performing classified IV&V and SSO work is relatively new to the IV&V Program, thus there it imperative to coordinate and document a comprehensive set of operational and information technology documents associated with this area.

3.6.2. **Period of Performance:** 9 months

3.6.3. **Task Description:** The Contractor shall provide a project manager (PM) to elicit, capture, document, and secure an agreement on operational and information technology (IT) requirements from both the IV&V Office (IVVO) and the S&MA Support Office (SSO) associated with the secure area being constructed on the bottom floor of the IV&V facility/building 1 called the Shed. This effort will require coordination with IVVO, SSO, the customers of IVVO and SSO, the Program Support Office (PSO) which is responsible for constructing the area, the Office of Information Technology (OIT) which will install and maintain all IT in the area, the resident Code 240 employee, and IV&V Program senior management. The PM must have knowledge of IVVO and SSO required analyses activities that will be performed in this secure area, as well as a good understanding of what roles PSO, OIT, and Code 240 have in operating the Shed after completion. This PM will work with all the above entities to develop a schedule associated with accomplishing the agreed upon requirements set. Additionally, this PM will start developing a Concept of Operations document identifying the roles and responsibilities of applicable positions needed to operate and maintain the Shed and their relationship to IVVO and SSO activities and current and future project needs. This PM will not have a budget or be responsible for execution of the build-out, but would pull requirements together for IV&V program management and the offices to approve.

3.7. Deliverables

3.7.1.1. A complete and finalized set of operational and information technology (IT) requirements

3.7.1.2. A draft Concept of Operations

3.7.1.3. Plan and schedule for implementing established operational and IT requirements

3.7.1.4. CD specific deliverables identified in section **3.5 Capability Development**

4. DELIVERABLES/SCHEDULES/MILESTONES

The Contractor shall electronically submit all deliverables directly to the designated ECM folder. All formal deliverables shall be in a format approved by the CO and COR.

5. PLACE OF PERFORMANCE

All IV&V personnel should be located at the IV&V Facility in Fairmont, WV, unless a project specific need or other pre-approved circumstance warrants location at another NASA center, developer location, or other off-site location.

6. MODIFICATION NOTES

6.1. Mod 2 – Added CD "3.5.3 Reusable Tech Reference Feasibility Study" in section **3.5 Support to Capability Development (CD).**
6.2. Mod 3 – FY19 work added. Updates to TQ&E, CD, and SWAT.
6.3. Mod 4 – not executed.
6.4. Mod 5 – FY20 updates for SAS Program Engineer Staff, TQ&E, CD, and SWAT.
6.5. Mod 6 – added a Directed Project under section **3.6 Directed Project**.
6.6. Mod 7 – added two FY20 CD initiatives
6.7. Mod 8 – added IV&V Project Effort Estimation and Risk Assessment CD support
6.8. Mod 9 – FY21 updates
6.9. Mod 10 – added back in scope for SWAT (section 3.4). This is a NO COST mod.