

SYSTEMS ENGINEERING ADVANCED SERVICES

Task Order Statement of Work (SOW)

Date: ~~01 August 2019~~ 17 August 2020

Task Name: James Webb Space Telescope (JWST) Mission Systems Engineering

Task No. / Mod: ~~100/03~~ 100/04

Task Monitor (TM): Mike Davis, Code 599

Contract number: NNG15CR66C

Contract SOW Reference:

Function 2 (Implementation Phase Services);

Sub-Section A: Operations Concept Development and Support

Sub-Section D: Verification and Validation

Sub-Section L: Integration, Test and Verification Services

Sub-Section M: Launch-Site Preparation and Post-Launch Support

I. Scope

- a. Background – The James Webb Space Telescope (JWST) is scheduled for launch in 2021. The Spacecraft Bus is built by Northrop Grumman of Redondo Beach, CA. The JWST instrument suite was assembled at NASA/GSFC and integrated with the Optical Telescope at NASA/GSFC and shipped to the Spacecraft vendor for integration and test with the Spacecraft Bus.
- b. Summary of work - The task will involve provision of Mission Systems Engineering Support for the JWST Project including Verification and Validation, Integration, Test and Verification Services, Operations Concept Development and Support, and Launch-Site Preparation and Post-Launch Support. Scope of work will include, but not be limited to, verification and validation of requirements, validation of flight and ground fault management design, line of sight pointing assessment and evaluation, avionics, communications and electrical integration, test and verification services and launch-site and post-launch support including launch-vehicle interface management and mission operations control center support. Personnel will need to work Extended Work Weeks at times during the performance of this task due to the need to support integration and testing and meet the required systems oversight workload.
- c. Required skills/knowledge - All tasks require extensive systems engineering experience, including extensive experience on JWST.
- d. Purpose of this mod: This mod is to extend Period of Performance to April 14, 2021.

II. Period of Performance

The period during which the work for this task order shall be performed is from 1 October 2020 thru 14 April 2021.

III. Subtask Description

Subarea 1 – Requirements Verification and Validation

Provide individuals to perform mission-level requirements verification and validation for the JWST mission. Perform design, drawing and specification reviews and provide comments as necessary. Review relevant integration and test plans and procedures and monitor execution of the procedures where necessary with emphasis on Spacecraft, Sunshield and Observatory-level efforts. Review link margins, hardware integration and test plans, compatibility assessment with Deep Space Network and Space Network assets, frequency management issues and review of test data from relevant integration and test activities. Generate Requirements Verification Reports for applicable JWST Mission Systems-level requirements. Review plans for checkout of launch site and launch site processing to ensure that all launch vehicle-related requirements can be complied with in a timely manner with minimal impact. This task shall also include the provision of a senior-level Systems Engineer for mission-systems level integration, test and verification support on-site at Northrop Grumman in Redondo Beach, California. This task shall also maintain a High-Fidelity time-domain model of the JWST combined Attitude Control System (ACS) and Fine Guidance control systems. The contractor shall support System Validation and Analysis efforts by performing ACS-related simulations and/or analysis. The contractor shall participate in mission operations user/interface meetings and joint integrated mission simulation training in order to achieve sufficient familiarity and skill in JWST Mission Operations to support eventual JWST Launch and Commissioning operations.

Subarea 2 – Fault Management Support

The purpose of this task is to provide surveillance and guidance of the Northrop Grumman Spacecraft Flight Software Fault Management Effort. Monitor ongoing flight software development design and test activities including verification/validation testing and assessment of fault management design robustness as demonstrated by Northrop Grumman software testbeds. Attend all technical meetings and reviews. Support all engineering tests as required and provide recommendations and assessment of requirements compliance as applicable.

Subarea 3 – Power Subsystem Support

The purpose of this task is to provide surveillance and guidance of the Northrop Grumman Spacecraft Power Subsystem Integration and Test Team. Review test plans and monitor execution of related tests as required. Review compliance documentation to ensure all applicable requirements are verified. Support documentation of non-conformances and dispositions as required. Provide requirements verification and validation as required.

Subarea 4 – Operations Engineering Lead

The contractor shall provide an operations engineering lead engineer to the JWST mission. This includes, but is not limited to, management of the overall definition and performance of services for JWST operations including assuring readiness of the mission subsystems and mission control centers, pre-launch testing of the delivered subsystems, and operation of associated ground support equipment. The contractor shall review and provide operations concepts, scenarios and mission rules and support Project strategic planning and oversee operations facilities and tools to ensure the capabilities and resources meet the goals and objectives of the mission. The contractor shall provide reports, assessments, and technical evaluations in order to effectively assess changes that have potential impact to operational procedures and vehicle safety. Additional systems engineering support is required under Subtask 4 to support the final mechanical mate of the Cooler refrigerant lines currently scheduled for February 2021. This support includes travel as required to NGAS Los Angeles CA.

Subarea 5 – Ground Segment Commissioning & Documentation Support

The contractor provides management services, oversee changes to JWST Commissioning Plan to ensure all assigned JWST engineering objectives are accomplished within specified schedule. The contractor shall support prelaunch commissioning readiness and the commissioning campaign as part of the ICDH/IRSU team. The contractor shall maintain the Ground Segment Requirements Document (GSRD), Institutional Systems Requirements Document (ISRD) and the Flight Observatory to Ground Segment IRCD. The contractor shall coordinate working groups as needed to address proposed Requests for Technical Coordination (RTCs) and submit proposed changes to the Configuration Management Office and coordinate the dispositions of comments against submitted changes.

IV. Deliverables/Schedules/Milestones

The contractor shall deliver the items specified below:

<u>Ref#</u>	<u>Deliverables</u>	<u>Due Date</u>
1	Status Reports	Monthly
2	Performance Reports	Monthly
3	End-of-task Report	End of task

NOTE: Deliverables shall include source code, executable and all related documents, if applicable.

V. Management Approach

a. Staff Allocation, Expertise, and Skill Mix

The contractor shall staff this work item with the appropriate skill mix and staffing level for the work.

b. Configuration Management

Systems and documents will be covered under the JWST Project Configuration Management Plan.

c. Facilities

Appropriate IT devices to support the analyses, specification development, and report development are required. It shall be the contractor's responsibility to provide and set up local workstations and network connections at the contractor's off-site facilities as required, and to install any required tools and utilities on the contractor's equipment.

d. Risk Management and Best Practices

The contractor shall manage schedule, cost, and technical risk through monitoring and reporting of progress and performance metrics, identifying issues well in advance of negative

consequences, recommending corrective action to the TM, and implementing corrective actions with the compliance of the TM.

e. Performance Metrics

The work performed for this task will be evaluated by the TM based on the technical merit. The TM shall develop detailed performance metrics that shall reflect the contractor's performance in meeting research analysis, specific mission requirements, deliverables and delivery schedule, and the contractor's cost. Technical evaluation of the task performance is a subjective combination of performance metrics, technical quality of deliverables, cost control, significant events, innovations and meeting requirements set forth in the SOW. The primary performance metric will be the percent complete as denoted by planned vs actual cost on the monthly 533.

f. Government Furnished Facilities, Equipment, Software and Other Resources

The Government will provide account and passwords to government-furnished workstations where existing versions of various relevant software packages shall be maintained. It shall be the contractor's responsibility to complete any GSFC required security-related training courses.

g. Quality Assurance Requirements

The contractor shall comply with the JWST Mission Assurance Requirements for the JWST Observatory, Phase 2 (JWST-RQMT-000650)

VI. ODC (Travel and Procurement)

Domestic travel is required as needed per the notional schedule shown in the below table.

Foreign travel is also required per the notional schedule shown in the below table.

Travel requirements for each subtask are provided below. Due to the nature of the JWST Project, meetings dates that the contractor is required to support are subject to frequent change.

<u>Location</u>	<u>Duration</u>	<u>Dates</u>
Subarea 1: GSFC to LA	5 days	4 people 1x per month
Subarea 1: GSFC to Paris	5 days	1 person Oct 2020 April 2021
Subarea 1: LA to GSFC	5 days	1 person 2 times during effort
Subarea 1: GSFC to Kourou French Guiana	6 days	1 person 3 times during effort
Subarea 1: GSFC to Cleveland Ohio	5 days	1 person 1 time during effort
Subarea 2: GSFC to LA	5 days	1 person 1x per month
Subarea 3: GSFC to LA	5 days	1 person 3x per month
Subarea 4: GSFC to Kourou French Guiana	6 days	1 person 1 time during effort
Subarea 4: GSFC to LA	5 days	3 people 1x per month

Subarea 4: GSFC to Denver	5 days	1 person 4 times during effort
Subarea 4: LA to GSFC	5 days	1 person 4 times during effort
Subarea 4: GSFC to Los Angeles for Cryocooler Integration Support	5 Days	2 people, 1 time during effort
Subarea 5: GSFC to Ottawa, Canada	7 days	1 person 1 time during effort
Subarea 5: GSFC to Munich, Germany	7 days	1 person 1 time during effort
Subarea 5: GSFC to LA	7 days	2 people 4 times during effort
Subarea 5: GSFC to Baltimore	1 day	1 person Daily

VII. Work Location

Subarea 1: This work shall be performed primarily on-site at the Goddard Space Flight Center, but the contractor is required to provide one person onsite at the JWST Observatory Contractor facility in Redondo Beach, CA (including the supply of a computer, monitor and personal VPN).

Subarea 2: This work shall be performed primarily on-site at the Goddard Space Flight Center, but the contractor may be required to perform some work at the contractor's facility or at another location as required.

Subarea 3: This work shall be performed primarily on-site at the Goddard Space Flight Center, but the contractor may be required to perform some work at the contractor's facility or at another location as required.

Subarea 4: This work shall be performed primarily on-site at the Goddard Space Flight Center, but the contractor may be required to perform some work at the contractor's facility or at another location as required.

Subarea 5: This work shall be performed primarily on-site at the Goddard Space Flight Center, but the contractor may be required to perform some work at the contractor's facility or at another location as required.

VIII. Reporting Requirements

Monthly performance report

The contractor shall provide monthly technical and schedule progress reporting to adequately describe the activities of the contractor team to the TM. The contractor shall provide month cost reporting in accordance with the WBS. The contractor, including subcontractors, shall be available to attend monthly status meetings.

Monthly Deliverable Report

The contractor shall provide no later than the 10th working day following the close of the contractor's monthly accounting period a 533M for each individual subtask and a summary 533M at the total task level. If it is not possible to provide the individual 533M at the subtask level, the contractor shall provide on the 10th working day following the close of the contractor's monthly accounting period a break out of hours and costs by subtasks to the Contract Resource Analyst, Contracting Officer, and the Task Monitor. The report shall include current period hours and costs, cumulative to date hours and costs, and cumulative costs with a one-month cost plan. When needed, the contractor shall make adjustments to the distribution of costs, layout of the report and change reportable elements as specified by the Task Monitor and/or the Contract Resource Analyst.

IX. Security Requirements

The contractor shall comply with Information Technology Security procedures and requirements as defined by NPR 2810.1A in the performance of this task. In addition, the contractor shall comply with all applicable federal rules and regulations and agency directives.

The Contractor shall adhere to project requirements regarding ITAR related information, as controlled by the ITAR, 22 CFR 120-130, by the U.S. Department of State. Any transfer of controlled information to a foreign person or entity requires an export license issued by the U.S. Department of State or an ITAR exemption to the license requirement prior to the export or transfer.

There will not be any handling of classified data for this effort.

X. Data Rights

This SOW shall adhere to all Data Rights Clauses as stated in the SES II contract.

XI. Applicable Documents

In the performance of this task, the contractor shall comply with the JWST Project Documentation as applicable.

XII. References

None