Task Order Statement of Work (SOW) Date: 04/16/2020
Task Name: PACE Mission Systems Engineering
Task No. / Mod: 1/9
Task Monitor (TM): Gary Davis
Contract number: NNG15CR66C
Contract SOW Reference: 2
FUNCTION 1- FORMULATION PHASE SERVICES
FUNCTION 2- IMPLEMENTATION PHASE SERVICES
FUNCTION 3- RESEARCH AND TECHNOLOGY SERVICES
FUNCTION 4- SUPPORT SERVICES

I. Scope

Background – This task provides general mission systems engineering support to the PACE project mission systems engineering team. The performance requires working with the OCI and polarimeter instrument teams, spacecraft team, launch vehicle team, ground systems team, mission operations team, and science team

Summary of work – The contractor shall provide mission systems engineering expertise to the PACE Mission Systems Engineering Team. In general, the contractor's primary responsibilities are:
SUBTASK 001.01: Subtask Closed
SUBTASK 001.02: Launch Vehicle Support
SUBTASK 001.03: Systems Engineering Support and DOORS Support

Required skills/knowledge - The work requested under this task order for systems engineering support requires experienced systems engineers with 10+ years of experience working with spaceflight missions, launch vehicles, instruments, requirements, development, verification, and operations.

II. Period of Performance
The period during which the work for this task order shall be performed is from task award through April 14, 2021

III. Subtask Description

Subtask 001.001 (Subtask Closed)

Subtask 001.02 Launch Vehicle Support

Provide Launch Vehicle Engineering support including;
1) Assist in the requirements definition, interface definition, flowdown, planning, and risk identification of launch vehicle efforts during the pre-formulation phase of the PACE Mission;
2) Participate in program status meetings, telecons, peer reviews, and major project reviews for mission, spacecraft, and launch vehicle;
3) Assist with launch vehicle related requirements definition, flow-down, validation and verification planning;
4) Assist with Project trade-studies;
5) Prepare and present technical information for technical meetings / reviews / briefings; 6) Identify launch vehicle risk elements, develop and execute mitigation steps; participate in the PACE risk board.

Subtask 001.003 Systems Engineering & DOORS Support

Provide Systems Engineering support including;
1) Provide system engineering support as needed to support PACE pre-formulation activities;
2) Participate in program status meetings, telecons, peer reviews, and major project reviews for mission, spacecraft, instruments, and launch vehicle;
3) Assist with mission-level, element-level, and subsystem-level requirements definition, flow-down, validation and verification planning;
4) Assist with Project trade-studies;
5) Prepare and present technical information for technical meetings / reviews / briefings;
6) Identify risk elements, develop and execute mitigation steps; participate in the PACE risk board.

Provide Electrical Systems Engineering support to the PACE Mission Systems Team including;
1) Work with the Systems and Spacecraft teams to update and maintain the PACE Requirements Documents;
2) Work with the Systems and Spacecraft teams to update and maintain the PACE Spacecraft to OCI Interface Requirements Document.

Provide Systems Engineering support to the PACE Mission Systems Team including:
1) Coordinate mission-systems issues across the PACE Project,
2) Manage ICDs across PACE systems, instruments, spacecraft, and launch vehicle,
3) Provide systems input to subsystem issues,
4) Plan and execute system-level alignment and verify alignment requirements,
5) Give systems input to GSE team for TVAC and other system-level tests,
6) Prepare for shipment of the PACE Observatory and GSE to the launch site, and,
7) Prepare for launch site checkout, integration and testing of flight and ground systems, including adequacy of the launch site facility.

Provide Requirements Management and Verification Systems Engineering Support including;
1) Assist in the planning, organizing, scheduling, managing and directing of efforts associated establishing, maintaining, and verifying the PACE requirements, particularly in areas of DOORS Relational Database Operations and Development;
2) Participate in program status meetings, telecons, peer reviews, and major project reviews for spacecraft, instruments, launch vehicle, mission operations system, and science data system;
3) Assist with requirements definition, flow-down, linking, validation and verification;
4) Prepare/Review project documentation and submit comments and recommendations;
5) Prepare and present technical information for technical meetings / reviews / briefings;
6) Analyze configuration, design, and procedural changes submitted to the Project change control boards.

Specific Tasks
The Contractor shall perform key mission and spacecraft-level systems engineering functions that include, but are not limited to:

a) Assist in the planning, organizing, scheduling, managing and directing of efforts in preparation for the PACE Project-level Reviews;
b) Support mission and instrument level interface requirements management, validation and verification;
c) Support trade-studies for instruments, space and ground segments;
d) Monitor and manage external interface documentation and requirements;
e) Participate in instruments, subsystems, space and ground segment design reviews / meetings;
f) Review project documentation and submit comments and recommendations;
g) Prepare and present technical information for technical meetings / reviews / briefings;
h) Provide written and oral reports as requested;
i) Support the development and management of system engineering documentation and products;
j) Provide support for package development and attend and participate in program status meetings, telecons, peer reviews, and major project reviews for spacecraft, instrument, launch vehicle, and ground systems;
k) Review and provide comments on project, schedule, system, subsystem, software, flight software, safety verification, and testing documentation;
l) Assist in providing responses to and in closing requests for action (RFAs) from major mission, system, subsystem gate and peer reviews;
m) Assist in the generation, review and response to waivers and deviations;
n) Analyze configuration, design, and procedural changes submitted to change control boards;
o) Identify risk elements, develop and execute mitigation steps; participate in the project and element risk board meetings;
p) Analyze contractor cost, schedule and technical performance.

Subtask 001.03: Polarimeter Instrument Engineering Support

General:
The contractor shall provide systems engineering support for the “SPEXone” and “HARP-2” polarimeter instruments, ranging from acceptance, testing, requirements closure, I&T support, and early operations support. This support will be one (or two) engineers who will report to the mission systems team and other PACE project personnel as needed while performing the following duties for the polarimeters as described below.

Provide Instrument Systems Engineering support including;
1) Provide system engineering support as needed to support PACE polarimeters;
2) Participate in program status meetings, telecons, peer reviews, and major project reviews for polarimeters, such as Pre-Ship Review, acceptance reviews, etc.;
3) Assist with polarimeter requirements definition, flow-down, validation and verification planning;
4) Assist with Project trade-studies pertaining to polarimeters;
5) Identify risk elements, develop and execute mitigation steps; participate in the PACE risk board as cognizant engineer for the polarimeters.

Provide Polarimeter Requirements support to the PACE Mission Systems Team including;
1) Work with the Systems and Spacecraft teams to update and maintain the PACE Spacecraft to polarimeter Interface Control/Requirements Documents;
2) Assist with polarimeter requirements V&V planning and closure;

Provide Polarimeter Integration support to the PACE polarimeter teams including;
1) Coordinate polarimeter issues across the PACE Project;
2) Manage polarimeter ICDs;
3) Provide integration support to guide polarimeter integration with the spacecraft;
4) Plan and execute polarimeter alignment with the PACE mechanical team;
5) Give polarimeter input to PACE team for TVAC and other system-level tests;
6) Assist with receiving and inspection of the PACE polarimeters;
7) Prepare for launch site checkout, integration and testing of polarimeters and EGSE, including developing operational procedures and on-orbit commissioning plans;
8) Work with spacecraft PDL team, GSFC I&T facilities team, and PACE project personnel as needed to work out polarimeter I&T issues;
9) Work with PACE contamination personnel to ensure polarimeters are kept in a clean environment and that their T-0 purge systems are operating;
10) Support the development of polarimeter portions of observatory-level I&T plans, test procedures, tests, simulations, and WOAs;
11) Track and keep PACE project and mission systems team informed of polarimeter problems, failures, issues, and work to resolve them;
12) Travel to UMBC as needed to consult with HARP-2 polarimeter team and assist them with technical issues.

IV. Deliverables/Schedules/Milestones
At a minimum, the contractor shall deliver the items specified below:

Ref#	Deliverables	Due Date
1	Status Reports	Weekly/Bi-weekly
2	Performance Reports	Monthly
3	End-of-task Report	End of task

All analytical verifications shall be documented in accordance with the PACE schedule. All formal documents shall be prepared according to PACE conventions and in accordance with the PACE CM (configuration management) plan.

V. Management Approach

Staff Allocation, Expertise, and Skill Mix

The work requested under this task order for systems engineering support requires experienced systems engineers with 10+ years of experience working with spaceflight missions, launch vehicles, instruments, requirements, development, verification, and operations.

Configuration Management

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

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.

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.

Performance Metrics

The work performed for this task will be evaluated by the TM based on the technical merit. 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.

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.

Quality Assurance Requirements

The contractor providing technical services shall comply with all CMMI Level 2 processes established for the Project and deliverable products. Applicable requirements include, but not limited to:

1. NPR 7120.5E NASA Space Flight Program and Project Management Requirements
2. NPR 7123.B NASA Systems Engineering Processes and Requirements
3. GPR 7120.99 Goddard Project Management
4. GPR 7120.5A Goddard Systems Engineering
5. GPR 7150.4 Goddard Software Engineering Requirements

VI. ODC (Travel and Procurement)

Some travel expected for support of PACE and/or OCI procurement technical meetings and launch vehicle / launch site technical meetings.

Travel may also be proposed for special training needs and other engineering support task activities as directed by the Project.

Location	Duration	Dates
1 trips to West Coast component vendors	3 days each	TBR 2020
1 trips to East Coast component vendors	3 days each	TBR 2020
1 trips to launch site (KSC in Florida)	5 days each	TBR 2020

VII. Work Location

This work shall be performed primarily at the Goddard Space Flight Center (On-site) or telework due to the COVID situation as approved by the PACE Project TR, but the contractor may be required to perform some work at the contractor's facility (Off-site).

VIII. Reporting Requirements

The contractor shall report status to the PACE project Technical Representative (TR) or designated alternates on a weekly basis via e-mail or other electronics format. No presentation slides are required except for special occasions. Reports shall include, but are not limited to, informal presentation of interim results, and status of development activities.

IX. Security Requirements

The contractor shall comply with Information Technology Security procedures and requirements as defined by NPG 2810.1A in the performance of this task. In addition, the contractor shall comply with all applicable federal rules and regulations and agency directives. There will not be any handling of classified data.

X. Data Rights

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

XI. Applicable Documents

In the performance of this task, the contractor shall comply with the following documents:
1. NPR 7150.2B NASA Software Engineering Requirements

XII. References

None