GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 1
Modification: 3
Task Name: Space Science Mission Operations Support

GSMO-2 SOW Reference: 2.1, 3.7.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	11/25/2017	11/23/2018	Extend task through Nov 2018.
2	11/24/2018	11/23/2019	Extend task through Nov 2019.
3	11/24/2019	11/28/2020	Extend task through Nov 2020.

II. Task Overview

The Space Science Mission Operations Support task provides IT system security support for the Space Science Mission Operations (SSMO) organization and its missions.

III. Requirements

1	**SSMO IT Security**
1.1	**SSMO IT Security Support**
1.1.1	The contractor shall serve as the SSMO Information System Security Officer (ISSO) with primary duty to assist and coordinate with SSMO Mission Teams, both at GSFC and remote, to establish and maintain appropriate and safe IT Security postures.
1.1.2	The contractor shall maintain awareness of upcoming IT Security policy changes and emerging threats that affect mission operations.
1.1.3	The contractor shall coordinate responses to all IT Security incidents affecting SSMO Mission Operations Centers.
1.1.4	The contractor shall report regularly and as needed with SSMO management and Mission Directors to inform the Project with regard to ongoing activities, upcoming changes, and recommendations with respect to implementation of IT Security policies within the Mission Operations Centers.
1.1.5	The contractor shall support SSMO to ensure Project Compliance with Agency guidance by developing and maintaining Project required documentation per OMB Circular A-130, NPR 2810.1a and applicable NIST requirements. The contractor is responsible for reviewing and commenting on proposed guidance and policy changes, and assessing impact and response plans to policy and guidance as necessary.
1.1.6	The contractor shall assess compliance with NISN (IONet) policies and recommend specific implementation strategies.

1.1.7	The contractor shall conduct self-assessments; prepare and track plan of action milestones (POAMs), risk assessments, provide impact assessment, policies and procedures, awareness training and notification procedures in the events of a security breach of the Project office as well as the individual missions, to analyze their results, and recommend follow up actions.
1.1.8	The contractor shall provide Certification and Accreditation support for both internal and remote missions systems.
1.1.9	The contractor shall conduct credential scans of the SSMO mission operations systems. The contractor shall maintain a historical database of scan results and work with the various System Administrators concerning finding and addressing identified vulnerabilities.
1.1.10	The contractor shall archive all raw scan data for possible review and/or distribution for future analysis.
1.2	**Anomaly Support**
1.2.1	The contractor shall support Anomaly investigation and resolution.
1.2.2	The contractor shall provide timely and responsive consultative services as required for the investigation and resolution of spacecraft anomalies.
1.3	**System Administration**
1.3.1	The contractor shall provide System Administration support.
1.3.2	The contractor shall provide System administrator work to support firewall implementation, scanning, and IT security work items as authorized for the maintenance of two workstations for the ARTEMIS mission. These machines are needed to provide a data relay from the DSN to the UCB MOC for ARTEMIS operations.
1.4	**Security Logging**
1.4.1	The contractor shall implement SSMO security logging to allow for growth, improve capabilities, and better meet current and future requirements.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 3
Modification: 4
Task Name: DSN Scheduling

GSMO-2 SOW Reference: 2.4.3, 3.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/25/2018	Initial task order statement of work.
1	05/26/2018	05/24/2019	Task mod extension
2	10/01/2018	05/24/2019	Descope of Labor costs
3	03/08/2019		Administrative Change
4	05/25/2019	05/23/2020	1 Year Extension. Completed Kepler mission.

II. Task Overview

The DSN Scheduling task provides for Deep Space Network (DSN) scheduling activities in order to generate conflict free schedules for STEREO, TESS and Parker Solar Probe DSN. DSN scheduling services for other SSMO missions are provided through individual mission operations task orders.

Subtask 1: Covers all work associated with DSN scheduling for KEPLER – COMPLETED.
Subtask 2: Covers all work associated with DSN scheduling for STEREO.
Subtask 3: Covers all work associated with DSN scheduling for TESS.
Subtask 4: Covers all work associated with DSN scheduling for Parker Solar Probe (PSP) previously known as Solar Probe Plus (SPP.)

III. Requirements

The requirements are x.1-x.14 apply to each of the specific missions below

1	**DSN scheduling for KEPLER – COMPLETED.**
2	**DSN scheduling for STEREO**
3	**DSN scheduling for TESS**
4	**DSN scheduling for Parker Solar Probe (PSP)**

x.1	The contractor shall provide a conflict-free schedule of activities for all spacecraft contacts, spacecraft activities, and instrument operations that are consistent with the overall Science Operations Plan for the specific mission.

x.2	The contractor shall secure adequate communications services through the DSN for the delivery of GSFC Code S spacecraft and instrument telemetry to the ground and the commanding and tracking to the spacecraft.
x.3	The contractor shall update the DSN Integrated Mission Scheduling Plan which describes in detail the contractor's approach to integrating GSFC DSN scheduling activities with FDF and JPL products.
x.4	The contractor shall support the JPL Resource Allocation Review mid-range scheduling activities in accordance with the mission PSLA. Typically, the long range schedule shall be six months ahead unless specified by JPL.
x.5	The contractor shall support the DSN short term scheduling activities in accordance with the mission's User Loading Profile.
x.6	The contractor shall routinely maintain the mid-range and short term schedules which includes working around s/c emergencies, launches, and ground station equipment outages.
x.7	The contractor shall review & maintain the RAP User Loading Profile for the mission. This activity is typically done twice a year unless specified otherwise by JPL.
x.8	The contractor shall notify the task monitor as soon as possible in the event of mission conflicts that are having resolution issues.
x.9	The contractor shall support the DSN Configuration Management approach for scheduling GSFC missions.
x.10	The contractor shall provide operational facilities and equipment to support the mission.
x.11	The contractor shall routinely identify risks associated with s/c emergencies, launches, and ground station equipment outages and shall recommend to the task monitor any changes to systems or procedures that could reduce or eliminate the risk**.** A Risk Status meeting to review the scheduling risk list will be done twice a year.
x.12	The contractor shall be responsible for Information Technology (IT) security for all systems operated by the contractor for NASA or used by the contractor to connect to any NASA network that requires compliance with GSFC and NASA security requirements.
x.13	The contractor shall make arrangements and coordinate security checks and scanning of operational systems as required by GSFC and the Agency.
x.14	The contractor shall apply IT security standards as defined by applicable Federal Rules and Regulations and Agency directives for systems classified as a Mission (MSN) for all Space Science IT systems.
	Requirements 3.2 through 3.14 are the same as listed above for 1.2 through 1.14.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
Support mission reviews, as needed.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The proposed material list should include:

Applicable hardware or software licenses.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

As requested summary of GSFC scheduling audit and lessons learned for all SSMO missions using the DSN.
Weekly Report. (COB Wednesday each week)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 4
Modification: 8
Task Name: Systems Engineering Support

GSMO-2 SOW Reference: 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	07/27/2018	Initial task order statement of work.
1	06/01/2017		Admin mod to correct task cost totals in TOMS.
2	06/01/2017		Admin mod to correct task cost totals in TOMS.
3	11/25/2017	11/23/2018	Adjust scope of work to align with SSMO multi-mission efforts and extend task through Nov 2018.
4	02/15/2018	11/23/2018	Add Subtask 6 to cover IMAGE recovery support.
5	11/24/2018	11/23/2019	Extend task through Nov 2019.
6	11/24/2018		Admin mod to correct task cost totals in TOMS.
7	04/27/2019	07/27/2019	Unsolicited replan modification from vendor.
8	11/24/2019	11/28/2020	Extend task through Nov 2020. Also, remove Subtask 6.

II. Task Overview

The Systems Engineering Support task provides expert system engineering in the analysis and resolution identification of the problems encountered for all the missions under the SSMO project.

Subtask 1: Covers all work associated with SSMO Project System Engineering Support.
Subtask 2: Covers all work associated with SDO System Engineering Support.
Subtask 3: Covers all work associated with DSCOVER Systems Engineering Support.
Subtask 4: Covers all work associated with OSIRIS-REx Systems Engineering Support.
Subtask 5: Covers all work associated with LRO Systems Engineering Support.
~~Subtask 6: Covers all work associated with IMAGE Recovery Support.~~

III. Requirements

1	SSMO Project System Engineering Support
1.1	The contractor shall have space flight experience.
1.2	The contractor shall have knowledge of spacecraft subsystems, such as, GN&C, thermal, power, and communication.
~~1.3~~	~~The contractor shall maintain LRO CASSIE.~~
1.4	The contractor shall assist in the analysis and resolution of issues detected in the weekly or long term trending reports as required.

1.5	The contractor shall provide analyses and recommendations to assure best engineering solutions/practices are implemented.
1.6	The contractor shall assist the Projects with the execution of the Anomaly Management process and participate in project directed anomaly assessments, investigations and resolution as appropriate.
1.7	The contractor shall support the identification and characterization of existing and emerging system levels risks, and participate in the development and implementation of mitigation plans.
1.8	The contractor shall be proactive in looking for anomalies and enhancements.
1.9	The contractor shall support development and deployment of the LRO Slew Verification Tool as directed by the task monitor.
1.10	The contractor shall provide power system expertise as directed by the task monitor.
1.11	The contractor shall assist in analyses and resolution of issues for all SSMO missions as directed by the task monitor.

2	**SDO System Engineering Support**
2.1	The contractor shall assist in the analysis and resolution of issues detected in the weekly reports as required.
2.2	The contractor shall provide analyses and recommendations to assure best engineering solutions/practices are implemented.
2.3	The contractor shall assist the SDO Project with the execution of the Anomaly Management process and participate in the SDO project directed anomaly assessments, investigations and resolution as appropriate.
2.4	The contractor shall support the identification and characterization of existing and emerging system level risks, and participate in the development and implementation of mitigation plans.
2.5	The contractor shall assist in the analysis and development of battery models and performance as directed.

3	**DSCOVER System Engineering Support**
3.1	The contractor shall provide expert systems engineering support as requested by the Task Monitor for the DSCOVR mission.

4	**OSIRIS-REx System Engineering Support**
4.1	The contractor shall provide expert systems engineering support as requested by the Task Monitor to support OSIRIS-Rex.

5	**LRO System Engineering Support**
5.1	The contractor shall provide expert LRO systems engineering in the analysis and resolution identification of problems encountered.
5.2	The contractor shall provide reaction wheel modeling, gyroless operations testing, and engineering support as needed.
5.3	The contractor shall provide Attitude Control Analysis support.

~~6~~	~~IMAGE Recovery Support~~
~~6.1~~	~~The contractor shall set up a simplified ground system, analyze telemetry, assess health of spacecraft.~~

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The contractor will be allowed access to the LRO operations facility in building 32 and other SSMO areas as needed in order interface, install, and test software as necessary as well as provide analytical support

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 7
Modification: 6
Task Name: LRO Mission Operations and Maintenance Support

GSMO-2 SOW Reference: 3, 3.3, 3.4, 3.6, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	08/21/2017	08/24/2018	Provide for an LRO IRU Gyro Life Expectancy analysis per requirement 2.1.
2	12/18/2017	08/24/2018	Provide for MOT travel to Project Science Working Group meeting in January, 2018.
3	08/25/18	09/07/18	NCE for 2 weeks
4	08/28/18		Admin Mod
5	9/8/2018	08/24/2019	One year extension
6	8/15/2019	08/29/2020	One year extension and add subtask 5 to cover MOC move verification

II. Task Overview

The LRO Mission Operations and Maintenance Support task provides all operations and engineering support required to perform LRO mission operations, anomaly identification and resolution, and delivery of science and engineering data products to the Instrument Science Operations Centers (SOCs) and other supporting GSFC organizations.

Subtask 1: Covers all work associated with LRO support.
Subtask 2: Covers all work associated with MIMU IRU support.
Subtask 3: Covers all work associated with LRO ITPS support.
Subtask 4: Covers all work associated with LRO FSW simulator support.
Subtask 5: Covers all work associated with LRO MOC move B32 to B14.

Note:
MIMU: Miniature inertial measurement unit
IRU: Inertial Reference Unit
ITPS: Integrated Trending and Plotting System
FSW: Flight Software
MOC: Mission Operations Control Center

III. Requirements

1	LRO Support

1.1	The contractor shall support various reviews and working groups, as necessary, by providing operations input to the review packages.
1.2	The contractor shall support ground system releases and perform acceptance and regression testing as appropriate.
1.3	The contractor shall maintain and adhere to Operations Agreements and Interface Control Documents (ICDs) between the LRO Science Operations Centers (SOCs) and the LRO Mission Operations Center (MOC).
1.4	The contractor shall provide telephone and on-site technical support for LRO spacecraft simulators users upon request. Assume 2 hour per month telephone support per user, and three days of on-site support per user of the whole task period. The contractor shall maintain the User's Manual and configuration logs for the simulators.
1.5	The contractor shall perform Orbiter operations.
1.6	The contractor shall report anomalies to the Space Science Mission Operation (SSMO) Project as defined in Section VII, Deliverables. The contractor shall provide a Root Cause and Corrective Action (RCCA) report within 10 business days of any anomaly caused by a personnel error.
1.7	The contractor shall provide Attitude Ground System (AGS) maintenance support.
1.8	The contractor shall provide Deep Space Network (DSN) Scheduling support.
1.9	The contractor shall prepare materials and lead a Command Authorization Meeting (CAM) for all special and non-nominal operations activities.
1.10	The contractor shall maintain the Backup Mission Operation Center (BMOC) equipment and test the BMOC systems and operations concept quarterly.
1.11	The contractor shall maintain the DPS at WSC and other stations as required.
1.12	The contractor shall maintain and support all MOC hardware and software (including Flatsat), including license renewals.
1.13	The contractor shall provide System Administration support for MOC systems and adhere to all IT security requirements.
1.14	The contractor shall compile periodic spacecraft trending reports to include key telemetry for all major subsystems and instruments, make note of all instances of limit violations and out-of-specification behavior. The contractor shall advise the SSMO Mission Director of significant anomalies and make recommendations for correction. Reports shall be compiled on a weekly and quarterly basis and shall be reviewed by the SSMO Project and cognizant Engineering Directorate (ED) personnel.
1.15	The contractor shall investigate and resolve issues with DMS performance.
1.16	The contractor shall develop, maintain, and provide configuration control of all LRO MOC documentation, flight procedures, Systems Test and Operation Language (STOL) procs, mission database and appropriate ground segment software.
1.17	The contractor shall provide coordination of all calibration and special operations with the LRO Project Science Team, the LRO MOT, and all Instrument SOCs, to include establishing instrument operational priorities. The contractor shall ensure all required subsystem analysis is completed for special operations requests, to include power and thermal analyses as required for

	orbiter attitude slew requests, and that all constraints and restrictions are satisfied.
1.18	The contractor shall support the SSMO Virtual Machine (VM) Net activity, as required.
1.19	The contractor shall coordinate requirements and interfaces with the Telemetry as a Service (TaaS) team.
1.20	The contractor shall support special communications events with the general public as requested by the Task Monitor (TM).
1.21	The contractor shall upgrade all equipment using RedHat Linux to the latest RedHat version or purchase extended support agreements.

2	**MIMU IRU Support**
2.1	The contractor shall provide on-orbit support of the LRO MIMU IRU. This support includes, but is not limited to, answering questions regarding on-orbit behavior, analyzing telemetry data to determine gyro life expectancies, supporting EEPROM refresh activities, anomaly resolution, etc. Requests will be made by a GSFC engineer to the MIMU vendor for a given task. The MIMU vendor shall provide the TM an estimate of the required hours necessary to complete the task and the TM shall provide confirmation of authorization to proceed.

3	**LRO ITPS Support**
3.1	The contractor shall provide software development and sustaining engineering support along with technical support pertaining to the ITPS system.
3.2	The contractor shall analyze all ITPS system problems, if any and provide NASA with an estimate of time needed to fix the problem, and seek approval before any problems are fixed.

4	**LRO FSW Simulator Support**
4.1	The contractor shall develop and deploy a software simulator that provides faster than real-time (minimum of ten times real-time) emulation of the LRO Command and Data Handling (C&DH), executes all LRO FSW, provides models of LRO hardware at the component level, models the space environment (orbit and attitude dynamics), and models all ground stations.

5	**LRO MOC Move**
5.1	The contractor shall support the facility footprint reduction in the B32 LRO MOC and the permanent move of the LRO MOC to B14. Support includes the verification of LRO ground support systems as equipment is moved.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Integrated Test and Operations System (ITOS) (NASA/GSFC Code 583)	GSC-16025-1
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
Data Management System (DMS)	
Attitude Ground System (AGS)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]	

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.
The list of task deliverables should include:

Weekly Report. (COB Wednesday each week)
Escalation Plan describing pre-approved anomaly responses, spacecraft (S/C) Subsystem Engineer Points-of-Contact, and management calling tree. (Updates as necessary)
Summary of Configuration Baseline. (Updated quarterly)
S/C Trending Report summarizing key telemetry for all major S/C subsystems and instruments, and identifying instances of limit violations and out-of-specification performance. (Compiled weekly and quarterly)

Anomaly Closeout Reports including root cause analysis of incidents, anomaly resolution, corrective actions/lessons learned, interim workarounds, and final resolution. (By the 10th business day following the resolution of Level I Anomaly)
MIMU Data Analysis Reports, MIMU Anomaly Reports, and other verbal and written correspondence regarding MIMU operations. The contractor shall provide an estimate of hours to complete any requested task and shall not proceed until authorized by the TM. (As Requested and Approved by TM and ED Representative)
Calendar of events to include all spacecraft and instrument special operations and calibration activities. These activities will be scheduled in detail at least one week in advance and projected, to the extent possible, one month in advance. (COB Thursday each week, showing the detailed schedule for the following week and projections for next three weeks following; covering a total of 4 weeks)
Prepare ancillary data and deliver to the Navigation and Ancillary Information Facility (NAIF) in accordance with the Interface Control Document between the LRO MOC and the NAIF (451-ICD-001201).
LRO Software Simulator and LRO Software Simulator User's Guide.
Plan and Schedule of any ground system upgrade as specified by the Mission Director

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 8
Modification: 4
Task Name: ESMO Hardware Sustaining Engineering and Network Security

GSMO-2 SOW Reference: 3.7.2, 3.7.3, 3.7.4, 3.7.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	12/1/2017	6/29/2018	Modification for Additional Network Requirements, Ending of GPM Tech Refresh, and additional Materials & Training. Added Subtask for PACE Network Development.
2	6/30/2018	6/29/2019	Extend Period of Performance
3	9/13/2018		Admin Mod to add new Resources Managers
4	2/11/2019	6/29/2019	Add IT Security Requirements

Deleted: 2

Deleted: 6/29/2019

Deleted: 4

Deleted: 1/22

Deleted: 6/29/2019

Deleted: Add IT Security Requirements

II. Task Overview

The ESMO Hardware Sustaining Engineering and Network Security task provides hardware sustaining engineering, hardware maintenance (including vendor maintenance), network design, implementation & sustaining; network security to upgrade & maintain the existing ESMO and ESDIS network infrastructure; facility support; system administration; database administration; specifications for COTS products; provide IT security documentation and support; and strategic planning for system evolution and automation.

Subtask 1: Covers all work associated with EOS Mission Operations System (EMOS).
Subtask 2: Covers all work associated with Project Management.
Subtask 3: Covers all work associated with Networks and Security.
Subtask 4: Covers all work associated with ESDIS.
Subtask 5: Covers all work associated with GPM.
Subtask 7: Covers all work associated with PACE

III. Requirements

The requirements table below is subdivided into six principal areas of support (A.1 through A.6). The contractor shall apply these requirements to each subtask (1 to 6), as noted:

A.1 Hardware Sustaining (subtask: 1, 2, 4, 5, 7)
A.2 Network Management (subtask: 3, 5, 7)
A.3 Network Security and Administration (subtask: 3, 5)
A.4 System and Database Administration (subtask: 1, 5)
A.5 System Security (subtask: 3, 5, 7)
A.6 Strategic Planning for System Evolution and Automation (subtask: 1, 3, 4, 5)

A.1	**Hardware Sustaining**
A.1.1	The contractor shall provide hardware sustaining engineering and maintenance for all EMOS ground system components as defined in this section.
A.1.2	The contractor shall obtain, assess, install, and configure vendor hardware upgrades/replacements including COTS and GOTS as necessary to maintain the EMOS ground system.
A.1.3	The contractor shall report on hardware obsolescence and provide engineering recommendations.
A.1.4	The contractor shall detect, troubleshoot, and resolve system, hardware, and interface problems.
A.1.5	The contractor shall coordinate with software, network Engineering, System Administration and database administration for the resolution of problems and upgrades.
A.1.6	The contractor shall provide analysis and impacts on DRs and Configuration Change Requests (CCRs) and participate in the Discrepancy Review Board (DRB) and EMOS CCR Review Board (ECRB).
A.1.7	The contractor shall resolve discrepancy reports (DRs) and implement CCRs based on priorities.
A.1.8	The contractor shall adhere to ESMO and element hardware configuration management (CM) practices for delivered changes.
A.1.9	The contractor shall submit hardware transfer/move documents for property tracking & management.
A.1.10	The contractor shall provide design updates, due to approved hardware changes, including as built design documentation, cabling, power, and network diagrams.
A.1.11	The contractor shall provide hardware support and service for all EMOS equipment (including ESMO Development & Test Facility (EDTF), EOS Development Lab (EDL)).
A.1.12	The contractor shall provide 24/7 on-call support for emergency on a best effort basis and support as required.
A.1.13	The contractor shall build and maintain development, test and operational environments, as required.

A.1.14	The contractor shall provide vendor interface, support, coordination and escorting at GSFC.
A.1.15	The contractor shall procure COTS products that include hardware and software in support of re-engineering and automation activities and security infrastructure changes for ESMO and ESDIS in support of Terra, Aqua, Aura, GPM and TRMM.
A.1.16	The contractor shall procure vendor maintenance and/or support agreements as required. Obtain funding/approval from Government Task Monitor for new COTS/vendor support services as required.
A.1.17	The contractor shall communicate any vendor provided renewal specific product information to the Government Task Monitor prior to service agreement renewal(s) decision.
A.1.18	The contractor shall provide COTS software license management based on updates from Government Task Monitor.
A.1.19	The contractor shall provide hardware equipment service for items without vendor service agreement support as directed and funded by Task Monitor.
A.1.20	The contractor shall provide coordination for system video displays with GPM and EOS.
A.1.21	The contractor shall build and transition the GPM Ground System through a Tech Refresh build out in the same Server Room that holds the EOS Mission Operations System.
A.2	**Network Management**
A.2.1	The contractor shall provide network management for the EOS Backbone Network (EBNet) in support of ESMO and ESDIS as defined in this section.
A.2.2	The contractor shall provide management and technical leadership of task assignment, prioritization, implementation, and completion of tasking assigned by the Task Monitor in support of ESMO and ESDIS.
A.2.3	The contractor shall lead Network Operations team personnel composed of GSMO and SES resources.
A.2.4	The contractor shall document current network configurations, match network requirements to the current implementation, and provide documentation of planned configuration changes, as required.
A.2.5	The contractor shall perform baseline assessments of the EBNet including recommendations for improvements, as required.
A.2.6	The contractor shall assess the impact of requirements changes by identifying, assessing, and reporting corresponding topology changes.
A.2.7	The contractor shall participate in the design of the EBNet Local Area Network (LAN) and WAN requirements; maintain LAN design documentation; deliver the documentation, as required.
A.2.8	The contractor shall participate in technical planning meetings and discussions regarding the EBNet, NISN network services implementation and operations, EOS Flight Projects, non-EOS research network organizations, and other external organizations to exchange technical and programmatic information.
A.2.9	The contractor shall participate in the coordination, troubleshooting, and resolution of technical issues identified during implementation and testing of

	activities involving EOSDIS systems and external organizations.
A.2.10	The contractor shall engineer network communications requirements (e.g., analysis, issue identification and resolution) for future missions based on project operations and interface requirements.
A.2.11	The contractor shall coordinate review and maintenance of ESMO level 3 requirements, as necessary.
A.2.12	The contractor shall attend and support configuration control board meetings with NASA and other organizations, as required.
A.2.13	The contractor shall participate in project planning and coordination of network implementation activities for EOS missions, and technical status reporting.
A.2.14	The contractor shall develop and deliver any new network design/topology jointly with SES contractor.
A.2.15	The contractor shall manage network design and architectures, monitor network stability and activity; make recommendations for additional resources and equipment as necessary.
A.2.16	The contractor shall maintain and renew IP Operational Network (IONET) gateway requests and waivers.
A.2.17	The contractor shall provide technical development support of significant modifications to existing network devices and support integration and interface of existing network equipment.
A.2.18	The contractor shall stay abreast of changes to the backbone network, in addition to new technologies, to proactively plan for the future needs for the ESMO, TRMM and ESDIS network and to leverage the network in a direction that is compatible with NASA network architectures.
A.2.19	The contractor shall provide Network staff to perform troubleshooting on any portion of the network, and to resolve problems covering protocol level, physical media, routing, switches and firewalls.
A.2.20	The contractor shall provide Network staff with 24X7 emergency on-call support for network failures affecting production traffic flows on EBNet LAN and WAN.
A.2.21	The contractor shall establish network baseline and detect and alert on deviations from the baseline from both a traffic and configuration perspective.
A.2.22	The contractor shall integrate several IT related systems to provide a holistic view of health of the networking environment.
A.2.23	The contractor shall provide network assets management through a relational database.
A.2.24	The contractor shall provide and execute a EBNet network architecture change management process which involves ESMO and ESDIS customers via the COMET CM system.
A.2.25	The contractor shall provide maintenance and training of the network traffic monitoring and analysis system.
A.2.26	The contractor shall provide monitoring and reporting of network traffic.
A.2.27	The contractor shall provide ongoing review and analysis of network traffic.
A.2.28	The contractor shall design and implement L2 VPN solutions to closed

	remote ground sites.
A.2.29	The contractor shall design and implement L3 VPN interfaces for enhanced access to IONet resources.
A.3	**Network Security and Administration**
A.3.1	The contractor shall provide network security and server administration for the EOS Backbone Network (EBNet) in support of ESMO and ESDIS as defined in this section.
A.3.2	The contractor shall implement ESMO and ESDIS IT Network security changes in response to changing project requirements.
A.3.3	The contractor shall maintain VPN concentrators configuration and procedures.
A.3.4	The contractor shall administer the VPN concentrators and RSA servers.
A.3.5	The contractor shall administer the KACE servers.
A.3.6	The contractor shall develop and maintain client software deployment procedures and provide them to the EOS System Administrators.
A.3.7	The contractor shall develop and maintain deployment architecture (i.e. groups, Admins, EOS contract facilities…).
A.3.8	The contractor shall develop and adhere to reporting procedures per ESMO and Agency requirements.
A.3.9	The contractor shall work with EOS system administrators to resolve any KACE and CDM issues.
A.3.10	The contractor shall configure RSA ACE servers to perform RSA and Radius authentication.
A.3.11	The contractor shall maintain the imported secure ID database from existing RSA server.
A.3.12	The contractor shall provide sustaining support of network devices to include VPN, RSA, KACE, and CDM servers.
A.3.13	The contractor shall provide Network Administration staff to assist troubleshooting on any portion of the network physical media, routing, switches and firewalls.
A.3.14	The contractor shall provide Network Administration staff with 24X7 emergency on call support of the ESMO network failures.
A.3.15	The contractor shall, if an external security audit of the ESMO infrastructure and systems is conducted, provide appropriate technical assistance in execution of the audit, and as prioritized by the task monitor will implement corrective actions to address any findings and recommendations.
A.3.16	The contractor shall remove or disable unnecessary network services.
A.3.17	The contractor shall configure network protocol parameters to prevent denial of service attack.
A.4	**System and Database Administration**
A.4.1	The contractor shall perform system and database administration as defined in this section.
A.4.2	The contractor shall provide user desktop administration support of all desktop and laptop computers on the administrative CNE network supporting ESMO.
A.4.3	**ERPS, MPS, ITPS and EDTF System Administration**

A.4.3.1	The contractor shall provide ERPS, MPS, ITPS and EDTF System Administration.
A.4.3.2	The contractor shall, with NASA's approval, install releases and patches of Operating Systems, Commercial Off-the-Shelf (COTS) software and other software products such as freeware.
A.4.3.3	The contractor shall design, implement, and regulate system and network configurations.
A.4.3.4	The contractor shall establish and implement a configuration management policy to ensure system and network integrity.
A.4.3.5	The contractor shall manage system and network resources such as Central Processing Unit (CPU) usage, memory usage, disk space usage, Input/Output (I/O) activities, processes control and network loading.
A.4.3.6	The contractor shall monitor and tune system and network performance. Resolve potential performance issues by developing and implementing appropriate preemptive measures.
A.4.3.7	The contractor shall automate routine and repetitive system administration tasks such as system monitoring and data collection by developing, scheduling and executing scripts.
A.4.3.8	The contractor shall manage network printers, print queues/spooler and terminal devices.
A.4.3.9	The contractor shall schedule and perform system backups and necessary recoveries.
A.4.3.10	The contractor shall establish and execute disaster recovery plans.
A.4.3.11	The contractor shall coordinate with operations staff in scheduling and performing non-automated system administration tasks.
A.4.3.12	The contractor shall research and recommend system/network software upgrades.
A.4.3.13	The contractor shall centralize system monitoring and logging to eliminate the need to retrieve information from individual systems.
A.4.3.14	The contractor shall standardize software tools and utilities for system administration and security to avoid unnecessary system complexity.
A.4.3.15	The contractor shall respond to customer support requests.
A.4.3.16	The contractor shall perform periodic audit of all OS and COTS software and maintain the vendor software database.
A.4.3.17	The contractor shall identify applicable software vendor maintenance licenses and assist in establishing and renewing licensing agreements.
A.4.3.18	The contractor shall configure and manage the operation of NetBackup to ensure the successful raw data archiving.
A.4.3.19	The contractor shall identify potential system problems and develop plans to avoid/mitigate them.
A.4.3.20	The contractor shall provide 24x7 system administration for emergencies and scheduled critical activities.
A.4.3.21	The contractor shall take immediate action to troubleshoot and resolve critical system software and/or network problems.
A.4.3.22	The contractor shall work with relevant Goddard Space Flight Center (GSFC) network personnel to resolve any network or firewall problems.

A.4.3.23	The contractor shall create and maintain user log-in identifications, user accounts and password files.
A.4.3.24	The contractor shall install the latest OS security patches.
A.4.4	**MIITS Database Administration**
A.4.4.1	The contractor shall provide MIITS database administration.
A.4.4.2	The contractor shall define database roles and enroll database users and control the access to the data.
A.4.4.3	The contractor shall allocate system storage and plan future storage requirements.
A.4.4.4	The contractor shall save the databases with automatic hot backup procedure to provide 24x7 database access.
A.4.4.5	The contractor shall provide quick database recovery up to the minutes before system crash to minimize loss of data.
A.4.4.6	The contractor shall monitor the database sizes to prevent database fill-up and interruption of service.
A.4.4.7	The contractor shall provide archival mechanism to keep the database in a manageable size.
A.4.4.8	The contractor shall monitor degree of database fragmentation and apply remedial measures to optimize the database performance.
A.4.4.9	The contractor shall validate the database integrity to ensure the overall database health.
A.4.4.10	The contractor shall maintain and document the database configuration and the database management procedures in the database administration guide.
A.4.4.11	The contractor shall contact vendor for technical support and research Oracle issues using the online Oracle Metalink website.
A.5	**System Security**
A.5.1	The contractor shall perform system security support as defined in this section.
A.5.2	The contractor shall ensure compliance with NASA Procedural Requirement (NPR) 2810.1A for systems classified as Mission (MSN) for all ESMO IT systems, and all Federal Rules and Regulations and Agency/ESMO directives.
A.5.3	The contractor shall periodically review and update project security documents – security plan, contingency plan, risk management plan, assessment report, EOS Workbook, and Plan of Actions and Milestones (POA&M).
A.5.4	The contractor shall periodically review system files and directories to ensure permissions are set properly.
A.5.5	The contractor shall periodically review system network services to ensure only necessary network services are running on systems.
A.5.6	The contractor shall periodically review system logging for any suspicious or abnormal activities.
A.5.7	The contractor shall run vulnerability-assessment tools periodically (such as TripWire, Tiger, COPS, snort, ISS Network Scanner, Nessus software) to identify security vulnerabilities or risks.
A.5.8	The contractor shall ensure network Transmission Control Protocol/Internet

	Protocol (TCP/IP) protocol parameters are set correctly to minimize network vulnerabilities and prevent denial of service attack.
A.5.9	The contractor shall review security notification E-mail for any related security vulnerabilities.
A.5.10	The contractor shall use encryption tunnel to prevent passwords, data and other sensitive information from crossing network in clear-text.
A.5.11	The contractor shall maintain the policies of the host-based or network-based filtering tools to restrict incoming and outgoing network traffic.
A.5.12	The contractor shall maintain the configuration of the password aging and password tools to ensure passwords meet the password policy.
A.5.13	The contractor shall maintain system auditing and review auditing report to detect potential security breaches.
A.5.14	The contractor shall provide support for the development and maintenance of EOS System Security Plans, perform EOS IT Security Assessments, create and maintain related IT Security Documentation, and ensure the compliance with NASA and Federal IT Security Requirements.
A.5.15	The contractor shall perform continuous monitoring tasks and support third-party A&A preparation.
A.5.16	The contractor shall perform NASA Security Assessment and Authorization Repository (NSAAR) migration from IT Security Center (ITSC) to Risk Information Compliance System (RICS) and ongoing/sustaining maintenance of IT Security documentation including Federal Information Security Management Act (FISMA) reporting (i.e. POA&Ms).
A.5.17	**The contractor shall provide oversight and guidance of all ESMO Security implementation, in coordination with other contractors orking for ESMO.**
A.6	**Strategic Planning for System Evolution and Automation**
A.6.1	The contractor shall work closely with NASA/ESMO and ESDIS leadership representatives and GSMO and associate contract personnel to ensure system evolution and automation activities meet NASA customer requirements and priorities.
A.6.2	The contractor shall manage changes brought about by problems encountered, new and/or conflicting requirements, and reprioritization of plan objectives. To include the evolutionary upgrade of team developed tools and utilities.
A.6.3	The contractor shall manage a fully integrated plan spanning two or more years, which is approved by ESMO leadership, routinely maintained, and successfully executed.
A.6.4	The contractor shall identify improvements in technology that reduce recurring operational costs, and/or operations risks.
A.6.5	The contractor shall coordinate activities among the ESMO support groups to avoid schedule conflicts, and identify and optimize schedule dependencies.
A.6.6	The contractor shall apply a systems engineering approach to the various project automation efforts.
A.6.7	The contractor shall facilitate (plan, schedule, coordinate, track) project

	automation efforts across providers, developers, integrators, administrator and users.

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment or software associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
ETS/MPS. (B32, Room C210H)
ETSF. (B32, Room C210 & B14, Room W224)
Terra Sim1 and Sim3. (B32, Room C210)
Terra Sim 2 & Flight Software Labs. (B1, Rooms 12, 17, 19, 23, 25, 25B & 29)
GPM MOC. (B32, Room N217)
GPM FlatSat. (B32, Room W030)
GPM EMOC, Dev/Test. (B3, Room S025E)
ERPS. (B32, Svalbard, Norway; Gilmore Creek, Alaska, Wallops Island, Virginia, and White Sands, New Mexico)
ESMO Infrastructure servers. (B32)
EOC – Mission Operations System (EMOS). Includes Online Subsystem - Raytheon Eclipse Product with modifications, Mission Management Subsystem (MMS), Analysis and its replacement system ITPS. (B32)
EOC- Backup Mission Operations Center (BEOC). (B13)
ESDIS (various network infrastructure). (B32)
Code 420 Division Office. (B36)

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The proposed material list should include:

The Contractor shall procure materials as required by the ESMO project to replace and upgrade outdated and failing equipment. The contractor shall monitor hardware and software version obsolescence and propose material that will need to be procured proactively during the period of performance to avoid operational system outages and IT security risks. The procurement of these items is required to follow the process

defined in the IT Procurement Information Circular, #13-04, dated June 6, 2013.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Hardware and other procurements for system maintenance/upgrades and vendor maintenance agreements. (as required)
Network, System Interface, and power diagram updates. (as required)
Updated System Security documentation - Risk Assessment Plans, SAIVs, Contingency Plans, EOS Workbooks, POA&M Report. (as required)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 8
Modification: 5
Task Name: ESMO Hardware Sustaining Engineering and Network Security

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GSMO-2 SOW Reference: 3.7.2, 3.7.3, 3.7.4, 3.7.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	12/1/2017	6/29/2018	Modification for Additional Network Requirements, Ending of GPM Tech Refresh, and additional Materials & Training. Added Subtask for PACE Network Development.
2	6/30/2018	6/29/2019	Extend Period of Performance
3	6/30/2018	6/29/2019	Admin Mod to add new Resources Managers
4	1/22/2019	6/29/2019	Add IT Security Requirements
5	6/30/2019	6/27/2020	Extend period of performance, remove Automation scope from task, no longer needed.

II. Task Overview

The ESMO Hardware Sustaining Engineering and Network Security task provides hardware sustaining engineering, hardware maintenance (including vendor maintenance), network design, implementation & sustaining; network security to upgrade & maintain the existing ESMO and ESDIS network infrastructure; facility support; system administration; database administration; specifications for COTS products; provide IT security documentation and support; and strategic planning for system evolution and automation.

Subtask 1: Covers all work associated with EOS Mission Operations System (EMOS).
Subtask 2: Covers all work associated with Project Management.
Subtask 3: Covers all work associated with Networks and Security.
Subtask 4: Covers all work associated with ESDIS.
Subtask 5: Covers all work associated with GPM.
Subtask 7: Covers all work associated with PACE

III. Requirements

The requirements table below is subdivided into six principal areas of support (A.1 through A.5). The contractor shall apply these requirements to each subtask (1 to 6), as noted:

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A.1 Hardware Sustaining (subtask: 1, 2, 4, 5, 7)
A.2 Network Management (subtask: 3, 5, 7)
A.3 Network Security and Administration (subtask: 3, 5)
A.4 System and Database Administration (subtask: 1, 5)
A.5 System Security (subtask: 3, 5, 7)

Deleted: A 6 Strategic Planning for System Evolution and Automation (subtask: 1, 3, 4, 5)

A.1	**Hardware Sustaining**
A.1.1	The contractor shall provide hardware sustaining engineering and maintenance for all EMOS ground system components as defined in this section.
A.1.2	The contractor shall obtain, assess, install, and configure vendor hardware upgrades/replacements including COTS and GOTS as necessary to maintain the EMOS ground system.
A.1.3	The contractor shall report on hardware obsolescence and provide engineering recommendations.
A.1.4	The contractor shall detect, troubleshoot, and resolve system, hardware, and interface problems.
A.1.5	The contractor shall coordinate with software, network Engineering, System Administration and database administration for the resolution of problems and upgrades.
A.1.6	The contractor shall provide analysis and impacts on DRs and Configuration Change Requests (CCRs) and participate in the Discrepancy Review Board (DRB) and EMOS CCR Review Board (ECRB).
A.1.7	The contractor shall resolve discrepancy reports (DRs) and implement CCRs based on priorities.
A.1.8	The contractor shall adhere to ESMO and element hardware configuration management (CM) practices for delivered changes.
A.1.9	The contractor shall submit hardware transfer/move documents for property tracking & management.
A.1.10	The contractor shall provide design updates, due to approved hardware changes, including as built design documentation, cabling, power, and network diagrams.
A.1.11	The contractor shall provide hardware support and service for all EMOS equipment (including ESMO Development & Test Facility (EDTF), EOS Development Lab (EDL)).
A.1.12	The contractor shall provide 24/7 on-call support for emergency on a best effort basis and support as required.
A.1.13	The contractor shall build and maintain development, test and operational environments, as required.
A.1.14	The contractor shall provide vendor interface, support, coordination and escorting at GSFC.
A.1.15	The contractor shall procure COTS products that include hardware and software in support of re-engineering and automation activities and security

	infrastructure changes for ESMO and ESDIS in support of Terra, Aqua, Aura, GPM and PACE.
A.1.16	The contractor shall procure vendor maintenance and/or support agreements as required. Obtain funding/approval from Government Task Monitor for new COTS/vendor support services as required.
A.1.17	The contractor shall communicate any vendor provided renewal specific product information to the Government Task Monitor prior to service agreement renewal(s) decision.
A.1.18	The contractor shall provide COTS software license management based on updates from Government Task Monitor.
A.1.19	The contractor shall provide hardware equipment service for items without vendor service agreement support as directed and funded by Task Monitor.
A.1.20	The contractor shall provide coordination for system video displays with GPM, PACE and EOS.
A.1.21	The contractor shall support the build-out and configuration of the PACE MOC and BMOC in coordination of the PACE Development Project and ESMO Management.
A.2	**Network Management**
A.2.1	The contractor shall provide network management for the EOS Backbone Network (EBNet) in support of ESMO and ESDIS as defined in this section.
A.2.2	The contractor shall provide management and technical leadership of task assignment, prioritization, implementation, and completion of tasking assigned by the Task Monitor in support of ESMO and ESDIS.
A.2.3	The contractor shall lead Network Operations team personnel composed of GSMO and SES resources.
A.2.4	The contractor shall document current network configurations, match network requirements to the current implementation, and provide documentation of planned configuration changes, as required.
A.2.5	The contractor shall perform baseline assessments of the EBNet including recommendations for improvements, as required.
A.2.6	The contractor shall assess the impact of requirements changes by identifying, assessing, and reporting corresponding topology changes.
A.2.7	The contractor shall participate in the design of the EBNet Local Area Network (LAN) and WAN requirements; maintain LAN design documentation; deliver the documentation, as required.
A.2.8	The contractor shall participate in technical planning meetings and discussions regarding the EBNet, NISN network services implementation and operations, EOS Flight Projects, non-EOS research network organizations, and other external organizations to exchange technical and programmatic information.
A.2.9	The contractor shall participate in the coordination, troubleshooting, and resolution of technical issues identified during implementation and testing of activities involving EOSDIS systems and external organizations.
A.2.10	The contractor shall engineer network communications requirements (e.g., analysis, issue identification and resolution) for future missions based on project operations and interface requirements.

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A.2.11	The contractor shall coordinate review and maintenance of ESMO level 3 requirements, as necessary.
A.2.12	The contractor shall attend and support configuration control board meetings with NASA and other organizations, as required.
A.2.13	The contractor shall participate in project planning and coordination of network implementation activities for EOS missions, and technical status reporting.
A.2.14	The contractor shall develop and deliver any new network design/topology jointly with SES contractor.
A.2.15	The contractor shall manage network design and architectures, monitor network stability and activity; make recommendations for additional resources and equipment as necessary.
A.2.16	The contractor shall maintain and renew IP Operational Network (IONET) gateway requests and waivers.
A.2.17	The contractor shall provide technical development support of significant modifications to existing network devices and support integration and interface of existing network equipment.
A.2.18	The contractor shall stay abreast of changes to the backbone network, in addition to new technologies, to proactively plan for the future needs for the ESMO and ESDIS network and to leverage the network in a direction that is compatible with NASA network architectures.
A.2.19	The contractor shall provide Network staff to perform troubleshooting on any portion of the network, and to resolve problems covering protocol level, physical media, routing, switches and firewalls.
A.2.20	The contractor shall provide Network staff with 24X7 emergency on-call support for network failures affecting production traffic flows on EBNet LAN and WAN.
A.2.21	The contractor shall establish network baseline and detect and alert on deviations from the baseline from both a traffic and configuration perspective.
A.2.22	The contractor shall integrate several IT related systems to provide a holistic view of health of the networking environment.
A.2.23	The contractor shall provide network assets management through a relational database.
A.2.24	The contractor shall provide and execute a EBNet network architecture change management process which involves ESMO and ESDIS customers via the COMET CM system.
A.2.25	The contractor shall provide maintenance and training of the network traffic monitoring and analysis system.
A.2.26	The contractor shall provide monitoring and reporting of network traffic.
A.2.27	The contractor shall provide ongoing review and analysis of network traffic.
A.2.28	The contractor shall design and implement L2 VPN solutions to closed remote ground sites.
A.2.29	The contractor shall design and implement L3 VPN interfaces for enhanced access to IONet resources.
A.3	**Network Security and Administration**

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A.3.1	The contractor shall provide network security and server administration for the EOS Backbone Network (EBNet) in support of ESMO and ESDIS as defined in this section.
A.3.2	The contractor shall implement ESMO and ESDIS IT Network security changes in response to changing project requirements.
A.3.3	The contractor shall maintain VPN concentrators configuration and procedures.
A.3.4	The contractor shall administer the VPN concentrators and RSA servers.
A.3.5	The contractor shall implement a Mission Exchange interface within EBNet and transition legacy flows in ESMO as appropriate.
A.3.6	The contractor shall develop and maintain client software deployment procedures and provide them to the EOS System Administrators.
A.3.7	The contractor shall develop and maintain deployment architecture (i.e. groups, Admins, EOS contract facilities…).
A.3.8	The contractor shall develop and adhere to reporting procedures per ESMO and Agency requirements.
A.3.9	The contractor shall work with EOS system administrators to resolve any KACE and CDM issues.
A.3.10	The contractor shall configure RSA ACE servers to perform RSA and Radius authentication.
A.3.11	The contractor shall maintain the imported secure ID database from existing RSA server.
A.3.12	The contractor shall provide sustaining support of network devices to include VPN, RSA, KACE, and CDM servers.
A.3.13	The contractor shall provide Network Administration staff to assist troubleshooting on any portion of the network physical media, routing, switches and firewalls.
A.3.14	The contractor shall provide Network Administration staff with 24X7 emergency on call support of the ESMO network failures.
A.3.15	The contractor shall, if an external security audit of the ESMO infrastructure and systems is conducted, provide appropriate technical assistance in execution of the audit, and as prioritized by the task monitor will implement corrective actions to address any findings and recommendations.
A.3.16	The contractor shall remove or disable unnecessary network services.
A.3.17	The contractor shall configure network protocol parameters to prevent denial of service attack.
A.3.18	The contractor shall provide expertise in analyzing IT Security & Network vulnerability assessments and incidents. The contractor shall possess the subject matter expertise and credentials needed to directly interact with Center and Agency Security and Network members as necessary for the subject analysis. Many times, this requires interacting at TS and TS/SCI levels depending on the incident or assessment needed to be performed.
A.4	**System and Database Administration**

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A.4.2	The contractor shall provide user desktop administration support of all desktop and laptop computers on the administrative CNE network supporting ESMO.
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A.4.3.2	The contractor shall, with NASA's approval, install releases and patches of Operating Systems, Commercial Off-the-Shelf (COTS) software and other software products such as freeware.
A.4.3.3	The contractor shall design, implement, and regulate system and network configurations.
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A.4.3.16	The contractor shall perform periodic audit of all OS and COTS software and maintain the vendor software database.
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A.5.4	The contractor shall periodically review system files and directories to ensure permissions are set properly.
A.5.5	The contractor shall periodically review system network services to ensure only necessary network services are running on systems.

A.5.6	The contractor shall periodically review system logging for any suspicious or abnormal activities.
A.5.7	The contractor shall run vulnerability-assessment tools periodically (such as TripWire, Tiger, COPS, snort, ISS Network Scanner, Nessus software) to identify security vulnerabilities or risks.
A.5.8	The contractor shall ensure network Transmission Control Protocol/Internet Protocol (TCP/IP) protocol parameters are set correctly to minimize network vulnerabilities and prevent denial of service attack.
A.5.9	The contractor shall review security notification E-mail for any related security vulnerabilities.
A.5.10	The contractor shall use encryption tunnel to prevent passwords, data and other sensitive information from crossing network in clear-text.
A.5.11	The contractor shall maintain the policies of the host-based or network-based filtering tools to restrict incoming and outgoing network traffic.
A.5.12	The contractor shall maintain the configuration of the password aging and password tools to ensure passwords meet the password policy.
A.5.13	The contractor shall maintain system auditing and review auditing report to detect potential security breaches.
A.5.14	The contractor shall provide support for the development and maintenance of EOS System Security Plans, perform EOS IT Security Assessments, create and maintain related IT Security Documentation, and ensure the compliance with NASA and Federal IT Security Requirements.
A.5.15	The contractor shall perform continuous monitoring tasks and support third-party A&A preparation.
A.5.16	The contractor shall perform NASA Security Assessment and Authorization Repository (NSAAR) migration from IT Security Center (ITSC) to Risk Information Compliance System (RICS) and ongoing/sustaining maintenance of IT Security documentation including Federal Information Security Management Act (FISMA) reporting (i.e. POA&Ms).
A.5.17	The contractor shall provide oversight and guidance of all ESMO Security implementation, in coordination with other contractors working for ESMO.

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IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment or software associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
ETS/MPS. (B32, Room C210H)
ETSF. (B32, Room C210 & B14, Room W224)
Terra Sim1 and Sim3. (B32, Room C210)
Terra Sim 2 & Flight Software Labs. (B1, Rooms 12, 17, 19, 23, 25, 25B & 29)
GPM MOC. (B32, Room N217)

GPM FlatSat. (B32, Room W030)
GPM EMOC, Dev/Test. (B3, Room S025E)
ERPS. (B32, Svalbard, Norway; Gilmore Creek, Alaska, Wallops Island, Virginia, and White Sands, New Mexico)
ESMO Infrastructure servers. (B32)
EOC – Mission Operations System (EMOS). Includes Online Subsystem - Raytheon Eclipse Product with modifications, Mission Management Subsystem (MMS), Analysis and its replacement system ITPS. (B32)
EOC- Backup Mission Operations Center (BEOC). (B13)
ESDIS (various network infrastructure). (B32)
Code 420 Division Office. (B36)
PACE MOC (B32, Room C221) PACE BMOC (B3, S005A)

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The proposed material list should include:

The Contractor shall procure materials as required by the ESMO project to replace and upgrade outdated and failing equipment. The contractor shall monitor hardware and software version obsolescence and propose material that will need to be procured proactively during the period of performance to avoid operational system outages and IT security risks. The procurement of these items is required to follow the process defined in the IT Procurement Information Circular, #13-04, dated June 6, 2013.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Hardware and other procurements for system maintenance/upgrades and vendor maintenance agreements. (as required)

Network, System Interface, and power diagram updates. (as required)
Updated System Security documentation - Risk Assessment Plans, SAIVs, Contingency Plans, EOS Workbooks, POA&M Report. (as required)

End of Task Order Statement of Work

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GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 9
Modification: 4
Task Name: ESMO Software Systems and Requirements Management

GSMO-2 SOW Reference: 3.1.1, 3.7.2, 3.7.4, 3.7.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2018	6/29/2018	Initial task order statement of work.
1	2/26/2018	6/29/2018	Add work for CRMS release 7 as well as adding SW Maintenance to GPM Covariance Realism Tool
2	6/30/2018	6/29/2019	Modification to extend period of performance 6/29/2019
3	9/13/2018		Admin Mod
4	6/30/2019	6/27/2020	Add work for CRMS R8 in support of CARA Devolution, added a new Subtask to support Network Software activities, and extend period of performance to 6/29/2020.

II. Task Overview

The ESMO Software Systems and Requirements Management task provides software sustaining engineering, requirements management, database maintenance, and independent test team and project support for the Aqua, Terra, Aura, and GPM missions.

Subtask 1: Covers all work associated with EOS Mission Operations System (EMOS).
Subtask 2: Covers all work associated with Mission Systems.
Subtask 3: Covers all work associated with GPM.
Subtask 4: Covers all work with NetOps Software.

III. Requirements

The requirements table below is subdivided into six principal areas of support (A.1 through A.5). The contractor shall apply these requirements to each subtask (1 to 3), as noted:

A.1 Software Development and Maintenance (subtask: 1, 2, 3, 4)
A.2 Requirements Management (subtask: 1, 2, 3)
A.3 Database Maintenance (subtask: 1, 3)
A.4 Independent Testing (subtask: 1, 3)
A.5 Project Support (subtask: 1, 3)

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A.1	Software Development and Maintenance
A.1.1	The contractor shall perform corrective maintenance of operational custom software systems, propose enhancements for the purpose of technology refresh and maintenance cost reduction, make modifications to existing operational custom software systems, support test and integration of new or modified software, document software changes and problems, maintain operational parameter databases, and control software system configurations as defined in this section.
A.1.2	The contractor shall maintain the custom software components of: • EOS Mission Management System (MMS) including interface to the Network Attached Storage (NAS) • EOS and GPM Integrated Plotting and Trending System (ITPS) • EOS Real-time Processing System (ERPS) • Data Distribution System (DDS) • EOS Multi-mission Portable Simulator (MPS) • GPM Linux Scalable Integrated Multi-mission Support System (LSIMSS) • GPM Mission Planning Subsystem (MPS) • GPM Mission Operations Center (MOC) – Precipitation Processing System (PPS) Interface Software Subsystem (MPISS) • Collision Risk Management System (CRMS) • GPM Covariance Realism Tool (CRT) • Mission Incident and Information Tracking System (MIITS) • Other utilities and automation tools (i.e., PDB, PMDB)
A.1.3	The contractor shall support the operational configuration of the mission applications including ensuring that the life of mission data is loaded onto the ITPS deployments.
A.1.4	The contractor shall provide content and schedules for software releases including detailed schedules reflecting workload, task duration, and resource allocation. Also include dependencies and critical path in detailed schedule.
A.1.5	The contractor shall resolve discrepancy reports (DRs) based on priorities set by the appropriate ESMO review board and according to staff skill mix.
A.1.6	The contractor shall implement software and database enhancements based on priorities set by the appropriate ESMO review board and according to staff resource levels.
A.1.7	The contractor shall detect, troubleshoot, and resolve system, software, database, and interface problems.
A.1.8	The contractor shall participate in Discrepancy Review Board (DRB) and Project Configuration Management Board (PCMB) as required by each element.
A.1.9	The contractor shall provide analysis and impacts on Discrepancy Reports and Configuration Change Requests (CCRs).
A.1.10	The contractor shall adhere to ESMO and element software configuration management (CM) practices for delivered changes.
A.1.11	The contractor shall update User's Guides, as necessary, to reflect approved software changes.
A.1.12	The contractor shall provide design updates, as necessary, due to approved

	software changes including the "as built" detailed design document.
A.1.13	The contractor shall adhere to element Functional and Performance Requirements Specification (F&PS), Interface Control Document (ICD), and Operations Agreement (OA) documents.
A.1.14	The contractor shall provide user assistance.
A.1.15	The contractor shall coordinate with hardware and network maintenance for the resolution of problems, upgrades, and cross-impact items.
A.1.16	The contractor shall review and comment on relevant documentation.
A.1.17	The contractor shall communicate any vendor provided renewal specific product information to the Government Task Monitor prior to service agreement renewal(s) decision.
A.1.18	The contractor shall recommend updates to documents, including those documents not directly updated in this task, that are deemed necessary by the software upgrades and changes performed in this task.
A.1.19	The contractor shall coordinate across the ESMO elements the update and delivery of the EMOS Operations & Maintenance (O&M) Manual.
A.1.20	The contractor shall develop and provide training to the FOT including demonstrations of new capability and assisting FOT in modifying local procedures as required.
A.1.21	The contractor shall maintain NASA websites in support of ESDIS and ESMO tools and libraries. Ensure supported systems are secure and comply with NASA security regulations. Such tools include: - ESDIS Data Management Library - EDOS Data Management Library - Network Requirements System - System Status database - Waiver Request System - EDOS Operations Log - Data Loss Tool - Application License Tracking Tool
A.1.22	**The contractor shall develop and maintain individual software subsystems needed by the ESDIS & ESMO NetOps operations requirements. Suth tools include:** **- ENAARC network security dedection and denial tool** **- CloudSearch** **- AWS Container Security** **- Code Security Scanner** **- AWS NetOps Tools** **- lowerCase** **- AWS Splunk Dashboard**
A.2	**Requirements Management**
A.2.1	The contractor shall support requirements management including supporting ESMO Science Interface Manager and Mission Directors in working with Instrument Operations Teams (IOTs) and FOTs to coordinate requirements changes, clarifications in requirements and resolution of deviations as defined in this section.

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A.2.2	The contractor shall participate in the management of requirements, from a total-system perspective throughout the life cycle, perform analysis and develop management plans, as necessary.
A.2.3	The contractor shall maintain the EMOS software requirements in the MIITS ERIS database based on the results of ECRB.
A.2.4	The contractor shall support the ESMO Mission Directors in the Requirements development and design assessment of the Constellation Coordination System (CCS).
A.2.5	The contractor shall support the ESMO Science Interface Manager and provide a science team interface for the EOS missions, including: • Coordinate special requests for information • Investigate and resolve technical problems identified by the science teams • Participate in Afternoon Constellation activities • Manage instrument operations agreements • Support the IOTs in documenting Instrument anomalies and resolution. • Produce data analysis and/or reports to document instrument health and performance and present results as needed. • Generate presentations and reporting documentation as required by the ESMO SIM and the ESMO Mission Director (MD).
A.2.6	The contractor shall maintain EOS network baseline requirements database; track and maintain changes to interface requirements documents to ensure database properly reflects updated requirements.
A.2.7	The contractor shall assist the ESMO MD and Ground System Manager (GSM) in the maintenance of the baseline GPM requirements and interface documentation listed below. The government serves as lead author for document 1, JAXA serves as the lead author for document 11, and the contractor is the lead author of the remaining documents. 1. GPM Ground System Requirements Document 2. GPM MOC Level 4 requirements specification 3. GPM Core Spacecraft Space-Ground ICD 4. GPM MOC-Precipitation Processing System (PPS) ICD 5. GPM MOC-Flight Dynamics Facility (FDF) ICD 6. GPM MOC-NASA Near Earth Network (NEN) ICD 7. GPM MOC-SN Gateway ICD 8. Robotic Systems Protection Program (RSPP) to GPM ICD 9. GPM MOC-Conjunction Assessment Risk Analysis (CARA) ICD 10. GPM Intra-MOC ICD 11. GPM MOC Design Specification 12. NASA-JAXA Mission Operations and Interface Specification (MOIS) – FOT document 13. GPM Ground System Configuration Management Plan – FOT document
A.3	**Database Maintenance**
A.3.1	The contractor shall perform database maintenance as defined in this section.
A.3.2	The contractor shall provide database administration (Access, Sybase, Oracle, Filemaker Pro, etc.) as necessary for operation of: • MIITS

	• MMS • Project Database (PDB) • EMOS Requirements Information System (ERIS) • ESDIS and ESMO libraries and tools identified in A.1 above • GPM Attention Database
A.3.3	The contractor shall, for ERIS support, provide biannual reports on requirements and deliveries and backups of the database, and provide additional reports on special request.
A.3.4	The contractor shall implement database and related software tool enhancements based on priorities set by the appropriate ESMO review board and according to staff resource levels.
A.3.5	The contractor shall detect, troubleshoot, and resolve system, software, database, and interface problems associated with the databases.
A.3.6	The contractor shall modify the database structure, as necessary, from information given by application developers and users.
A.3.7	The contractor shall maintain and monitor database export, archiving and deletion scripts.
A.3.8	The contractor shall create and execute database scripts that are needed for operations.
A.3.9	The contractor shall create, modify, and delete MIITS user and group accounts at the direction of the responsible NASA official via IDMax requests.
A.3.10	The contractor shall assist users with database problems and questions such as account password and access problems.
A.3.11	The contractor shall provide database security/watchdog activities such as checking the active/inactive users and providing user activity lists.
A.3.12	The contractor shall develop and provide training to the FOT including demonstrations of new capability and assisting FOT in modifying local procedures as required.
A.4	**Independent Testing**
A.4.1	The contractor shall provide test engineering support to the FOT as defined in this section.
A.4.2	The contractor shall ensure the following systems and infrastructures that support the EOS FOT are fully verified prior to deployment into Operations: • Integrated Trending and Plotting System (ITPS) • MMS • Online • ERPS CRPs • ERPS GSIPs • Flight Dynamics System (FDS) • Constellation Coordination System (CCS) • Network Architecture • FOT Infrastructure tools • EOS Automation (EA) • GPM MPS • GPM MPISS • CRMS

A.4.3	The contractor shall maintain the overall ESMO Test Plan developed under the EMP effort.
A.4.4	The contractor shall analyze system and functional requirements, including mapping of requirements to test cases.
A.4.5	The contractor shall re-use or modify existing FOT test procedures as applicable.
A.4.6	The contractor shall maintain and support the execution of test plans and procedures for individual systems/subsystems.
A.4.7	The contractor shall support Test Readiness Reviews for major deliveries.
A.4.8	The contractor shall maintain and execute integrated test plans and procedures based on operational requirements, processes, procedures.
A.4.9	The contractor shall support system and functional tests, including findings from testing activity, requirements that were verified, new DRs opened, and recommendation to accept or reject release.
A.4.10	The contractor shall support analysis, documentation, and reporting of test results.
A.4.11	The contractor shall develop and provide training to the FOT, including demonstrations of new testing capability and/or modified procedures, and assist FOT in modifying local test procedures as required.
A.4.12	The contractor shall update test procedures to include IT security testing at the application level.
A.5	**Project Support**
A.5.1	The contractor shall facilitate the EOS Change Review Board (ECRB) preparing and distributing agendas and minutes.
A.5.2	The contractor shall facilitate the following Discrepancy Review Boards (DRBs) preparing and distributing agendas and minutes - EMOS - ITT - GPM - FDS - CCS
A.5.3	The contractor shall coordinate, track and update the contents and status of ESMO DRs in MIITS.
A.5.4	The contractor shall coordinate, track and update the ESMO master schedule.
A.5.5	The contractor shall provide support for the management of schedules for specific activities such as automation.
A.5.6	The contractor shall provide systems engineering support to the ESMO Project. The systems engineers shall be technically qualified and sufficiently experienced to provide support, as follows: • Lead working groups in support of ESMO ground system efforts such as requirements analysis, development, sustaining engineering, and evolution of system components, deployment, and testing. • Coordinate and track progress of activities for assigned ESMO ground systems. • Develop and maintain schedules. • Generate presentations and reporting documentation (weekly, monthly,

	formal reviews) as required.
A.5.7	The contractor shall support review and documentation of the enterprise architecture, including: • Identify all flows and system interfaces • Search for potential security concerns • Update architecture and dataflow diagrams • Review configuration management and software baselines
A.5.8	The contractor shall provide technical writing and documentation support for Earth Observing System (EOS) Mission Operations System (EMOS) Project plans and documentation, which includes: • developing and finalizing the ESMO Project Management Plan in compliance with NPR 7120 (NASA Space Flight Program and Project Management Handbook • coordinating input, data, and peer reviews from multiple subject matter experts • adherence to ESMO Configuration Management (CM) procedures for documentation (ESMO Project CM Procedures, 428-PG-1410.2.2)

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
EDTF MMS Development and Test. (B13, Room 141)
ETSF. (B32, Room C210 & B14, Room W224)
ERPS GSIPs. (Svalbard, Norway; Gilmore Creek, Alaska, Wallops Island, Virginia, and White Sands, New Mexico)
ESMO Infrastructure servers. (B32 Room E139)
EOC – Mission Operations System (EMOS). Includes Online Subsystem – Raytheon Eclipse Product with modifications, Mission Management Subsystem (MMS), Analysis and its replacement system ITPS, Data Distribution System (DDS), ERPS CRPs and test GSIPs, EOS Automation Integration and Test. (B32 Room C210)
Backup Mission Operations Center (BEOC). (B13 Room 141)
ERPS Development and Test. (B32 Room S009)
GPM MOC. (B32, Room N217)
GPM FlatSat. (B32, Room W030)
GPM EMOC, Development and Test. (B3, Room S025E)
CRMS. (B32 Room C210)

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
EOS Real-time Processing System (ERPS) (NASA/GSFC Code 420)	
Portable Spacecraft Simulator / Linux Scalable Integrated Multi-mission Support System (PSS/LSIMSS) (NASA/GSFC Code 581)	
Attitude Ground System (AGS) (NASA/GSFC Code 595)	
ESMO Mission Management System (MMS)	
Command Management System (CMS)	
FORMATS	
Eclipse™ (Raytheon)	
ESMO Mission Information and Issue Tracking System (MIITS)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Software System Deliveries: (per each delivery) - Source and executable code - Release Notes - Build and Install procedures - Design documentation - Documentation of interfaces - EMOS O&M Manual updates

- Updated user's guide (if necessary)
Testing Documentation: - Test records (At ORR) - Test Report (ORR + 2 weeks)
Process Reviews: (As necessary for each software system release) - Content Review - Design Reviews - Ops Readiness Review - Test Readiness Review - Pre-ship Review
List of maintained software applications with operational release number. (updates upon request)
Documentation for CRMS: (as required) - Operations Concept - Aqua ICD updates - Aura ICD updates - Terra ICD updates - GPM ICD updates

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS 2 (GSMO-2)
TASK ORDER

Task No: 12
Modification: 5
Task Name: EDOS Operations and Engineering

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GSMO-2 SOW Reference: 2.4.6, 3.6, 3.7.2

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	10/01/2017	06/29/2018	Additional EBox-R capacity for JPSS missions
2	06/30/2018	06/29/2019	Renewal of Task Order
3	10/01/2018	06/29/2019	Procure JPSS mission hardware and RBox SW Upgrade
4	12/10/2018	06/29/2019	Modify EDOS software for ICESat-2 to process new VC-5 APIDs and produce new PDS products & Provide on-site vendor support for M&C and GUI troubleshooting
5	06/30/2019	06/27/2020	Annual renewal of Task Order

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II. Task Overview

The EDOS Operations and Engineering task provides EDOS operations and engineering services necessary to meet the requirements for the EDOS system as specified in the applicable Functional & Performance Specifications (F&PS), Interface Control Documents (ICD)s and Operational Agreements (OA)s.

III. Requirements

1	**EDOS Operations and Engineering**
1.1	**Project Management**
1.1.1	The contractor shall ensure that resources are adequate to meet project schedules and deliverables.
1.1.2	The contractor shall ensure project schedules and budgets are met.
1.1.3	The contractor shall ensure monthly project status report is delivered on schedule.
1.1.4	The contractor shall ensure availability and competence of the work force necessary to execute the technical activities specified in this Task Order.
1.1.5	The contractor shall generate a detailed technical staffing approach and ensure the project is staffed with appropriate skill levels and number of personnel.
1.1.6	The contractor shall ensure task stays within scope as specified within this SOW.

1.1.7	The contractor shall plan, manage and coordinate EDOS-related T&M support with prime vendor, (b) (4) [redacted]
1.1.8	The contractor shall provide technical coordination between EDOS and other GSMO-2, ESDIS, JPSS, SDSS, NEN and ESMO organizations.
1.1.9	The contractor shall promote EDOS capabilities within ESMO and other organizations for future EDOS mission support.
1.1.10	The contractor shall support NASA efforts to capture new mission business on EDOS.
1.2	**Operations Support**
1.2.1	The contractor shall monitor EDOS high-rate data capture at ground stations for all EDOS-supported non-JPSS missions.
1.2.2	The contractor shall provide 24x7 on-console system operations at the EDOS LZPF/BLZPF for all EDOS-supported missions, including routine monitoring of nominal operations and the handling of contingency operations.
1.2.3	The contractor shall provide daily troubleshooting to handle anomalies for ground station issues, resolution of missing or partial data, re-delivery of data due to network failures or end-user outages, and reprocessing of previously delivered data to resolve anomalies.
1.2.4	The contractor shall provide analysis of X-band science data at the request of Flight Operations to assist in resolving on-board spacecraft anomalies.
1.2.5	The contractor shall ensure that the EDOS system generates and electronically delivers EDS/PDS products to EDOS customers within 3/24 hours of receipt of last bit of data 95/98% of the time.
1.2.6	The contractor shall ensure that the EDOS system generates and electronically delivers rate-buffered (near real-time) data within 3 hours of receipt of last bit of data at least 95% of the time.
1.2.7	The contractor shall ensure that the EDOS system generates and electronically delivers real-time data (selected VC streams) within 5 minutes after receipt of data.
1.2.8	The contractor shall monitor product delivery completeness by product including numbers and per cents of products. Where this metric is also requested from another ESMO task, the same data, graphs, and/or charts may be provided by generating unique charts for this task. Provide metrics to EMS system in an appropriate format.
1.2.9	The contractor shall monitor system operations, taking approved corrective actions and following problem escalation procedures, as necessary. Insure work instructions are kept up to date.
1.2.10	The contractor shall offer alternative operations concepts and procedures in support of evolving system and mission processes and/or to improve ongoing operations.
1.2.11	The contractor shall coordinate new activities with appropriate Flight Operations Teams, Mission Directors, and all affected customers, as needed.
1.2.12	The contractor shall participate in Project Configuration Management Board (PCMB). Provide analysis and impacts on DRs and Configuration Change Requests (CCRs) using GFE automated tools. Generate discrepancy reports

	(DRs) for problems encountered in the operational system as well as for system change requests.
1.2.13	The contractor shall apply EDOS operations engineering expertise and other level zero system experience to enhancements for system automation, operability, flexibility, and reduction of life cycle costs.
1.2.14	The contractor shall perform integration and system-level testing of software changes, including test-planning, execution, and reporting.
1.2.15	The contractor shall coordinate with ground station support tasks as needed, including non-routine operations, test support, corrective and preventive maintenance of EDOS hardware and software, and EDOS DAF operations.
1.2.16	The contractor shall perform system Acceptance Testing on software releases provided by the EDOS Software Engineering team.
1.2.17	The contractor shall provide representation at EDOS status and briefing meetings and provide regular reports to NASA regarding operations status, testing progress and plans.
1.2.18	The contractor shall participate in, and evaluate, regression testing of the interfaces within the EDOS system and between EDOS and external customers.
1.2.19	The contractor shall provide drafts of new OAs and periodic updates to existing OAs.
1.2.20	The contractor shall provide backup network monitoring for the ESMO network operations, including opening trouble tickets and coordinating problems with the on-call network engineers.
1.2.21	The contractor shall participate in pre-launch readiness tests, launch support, early orbit checkout, and sustaining operations for new missions supported by EDOS.
1.2.22	The contractor shall participate in new antenna and new ground station certifications with flight operations teams for EDOS-supported missions.
1.2.23	The contractor shall provide operational support for the SMAP Emergency Control Center hosted by ESMO by monitoring the health of the system and reporting problems back to SMAP project.
1.2.24	The contractor shall retrieve and re-deliver selected level zero production data sets from the Aqua/Aura/Terra life-of-mission archive (DAF) to support science reprocessing campaigns or to fill missing data gaps from end-users.
1.3	**Software Development & Software Sustaining Engineering**
1.3.1	The contractor shall provide an operations concept and high-level design to automatically verify and display successful delivery and completeness of data products to end users.
1.3.2	The contractor shall provide alternative designs to "strip-and-ship" of selected VCIDs and/or APIDs from the X-band downlink to users of direct broadcast (DB) data who are impacted by X-band downlink interference with DB.
1.3.3	The contractor shall implement near real-time quick-look displays for applicable instruments with visual data.
1.3.4	The contractor shall implement software required to insert new missions into EDOS, including support for new spacecraft ID, Virtual Channel IDs, APIDs,

	required level-zero processing and product generation, and data delivery protocols and destinations.
1.3.5	The contractor shall provide development and test system software maintenance.
1.3.6	The contractor shall provide content and schedules for software releases including detailed schedules reflecting workload, task duration, and resource allocation. Also include dependencies and critical path in detailed schedule.
1.3.7	The contractor shall provide design updates, as necessary, including documentation updates to as-built specification.
1.3.8	The contractor shall study and develop scripts required for system performance improvements.
1.3.9	The contractor shall support preparation of system test plans and procedures.
1.3.10	The contractor shall troubleshoot, and resolve major system problems via short term workarounds and follow up with permanent upgrades.
1.3.11	The contractor shall provide 24/7 on call support for emergency or critical situations such as an operational transition.
1.3.12	The contractor shall implement latency enhancements whenever possible to provide end user near real-time products as soon as possible.
1.3.13	The contractor shall obtain, assess, install, and configure vendor software upgrades including COTS and GOTS.
1.3.14	The contractor shall resolve discrepancy reports (DRs) based on priorities set by the EDOS review board and according to staff skill mix. Provide updates to DRs via the DR tracking tool.
1.3.15	The contractor shall implement software and database changes based on priorities set by the appropriate EDOS review board and according to staff resource levels.
1.3.16	The contractor shall detect, troubleshoot, and resolve system, software, database, and interface problems.
1.3.17	The contractor shall adhere to ESMO and element software configuration management (CM) practices for delivered changes.
1.3.18	The contractor shall update the appropriate user guides, as necessary due to approved software changes.
1.3.19	The contractor shall coordinate with hardware maintenance, Database, Mission Engineering, and System Administration for the resolution of problems, upgrades, and cross-impact items.
1.3.20	The contractor shall review and adhere to element F&PS, ICD, and Operation Agreements (OA) documents.
1.3.21	The contractor shall provide User assistance as needed in support of EDOS operations.
1.3.22	The contractor shall participate in Project Configuration Management Board (PCMB) as requested, and provide analysis and impacts on DRs and Configuration Change Requests (CCRs) using GFE automated tools.
1.3.23	The contractor shall develop and integrate the monitor and control software and vendor-supplied middleware needed to support any new EDOS tech refresh activities.

1.3.24	The contractor shall provide a software design for virtualization of the EDOS back-end software (Ebox-R) to eliminate mission specific Ebox-R assignments and failover challenges.
1.3.25	The contractor shall test adaptive Intermediate Frequency (IF) development by vendor to provide multi-mission data-driven capabilities at ground stations supplying IF interface.
1.3.26	The contractor shall implement support for new JPSS missions as requested, performing level zero processing, product generation and delivery of JPSS science mission data to the NASA SIPS. JPSS data will be relayed to EDOS via high-rate SLE network interface, not directly from the ground station.
1.3.27	The contractor shall test compression software to enhance WAN performance by increasing the effective transfer rate.
1.3.28	The contractor shall research and implement enhancements to improve level 0 processing performance, such as multi-threaded service processor capability or high-priority queues.
1.3.29	The contractor shall continue to update the design of EDOS operational GUIs with new vendor-supplied middleware versions as they become available to enhance efficiency of EDOS operations.
1.3.30	The contractor shall implement software changes for approved DRs to be included in releases as directed by the DRB.
1.3.31	The contractor shall insure that implementation of any new enhancements do not impact any existing capabilities and functions.
1.3.32	The contractor shall implement software to collect metrics on input volume and source by ground station and mission, elapsed time for transfer, processing and distribution, and output volume by product type, mission, and destination.
1.3.33	The contractor shall implement any DTN protocol capabilities, as necessary, to support new business initiatives as requested by NASA.
1.3.34	Upgrade all the EDOS Ebox-R systems from obsolete SLES 11 SP 3 to SLES 12 SP 3 including all required vendor middleware integration. This security upgrade resolves Linux OS vulnerabilities and will make the Ebox-R systems compliant and maintainable.
1.3.35	Modify EDOS software for ICESat-2 to process new VC-5 APIDs and produce new production data sets for 5 APIDs in VC-5, when present: APID 27, APID 133, APID 142, APID144, and APID 153. These PDS files will be sent to the ICESat-2 SIPS and NSIDC. Expedited data sets for these APIDs will also be produced and delivered to the SIPS, upon request. Update the EDOS ICESat-2 ICD to include these new APIDs and associated products.
1.3.36	Provide vendor on-site engineering support to troubleshoot new monitor and control and GUI performance problems.
1.4	**Hardware Sustaining Engineering**
1.4.1	The contractor shall deploy new high rate ECL matrix switches at ground stations if needed to support additional antenna feeds, to replace defective switches for repair, to replace existing obsolete switch hardware, or if needed to support higher data rates.
1.4.2	The contractor shall insure any hardware sent to remote ground stations has been thoroughly tested prior to shipment.

1.4.3	The contractor shall augment remote EDOS equipment (HBOX, NAS, log server, QoS, etc.) if needed to support additional antennas at ground stations.
1.4.4	The contractor shall evaluate alternatives and determine how to provide follow-on to the Data Archive Facility (DAF) tape conversion project for EOS mission data if DAF equipment approaches end-of-life before life of mission plus 3 years (Aqua/Aura/Terra).
1.4.5	The contractor shall explore the concept of implementing and deploying virtual Rbox(s) into development and test, and LZPF/BLZPF operational environments.
1.4.6	The contractor shall maintain the LZPF/BLZPF operations, development and test, and DAF environments as required.
1.4.7	The contractor shall procure hardware equipment as necessary to meet mission requirements as required.
1.4.8	The contractor shall provide maintenance of EDOS high-rate matrix switches at EDOS-supported ground stations, as needed.
1.4.9	The contractor shall detect, troubleshoot, and resolve system, hardware, and interface problems.
1.4.10	The contractor shall coordinate with software and network maintenance for the resolution of problems, upgrades, and cross-impact items.
1.4.11	The contractor shall provide content and schedules for hardware maintenance activities including detailed schedules reflecting workload, task duration, and resource allocation. Also include dependencies and critical path in detailed schedule as required.
1.4.12	The contractor shall provide design updates, as necessary due to approved hardware changes, including as built design documentation, cabling and network diagrams.
1.4.13	The contractor shall provide 24/7 on-call support for emergencies such as operational transitions and launch support.
1.4.14	The contractor shall obtain, assess, install, and configure vendor hardware upgrades/replacements including COTS and GOTS.
1.4.15	The contractor shall report on hardware obsolescence and provide engineering recommendations to ensure compatibility between development, test, operational and backup system strings and extended end-of-life through 2023.
1.4.16	The contractor shall evaluate options to reduce hardware maintenance costs and provide engineering recommendations.
1.4.17	The contractor shall implement hardware modifications based on priorities set by the Task Monitor and according to staff resources.
1.4.18	The contractor shall participate in Discrepancy Review (DR) Board and Project Configuration Management Board (PCMB); provide analysis and impacts on DRs and Configuration Change Requests (CCRs) in GFE automated tools where available.
1.4.19	The contractor shall adhere to ESMO and EDOS hardware CM practices for delivered changes.
1.4.20	The contractor shall update User's Guides, work instructions, or CM documents as necessary due to approved hardware changes.

1.4.21	The contractor shall perform system enhancements, augmentation and replacement as approved by the task monitor.
1.4.22	The contractor shall perform procurement specifications and procurement package preparation.
1.4.23	The contractor shall perform feasibility, proof-of-concept and cost tradeoff studies as requested by the Task Monitor.
1.4.24	The contractor shall perform firmware maintenance and upgrades with vendor support, as necessary.
1.4.25	The contractor shall provide training on new hardware systems as needed.
1.4.26	The contractor shall travel to remote sites for new equipment installations, system modifications or system reconfigurations that cannot be performed remotely or by site personnel.
1.4.27	The contractor shall procure new hardware as replacements for end-of-life systems or as part of ongoing EDOS tech refresh activities, with approval of the task monitor.
1.4.28	The contractor shall provide loaner front-end equipment to other projects for User Local Equipment testing at their testbed (or other location) in preparation for ground station deployment, if spare equipment is available and with task monitor approval.
1.4.29	The contractor shall procure adequate spare hardware that can be used to replace failed servers or failed components in operational servers that can be replaced. Adequate sparing will be provided on site at remote ground stations.
1.4.30	The contractor shall perform periodic Technology Refresh on all EDOS non-licensed hardware platforms to enable upgrades to latest OS and security patches. This will provide compatibility with current vendor-licensed platforms and avoids end-of-life security problems. Periodically evaluate all platforms for refresh consideration versus retiring the server by combining functionality or dropping service that is no longer needed.
1.4.31	The contractor shall procure additional licensed EBox-R servers from the (b) (4) [redacted] vendor for the operational LZPF and BLZPF to support unanticipated additional capacity needed to support concurrent operational and test dataflows with JPSS missions (SNPP, JPSS-1, and JPSS-2).
1.4.32	The contractor shall procure one PPH system to provide backup capabilities for JPSS mission support.
1.5	**Hardware and Software Maintenance**
1.5.1	The contractor shall report on system availability including minutes and percent of down time for individual servers as well as multi-server functional subsystems.
1.5.2	The contractor shall provide 24x7 best efforts response for both hardware and software maintenance issues.
1.5.3	The contractor shall repair or replace hardware equipment without service agreement support as requested.
1.5.4	The contractor shall manage all software licenses, software maintenance, hardware maintenance, and hardware warranty contracts.
1.5.5	The contractor shall provide T&M coordination for critical 3rd party software modifications as required, with concurrence of the Task Monitor.

1.5.6	The contractor shall respond to trouble calls & resolve problems, as needed.
1.5.7	The contractor shall interface with vendors to obtain quotes and to coordinate external vendor support.
1.5.8	The contractor shall maintain hardware related software licenses (OS) and COTS software vendor maintenance services.
1.5.9	The contractor shall keep track of COTS products vendor service agreements & renewals.
1.5.10	The contractor shall provide vendor maintenance and/or support agreements as required.
1.5.11	The contractor shall support property tracking & management, and prepare required property tracking forms for equipment relocations.
1.5.12	The contractor shall provide ongoing status of procurement activities to the government task lead.
1.5.13	The contractor shall excess equipment marked by Task leads as quickly as possible.
1.5.14	The contractor shall anticipate and recommend system and procedural (hardware/software upgrades, staffing adjustments, procedure modifications, facility enhancement, etc.) changes to improve ongoing operations or increase resource or cost efficiencies.
1.6	**Database Administration**
1.6.1	The contractor shall perform Oracle database upgrades as necessary to maintain current Oracle version compatibility with Oracle support, security requirements, and application software.
1.6.2	The contractor shall perform development, test, and operational database changes as needed to implement changing requirements.
1.6.3	The contractor shall provide 24x7 best efforts on-call database support.
1.6.4	The contractor shall plan and implement database changes in support of application releases and customer requests with minimal impact to Operations. Ensure scripts provide a time stamped log to enable access to time of change, pre-change values, and post-change values and therefore an easy means of rolling back changes.
1.6.5	The contractor shall work with the developers in transitioning to new release in order to minimize Operational downtime and potential risks during transitions.
1.6.6	The contractor shall, for all EDOS environments (i.e. development, test, and operations), install Oracle software and maintain its configuration files. Create and maintain all application accounts, objects, privileges, and data (backups, archival, restores, etc.). Plan and implement backup and recovery strategy of the entire database to ensure availability and a timely database recovery.
1.6.7	The contractor shall provide input to developers on design concerns in database routines which may impact the operational environment. (e.g. archival and deletion of data in the database, access to large volume of data) Work toward continuous improvements with minimal performance impacts due to functional enhancements.
1.6.8	The contractor shall aid in planning, designing and implementing new release design changes.

1.6.9	The contractor shall review Oracle security and patch notifications with respect to needs of the application software. Apply patches and upgrades as approved by the project.
1.7	**Systems/Network Administration**
1.7.1	The contractor shall provide system administration performing baseline backups and weekly backups, user account administration, and system monitoring (disk space, security, etc.).
1.7.2	The contractor shall manage system and network resources such as CPU usage, memory usage, disk space usage, I/O activities, processes control and network loading; monitor and tune system and network performance.
1.7.3	The contractor shall provide 24X7 on-call emergency support for troubleshooting system software, hardware and network problems encountered by operations, and operational transitions.
1.7.4	The contractor shall define and test additional network flows and firewall rules needed to implement changing requirements.
1.7.5	The contractor shall detect and help resolve network problems.
1.7.6	The contractor shall work with network engineering personnel to resolve any network or firewall problems.
1.7.7	The contractor shall perform operating system installations as needed to implement changing requirements.
1.7.8	The contractor shall evaluate security vulnerabilities that have been identified by NASA and vendors.
1.7.9	The contractor shall provide security vulnerability assessment responses and resolutions and identify appropriate actions to take.
1.7.10	The contractor shall provide engineering resources to provide ongoing IT security upgrades to mitigate security audit vulnerabilities, including installation and test of recommended security patches and kernel upgrades and to respond to data calls in a timely manner.
1.7.11	The contractor shall provide off-site storage for EDOS software backup media that meets C&A audit requirements and implement a procedure to periodically store backup media at the site.
1.7.12	The contractor shall centralize system monitoring and logging to eliminate the need to retrieve information from individual systems.
1.7.13	The contractor shall periodically review system logging for any suspicious or abnormal activities.
1.7.14	The contractor shall maintain the security and integrity of the systems and networks by developing and enforcing security procedures in accordance with NPG 2810.1 standards.
1.7.15	The contractor shall periodically review and update project security documents – security plan, contingency plan, and risk management plan.
1.7.16	The contractor shall run vulnerability-assessment tools periodically to identify security vulnerabilities or risks.
1.7.17	The contractor shall maintain system auditing and review auditing report to detect potential security breaches.
1.7.18	The contractor shall perform periodic network throughput performance measurements and retain historical data for baseline reference.

1.7.19	The contractor shall provide systems administration and contingency support for the SMAP Emergency Control Center hosted by ESMO.
1.7.20	The contractor shall enforce annual update plan with vendor to test SUSE OS upgrades and mandatory security patches, and insure delivered patches and upgrades are installed throughout the network in a timely manner.
1.7.21	The contractor shall test and support changes to high rate network interfaces with the ground stations, as needed.
1.7.22	The contractor shall work with NetOps organization to utilize the enterprise load balancer to split EDOS traffic between the LZPF and BLZPF, and coordinate with external users to use public load balancer addresses.
1.8	**Systems and Mission Engineering**
1.8.1	The contractor shall support ESMO Automation activities in conjunction with FOT.
1.8.2	The contractor shall, if needed, prototype CCSDS File Delivery Protocol (CFDP) and other related CCSDS technologies for potential new mission customers.
1.8.3	The contractor shall perform end-to-end data information systems engineering for all EDOS data flows: formats, processing steps, and data encapsulation.
1.8.4	The contractor shall coordinate troubleshooting between engineering and operations teams and lead root cause analyses.
1.8.5	The contractor shall perform systems-level technical coordination between EDOS and (b) (4) [redacted] to implement approved technology enhancements.
1.8.6	The contractor shall prepare technical papers and presentations promoting EDOS accomplishments and capabilities, as requested by task monitor.
1.8.7	The contractor shall maintain project knowledge of EOS mission specifics and data formats, operations concepts, and problem resolution.
1.8.8	The contractor shall provide technical engineering, management support and outreach activities as requested by the NASA task monitor to leverage EDOS science capture and distribution capabilities for future missions.
1.8.9	The contractor shall promote EDOS capabilities for other organizations and future missions. Such support may include attending conferences, presenting papers, attending meetings with prospective missions, and preparing marketing materials as approved and requested by the task order monitor.
1.8.10	The contractor shall provide engineering support for new missions, including attending technical interchange meetings, performing studies and audits as requested, developing Memorandum of Agreements and developing ops concepts and requirements.
1.8.11	The contractor shall perform modeling and engineering studies to analyze EDOS network utilization and capability for future mission growth.
1.8.12	The contractor shall perform data analysis for CCSDS telemetry and level zero products, including detailed investigation into mission data anomalies, pre-launch test data analysis, and test data validation.
1.8.13	The contractor shall perform system engineering and analysis for new requirements, derivation of operational requirements for system enhancements, user interfaces, and new mission insertion.

1.8.14	The contractor shall ensure EDOS systems requirements (Functional & Performance Specifications) are updated as required.
1.8.15	The contractor shall develop and maintain EDOS ICDs as required.
1.8.16	The contractor shall provide systems re-engineering support for automation of all routine EDOS operator functions.
1.8.17	The contractor shall develop an Ops Concept description for all new missions explaining in detail how the mission will be supported by EDOS operations.
1.8.18	The contractor shall apply knowledge of EDOS system design and lessons learned to future enhancements, re-engineering and automation.
1.8.19	The contractor shall keep up to date with current trends, CCSDS standards and new technology and recommend new technology insertion where appropriate.
1.8.20	The contractor shall lead design efforts to modify EDOS systems architecture and maintain a strategic vision of future EDOS architecture.
1.8.21	The contractor shall participate in new mission thread tests, end-to-end tests, day-in-the-life tests, and operational readiness tests for all new missions.
1.8.22	The contractor shall analyze new mission technologies/features to evolve the existing capabilities and infrastructure to support new high-rate missions.
1.9	**Software, Hardware and Documentation Configuration Management**
1.9.1	The contractor shall ensure that all software components which reside on development, test, operations, remote sites, and backup facility hardware strings are executing at current version level.
1.9.2	The contractor shall use CM tools to remove/replace software components for development and testing.
1.9.3	The contractor shall maintain documentation to describe software CM processes and procedures.
1.9.4	The contractor shall ensure Discrepancy Reports (DR)s and waivers are written to document any software changes to existing baselines.
1.9.5	The contractor shall ensure that all hardware/firmware equipment which comprises the development, test, operations, remote sites, and backup facility are executing at current version level.
1.9.6	The contractor shall use CM tools to remove/replace firmware components for development and testing.
1.9.7	The contractor shall maintain documentation to describe hardware CM processes and procedures.
1.9.8	The contractor shall ensure hardware schematics are updated to document any hardware changes to existing baselines.
1.9.9	The contractor shall support the Project Configuration Management Board (PCMB) by serving as the PCMB secretary which includes preparing CCR packages, draft minutes, and track action items associated with CCRs.
1.9.10	The contractor shall support the Discrepancy Review Board (DRB) by serving as the DRB administrator, includes assigning DRs, tracking status of DRs, preparing reports/minutes and other supporting materials as requested.
1.9.11	The contractor shall provide Documentation CM support by serving as the EDOS Configuration Manger, which includes backup support for EDOS through the configuration and account administration of the Mission Information & Issue Tracking System (MIITS).

1.9.12	The contractor shall provide analysis and impacts on DRs and Configuration Change Requests (CCRs) using the GFE automated tools as available, coordinate configuration tracking for all changes resulting from activities associated with this task with the appropriate ESMO, ESDIS, and external contacts.
1.9.13	The contractor shall ensure the following set of EDOS documentation remains current such as ICDs, OAs, HMP (Hardware Management Plan), DBA SOPs (Database Administrators), SA (System Administration) SOPs, SDS (Software Design Spec), SMP (Software Management Plan), EDOS Ops Concept, SW SMP, F&PS, CM PG (Configuration Management Procedures), SW Install Procedures, NASA GSFC Contingency Plan for EDOS, NASA GSFC Risk Assessment Report for EDOS.

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
EDOS LZPF and EDOS Development and Test. (B32, Rooms C210 and S9)
EDOS Backup LZPF. (B13, Rooms 141 and 145)
EDOS GSIFs. (Svalbard, Norway; Gilmore Creek, Alaska; White Sands, New Mexico; Wallops Island, Virginia; Alaska Satellite Facility, Fairbanks, Alaska; USN North Pole, Fairbanks, Alaska; TrollSat, Antarctica [Norway])
EDOS DAF. (White Sands, New Mexico)

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

EDOS Project Status Report. (monthly)
Detailed technical schedules. (monthly)
Technical and managerial meeting minutes, reports and presentations. (as required)
Documentation updates and/or revisions of the EDOS OAs, ICDs, F&PS, and as-built documents. (as requested)
Software, Hardware, SA and DBA documents. (as needed)
Test Reports during routine periods and daily during critical periods. (As requested within two weeks of test completion)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 13
Modification: 2
Task Name: SDO Ground System Support

GSMO-2 SOW Reference: 3

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/25/2018	Initial task order statement of work
1	05/26/2018	05/24/2019	Extend task for one year
2	05/25/2019	05/23/2020	Extend task for one year

II. Task Overview

The SDO Ground System Support task provides technical and managerial work required to ensure successful support for and operations of the SDO satellite and the SDO Ground System.

III. Requirements

1	SDO Ground System Support
1.1	The contractor shall support the Ground System Configuration Control Board (CCB) process, maintain the Mission Operations Change Request (MOCR) database, and provide MOCR technical review and impact assessments as needed.
1.2	The contractor shall maintain and update Interface Control Documents as necessary.
1.3	The contractor shall provide support to the MD in the generation of technical presentation packages as required. Provide technical review of Project documents as applicable to GS and/or operations.
1.4	The contractor shall assist the SDO Mission Director in maintaining the operations configuration of all primary MOC functions and subsystems including: a. Real-time Telemetry and Command (T&C) System b. Mission Planning System (MPS) c. Integrated Trending and Plotting System (ITPS) d. Flight Dynamics System (FDS) e. SDOGS and DDS Monitor and Control Functions f. Alert Notification System (ANS) g. MOC Automation Systems h. MOC Time Display System

	i. Internal File Server (IFS) j. DMZ Product server k. Mini-MOC (located at WSC)
1.5	The contractor shall develop and maintain scripts and procedures as needed to support MOC automation functions.
1.6	The contractor shall support the SSMO configuration management process for ground system software releases, and data products.
1.7	The contractor shall maintain Science Data Accounting tools and processes.
1.8	The contractor shall maintain the MOC 'lights-out' automation software and hardware tools and processes including the ANS paging system, remote access to the MOC DMZ, and maintaining service accounts for mobile two-way text messaging capabilities with internet and/or wireless service providers.
1.9	The contractor shall support acceptance and regression testing of all MOC software patches.
1.10	The contractor shall support the MD in maintaining the GMSEC architecture in the MOC design.
1.11	The contractor shall perform updates, validation, configuration control, and distribution of the SDO Project Database (PDB). Perform the Lead PDB Administrator role for coordinating formal SDO PDB releases.
1.12	The contractor shall maintain the MOC Maintenance Manual.
1.13	The contractor shall provide training of the FOT on MOC system operations as appropriate.
1.14	The contractor shall support the SDO Flight Software Configuration Control Board (CCB), GSFC Code 582, and provide CCR technical review and impact assessments as needed.
1.15	The contractor shall provide general MOC facility support to include running of network and power cables, repair of raised floor tiles, and other basic facility maintenance/repair support.
1.16	The contractor shall perform System Administration (SA) and Configuration Management (CM) duties of the MOC hardware, software, databases, network, mission and other operations data.
1.17	The contractor shall provide Lead System Administrator support of all MOC computer systems, SDOGS XR-1s, HDR's, and the DDS. This effort includes establishing user accounts, performing system backups, performing ground system firewall rule coordination with IP-NOC, installing applications software, and maintaining the required patch level of the operating systems on Linux, Windows, and Mac OSX platforms. The contractor shall recommend specific maintenance contracts with SDOGS hardware vendors when these are analyzed to represent a likely savings over performing all of the work in-house. These recommended maintenance contract purchases shall be presented to the MD and SSMO-staff for final approval prior to purchase.
1.18	The contractor shall install, configure, and maintain MOC hardware including computer systems, servers, RAIDs, KVM switches, network switches and routers, printers, etc.
1.19	The contractor shall maintain all operations products required for Flight Operations including STOL procedures, display pages, stored command load

	templates, and Local Operating Procedures (LOPs) for normal, L&EO, and contingency operations.
1.20	The contractor shall maintain the ASIST database required to monitor and control the SDOGS and DDS systems.
1.21	The contractor shall perform user acceptance and regression testing of the MOC, SDOGS, and DDS systems as needed.
1.22	The contractor shall maintain SDOGS and DDS Local Operating Procedures.
1.23	The contractor shall update and maintain FOT training and certification material as needed.
1.24	The contractor shall operate and maintain all SDO ground systems as required to meet mission objectives. This includes operation of all MOC T&C Systems, MPS, FDS, ITPS, PSS, and ANS subsystems; operation of the two SDO Ground Stations (SDOGS); and operation of the Data Distribution System (DDS) for both normal and contingency operations.
1.25	The contractor shall plan and execute daily operations as per the SDO Flight Operations Plan.
1.26	The contractor shall maintain Configuration Management over all operations products including the T&C Database, Display Page Definitions, STOL Procedures, LOPs, and baseline configuration files for the MOC subsystems.
1.27	The contractor shall document all space and ground segment anomalies and coordinate anomaly resolution with the NASA Mission Director (MD) and AETD Spacecraft Engineers as appropriate.
1.28	The contractor shall provide System Administration of all MOC subsystems including the T&C Systems, MPS, FDS, ITPS, and ANS subsystems.
1.29	The contractor shall provide System Administration of the DDS and support SA of the SDOGS.
1.30	The contractor shall staff the MOC Monday thru Friday from 8:00 AM to 6:00 PM (ET).
1.31	The contractor shall provide on-call FOT support to cover off-hours and weekends.
1.32	The contractor shall generate, uplink, and verify spacecraft commands as needed to carry out the daily operations plan and to maximize science data return.
1.33	The contractor shall monitor and maintain the health and safety of the SDO housekeeping systems.
1.34	The contractor shall detect and respond to observatory anomalies as per approved contingency plans and return the observatory to a state of normal operations in a timely and safe manner.
1.35	The contractor shall compile periodic spacecraft trending reports to include key telemetry for all major spacecraft subsystems and instruments. The contractor shall make note of all instances of limit violations and out of specification behavior. The reports shall be compiled on weekly and quarterly bases. The reports will be reviewed by Project and cognizant AETD personnel.
1.36	The contractor shall identify obsolete or likely to soon become obsolete hardware or software components of the SDO Ground System, including SDO Project GSE, and shall notify the MD of the identified need for replacement of these items in a timely manner.

1.37	The contractor shall work with the MD, FPD and AETD Engineers as appropriate to develop technology refresh plans for identified obsolete hardware or software items, and will support the development and implementation of these technology refresh plans as needed. This includes support for planning the long term evolution, operations and maintenance of the SDOGS, SDO Flight Software Lab, and SDO Science Data Delivery modernization.
1.38	The contractor shall coordinate security audits on a periodic basis of all installed SDO Ground System hardware and facilities, including SOCs.
1.39	The contractor shall maintain applications designed to manage and perform routine IT security tasks such as monitoring of MOC system logs and error/audit reports.
1.40	The contractor shall maintain procedures in accordance with the security plan for managing user accounts, backing up data, and configuring systems.
1.41	The contractor shall ensure that systems are kept up to date with latest security patches in accordance with GSFC Code 400/700 direction.
1.42	The contractor shall ensure the availability and competence of the work force necessary to execute the management and technical activities of this Task Order.
1.43	The contractor shall manage staff allocation to the required tasks specified.
1.44	The contractor shall supply all anticipated personnel training requirements (both dates and costs) and any associated ODC costs anticipated during this period of performance.
1.45	The contractor shall work with the MD, Science Teams, SSMO, FPD and AETD Engineers as appropriate to develop maintenance plans to maintain SDO Project GSE hardware including components of the SDO Flight Software Laboratory, SDO Spacecraft Simulator GSE, and all of the SDOGS GSE at White Sands. The contractor shall provide these plans to the MD for review and concurrence, and to the appropriate hardware custodians for implementation. The contractor shall monitor the implementation and performance of the plans and shall report the status to the MD. The contractor shall advise the MD when GSE units need to be transported to GSFC for servicing by the contractor. The contractor shall work with SSMO to incorporate the SDO Flight Software Laboratory into the SSMO Security Plan and the SSMO vMOCC Network IP Address Space.
1.46	The contractor shall provide support for the effort to test and implement the TaaS trending utility for SDO.
1.47	The contractor shall provide support for the effort to test and implement the NaaS utility for SDO.
1.48	The contractor shall provide support for the effort to test and implement the Dashboard monitoring system for SDO.
1.49	The contractor shall continue work on the topic: "Analysis of Gyroless ACS modes for SDO to Mitigate Potential IRU Failure", and shall document this work in a technical paper. This is a mission critical activity.
1.50	The contractor shall perform all analysis necessary for Flight Dynamics Support of SDO, including monitoring the health and integrity of the ACS and ground FDS system, planning and performing null momentum bias applications and removals, momentum unload maneuvers, station-keeping maneuvers, and eventual spacecraft disposal maneuvers documented in an Baseline End of

	Mission Disposal Maneuver Plan. The contractor shall work with the MD to prototype routine monitoring of the SDOGS Tracking Data with GMAT and subsequently add this function to SDO Ground System Automation.]

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
All computer systems that comprise the MOC subsystems and associated peripheral equipment will be government furnished. This includes all hardware associated with the MOC T&C System, MPS, ITPS, ANS, FDS, IFS, servers, printers, and data storage and backup systems. The contractor shall provide property management of these systems.
All computer systems that comprise the MOC subsystems and associated peripheral equipment will be government furnished. This includes all hardware associated with the MOC T&C System, MPS, ITPS, ANS, FDS, IFS, servers, printers, and data storage and backup systems. The GSMO contractor shall provide property management of these systems.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test (ASIST) (NASA/GSFC Code 583)	GSC-16783-1
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1
Flight Dynamics System Executive (XFDS) (NASA/GSFC Code 583)	GSC-15618-1
Portable Spacecraft Simulator / Linux Scalable Integrated Multi-mission Support System (PSS/LSIMSS) (NASA/GSFC Code 581)	
Mission Planning System (MPS) (NASA/GSFC Code 581)	
Front-End Data System (FEDS)	
SDO DDS (Data Distribution System)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Updates to the ANS per approved Configuration Change Requests. (as needed)
Weekly SDO Operations Status Report. (every Wednesday)
Quarterly Planning Meeting Reports. (on Wednesday following Quarterly)
Real-Time Operations Certifications for FOT New Hires. (as applicable)
Weekly and Quarterly Spacecraft Status Reports Including Subsystem Trending. (Reported Weekly and by One Month after Each Quarter)
Mission Operations CCB. (as needed)
Weekly Operations Planning Meeting. (every Tuesday)
Weekly Science Data Accounting Report. (every Tuesday)
Monthly Science Data Accounting Report. (monthly by the 5th)
Science Operations Activity Report (.sxc file). (monthly by the 5th)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

Task Order Statement of Work (SOW)

Date: April 05, 2019
Task Name: GOES-R Mission Support
Task No. / Mod: 14/5
Task Monitor (TM): Gyanesh Chander
Contract Number: NNG17HP02C
Contract SOW: GSMO-2 SOW Reference: 2.1, 2.2, 2.4, 2.4.10

Deleted: February 6, 2019
Deleted: 3
Deleted: Heather Keller

I. Task Order History:

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	04/28/2018	04/26/2019	Extension of the Period of Performance, minimal change to scope, add in Tech Refresh support.
2	12/10/2018		Admin mod.
3	04/01/2019	03/28/2020	Extension of the Period of Performance, add in Ground Data Systems Support
4	04/02/2019	04/02/2019	Administrative Mod to change the TM
5	05/15/2019	03/28/2020	Adds increased GS-PRO Support

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II. Background:

The National Oceanic and Atmospheric Administration (NOAA) operates a system of Geostationary Operational Environmental Satellites (GOES), providing continuous monitoring from directly above the Earth's equator. GOES satellites provide critical atmospheric, oceanic, climatic and solar products supporting weather forecasting and warnings, climatologic analysis and prediction, ecosystems management, and safe and efficient public and private transportation. The GOES satellites also provide platforms for space environmental observations and communication links for remote data collection, satellite aided search and rescue, and other data services.

The program is a collaborative development and acquisition effort between the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). The GOES-R satellites provide continuous imagery and atmospheric measurements of the Earth's Western Hemisphere and provide space weather monitoring. GOES-R shall be the primary tool for the detection and tracking of hurricanes and severe weather and provide new and improved applications and products for fulfilling NOAA's goals of Water and Weather, Climate, Commerce, and Ecosystem. The GOES-R Program is managed by NOAA with an integrated NOAA-NASA program office organization, staffed with personnel from NOAA and NASA, and supported by industry contractors. The Program is located at NASA's Goddard Space Flight Center. GOES-R series satellite and science data operations are conducted from the NOAA Satellite Operations Facility (NSOF) in Suitland, Maryland; the Wallops Command and Data Acquisition Station (WCDAS) in Wallops, Virginia; the National

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

Climate and Weather Prediction Center (NCWCP) in College Park, Maryland; and the Consolidated Backup (CBU) in Fairmont, West Virginia.

III. Task Overview:

The GOES-R Mission Support task provides Technical and Program Support in the form of identification and resolution of issues as well as preparation of plans, briefings, and documents in the areas of program planning and scheduling, technical services, program advocacy, and capital asset planning and data management services for NOAA/NESDIS Geostationary Operational Environmental Satellite (GOES) R-Series Program. The task also provides support for the GOES- R Ground System Project (GSP) by performing operations and sustainment engineering tasks.

In addition, this task also support the GOES-R Program by providing Product Algorithm and Science Support. The task also supports a technology refresh of the ground segment software and hardware. This work includes the technical and management activities described in this Statement of Work (SOW). Support the GOES-R Ground Segment (GS) Technology and Server Refresh (TR) effort that will analyze both software and hardware tools, standards and COTS, to ensure the hardware and software systems that process and distribute the science data will maintain science mission continuity and where feasible, improve the efficiency and/or cost of science data capture. This shall include data processing and product distribution, address subsystem obsolescence, and optimize ground system sustainment and flight operations. Tech refresh trades and Special Studies shall be co-led by the government. Trades and studies shall include helping to evaluate previous results, support the development of a Tech Refresh support plan and implementation schedule, as well as include identifying potential areas of conflict with GOES-R mission activities.

IV. Statement of Work (SOW):

1	**GOES-R Ground Project Office Support:**
1.1	**Engineering Support**
1.1.1	The contractor shall provide satellite ground system engineering support to the GOES-R Program and GOES-R Series Ground Segment (GS) Project (GSP) on technical management, schedule, architecture assessment, requirements, verification, and validation of the full GOES-R Series GS, including Antenna System, and all GS interfaces.
1.1.2	The contractor shall provide support for interface meetings between the spacecraft, GS and instrument contractors to reduce implementation risk and ensure verification of all system interfaces.
1.1.3	The contractor shall provide technical assistance to risk reduction efforts, including enterprise and communications studies.0
1.1.4	The contractor shall provide general and systems engineering support, including corporate ad hoc “reach-back” capability for special topics as requested.
1.1.5	The contractor shall provide impact analysis for the GOES-R Series Program, Project, and contractor-derived requirements change requests, deviations, and

	waivers. This includes analysis and support for engineering activities relating to Tech Refresh for the GOES-R Series GSP Systems.
1.1.6	The contractor shall provide SE support for engineering process generation, management and coordination including technical support to the Engineering Change Review Board (ECRB).
1.1.7	The contractor shall support the performance monitoring and review of all special studies and analyses.
1.1.8	The contractor shall support the Subject Matter Expert processes including monitoring and reviewing performance, actuals, and estimates needed for future planning.

1.2	**Integration and Test**
1.2.1	The contractor shall provide technical support for the management, analysis, design, integration and test, deployment, operations, and maintenance of GOES-R Series Ground Segment hardware and software.
1.2.2	The contractor shall provide evaluation capability for software quality assurance; support code reviews; conduct software development and process assessments of the development, maintenance and sustainment efforts.

1.3	**IT Security**
1.3.1	The contractor shall provide technical support to the design, implementation, and evaluation of all phases of mission security and information assurance solutions for GOES-R series.
1.3.2	The contractor shall provide technical support for the planning and implementation of NIST FIPS and NOAA IT security policies and requirements.
1.3.3	The contractor shall support planning and execution of Assessment and Authorization work, including activities to achieve and maintain Authority to Operate. Information System Security Officer (ISSO) services shall only be provided by persons who possess and maintain a Department of Commerce-required professional certification, such as Certified Information System Security Professional (CISSP).
1.3.4	The contractor shall provide IT Security support to the MOST and interface with the GS Project Information System Security Officer (ISSO) to assist with technical evaluation and trade-off between security requirements and operational needs.
1.3.5	The contractor shall, when IT incidents or discrepancies are encountered, assess problems, ensure they are properly and safely documented, and evaluate proposed solutions to ensure compliance with the NOAA and Federal IT Security Guidelines. Support the GS Project ISSO in selecting solutions.
1.3.6	The contractor shall monitor the implementation and integration of modifications to the operational GS with a focus on IT security

1.4	**Technical Communications**
1.4.1	The contractor shall provide technical communications support, including meeting facilitation, management briefing development, process improvement, status reporting,

	Work Request (WR) management, Risk management, and other activities identified by Project or Program management.

2	**GOES-R Series Operations Engineering Support:**
2.1	**Ground System and Antenna Sustainment Engineering**
2.1.1	The contractor shall support the GS Project Maintenance, Sustainment and Training (MST) team during various Project meetings, Program meetings, and working group meetings.
2.1.2	The contractor shall support the MST team in the review and finalization of operations and maintenance concepts, scenarios, and procedures as they evolve through the implementation, integration, and verification phases.
2.1.3	The contractor shall support the coordination of efforts between MST and other GOES-R Series groups, including the Mission Operation Support Team (MOST), the Flight Project, the Data Operations Support Team (DOST), the Ground Readiness Team (GRT), the Product Readiness and Operations (PRO) team, and the Antenna team. This requires contributing system engineering input and mission operations knowledge to find solutions to various operational and system sustainability issues.
2.1.4	The contractor shall provide technical review of GS Project documents as applicable to maintenance and sustainment.
2.1.5	The contractor shall support the Work Request Review Board (WRB) process: maintain the WR database, and produce meeting agenda and minutes as required.
2.1.6	The contractor shall support the Delivery Content Review Board (DCRB) process and produce meeting agenda and minutes as required.
2.1.7	The contractor shall support Core Ground System, Antenna System, and operations test planning and execution (e.g., end-to-end tests, mission operations simulations and rehearsals, antenna site acceptance tests), tech refresh analysis & support as required.
2.1.8	The contractor shall support the establishment by NOAA of an Enterprise-level Configuration Management tool useable for GOES-R as well as heritage missions.
2.1.9	The contractor shall support resources scheduling and tracking: monitor hardware and commercial licenses, warranties, life cycle, and replacement approach; manage periodic status reports, maintain resource calendar for maintenance and sustainment activities, installations, and tests.
2.1.10	The contractor shall support the deployment and integration of GOES-R Series subsystem deliveries, including the Enterprise Management (EM) and Infrastructure System (IS) subsystem.
2.1.11	The contractor shall ensure that the EM/IS delivered to the Project is properly functioning and all artifacts necessary for a successful transition to the maintenance phase are provided.
2.1.12	The contractor shall support Communication Network engineering for the GOES-R Series GS, including intra-site, cross-site and external network communications, and interaction with the GOES-R Series IT security specialists to ensure that IT security goals and requirements are met.
2.1.13	The contractor shall support MST for Configuration Management (CM), both on-site at NSOF and at GSFC. Responsibilities include supporting the DOST, GRT and PRO teams in their CM activities, generating weekly WR statistics and metrics for

	reporting to GSP management, and facilitating the weekly Operational Configuration Control Board (OCCB) meeting.
2.1.14	Provide oversight of the tools and processes that enable successful auditing of the Ground Segment. This includes the activities for discovery, configuration management integration, reconciliation and remediation. As needed, oversee the development of modifications of the baseline Enhanced Auditing capability.

2.2	**Operations Support Engineering**
2.2.1	The contractor shall assist the Operations Support Teams (DOST and MOST) by providing WRB, DCRB, OCCB, and Algorithm Review Board (ARB) support, and assisting with integration, test, and check-out for software deliveries.
2.2.2	The contractor shall provide management and technical review of Project documents as applicable to MST activities.
2.2.3	The contractor shall support the Operations Support Teams in the revision and finalization of operations concepts and scenarios as they evolve through the implementation, integration and verification phases.
2.2.4	The contractor shall support the Operations Support Teams activities in mission operations end-to-end tests.
2.2.5	The contractor shall engage when required with key stakeholders including NOAA's customers, International community, the Broadcast user community, the Commercial, Defense, and Academic Sectors related to current and future GOES-R Series products and services.
2.2.6	The contractor shall work when required with the Cal/Val community (including AWG, CWG) to ensure successful deployment of current and future GOES-R Series products.
2.2.7	The contractor shall provide technical support for the planning and transition to operations of the GOES-R Series GS, including training, documentation, and process development. Support the development and implementation of data and mission operations products.
2.2.8	The contractor shall prepare artifacts and materials to support multiple system readiness reviews leading to launch and post-launch acceptance reviews.
2.2.9	The contractor shall work with Flight Project, GS Project, Program, government technical support teams, and development contractor teams to ensure that end user needs are met by the GOES-R system.
2.2.10	The contractor shall provide technical support to the design, implementation, and evaluation of all phases of mission solutions for the GOES-R Series missions.

2.3	**Antenna RF Engineering**
2.3.1	The contractor shall support radio frequency (RF) analysis in implementing a spacecraft-to-ground communications design that satisfies the RF requirements and end-users needs. Conduct RF link analyses and RF interference analyses, assist in the RF National Telecommunications and Information Administration (NTIA) and

	International Telecommunications Union (ITU) filings, perform RF tradeoff analyses, and perform miscellaneous RF studies.
2.3.2	The contractor shall support investigation and resolution of technical problems encountered with the antenna stations.

2.4	**Project Support**
2.4.1	The contractor shall provide support in the generation of technical presentation packages and follow up on any Requests for Action as required; GOES-R Series reviews to be supported include but are not limited to Mission Operations Reviews and Operations Readiness Reviews.

3	**GOES-R Ground Data System Science Support:**
3.1	**GOES-R Product Readiness and Operations (PRO) Support:**
3.1.1	Work closely with the DE Manager to ensure that all activities are coordinated on the DE
3.1.2	Support CM activities on the DE
3.1.3	Support Integration Test & Check Out (ITCO) Activities relating to L1 and L2+ algorithms
3.1.4	Support the Engineering Release build schedule
3.1.5	Work closely with Algorithm Working Group (AWG)/Calibration Working Group (CWG), National Weather Service (NWS) and NOAA Office of Satellite & Product Operations (OSPO) Product Area Leads (PALs) to ensure algorithm quality and implementation issues are identified
3.1.6	Provide data from the ground system data stores to the Cal/Val teams for analysis when requested
3.1.7	Work with PRO Members to ensure that algorithm updates, Look Up Table (LUT) changes and new algorithms are implemented on the system
3.1.8	Support the Work Request (WR) Checkout process relating to algorithm quality issues. This support will not in any way involve performance assessment of Harris or any of their other subcontractors as it regards work performed under Engineering Services for the *Geostationary Operational Environmental Satellites-R (GOES-R) Series for the Ground Segment* Program under Prime Contract DG133E09CN0094
3.1.9	Support the PRO tool manager to ensure tools on the ground system are inventoried and assist with updating the tools as necessary
3.1.10	Support the Algorithm Action Review Team (AART), and Algorithm Review Board (ARB) activities
3.1.11	Lead root cause analysis activities when issues are identified at the AART.
3.1.12	Support validation of the GOES-R Series implementation across the NWS user community
3.1.13	Support integration of WR management activities across the Ground and Flight projects, including science instrument vendor coordination. Synchronizes instruments and science data processing system as corrections and enhancements are applied and verified.

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3.2	**Science Product Maturity:**
3.2.1	The contractor shall provide increased support to the PRO Team, particularly in support of the Product Quality Sub-Team
3.2.2	Work closely with PSE and the GOES-R Flight Project instrument managers and PLT manager to stay abreast of schedule activities and instrument maturity issues which relate to science product readiness and validation maturity
3.2.3	Facilitate Peer Stakeholder – Product Validation Reviews (PS-PVRs) for all validation maturities of each instrument
3.2.4	Generate and maintain Readiness and Implementation Management Plans (RIMPs) for the entire L1b and L2+ product science portfolio from all instruments

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3.3	**User Readiness Coordination:**
3.3.1	Support the development, coordination and delivery of GOES-R training courses. Work with GOES-R and OSPO SMEs to accumulate and present training content on GOES-R ground segment product generation and distribution.
3.3.2	Support the GOES-R Ground Segment Product Readiness & Operations Team's GOES-R User Services Coordinator in assembling training packages and conducting training sessions
3.3.3	Coordinate with GOES-R Handover and Transition working groups to ensure post-launch operations training is progressing and on track with margin to complete readiness.
3.3.4	Provide training forecasts, periodic tracking, and accomplishment summary metrics.
3.3.5	Perform assessment of existing training materials and provide suggested improvements, module creation, and target audience analysis.

3.4	**Science Community Support**
3.4.1	The contractor shall support coordination efforts with the science community (e.g. CWG/AWG, OSPO, NWS, PDA, CLASS) regarding first public image release, data distribution schedules, and system configuration tests which impact data availability.

3.5	**GOES-17 ABI Loop Heat Pipe Anomaly Resolution**
3.5.1	The contractor shall support algorithm integration, promotion, and sustainment activities associated with the ABI L2+ SCH mitigations to the same degree as the existing baseline ABI L2+ algorithms stated previously. The mitigations include logic to ingest temperature driven data quality flags, channel swapping, and integration of new enterprise algorithms with improved flexibility of channel swapping and tolerance of varied saturation.

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

V. Period Of Performance:

The period during which the work for this task shall be performed is from task award, May 15, 2019 thru March 31, 2020.

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VI. Task Deliverables:

All deliverables shall be accepted by the Task Monitor, or his representative. If the deliverable is deemed unacceptable or incomplete, the task monitor will state the reason and the deliverable shall be corrected by the contractor and resubmitted for acceptance. At a minimum, the contractor shall deliver the items specified below

Deliverable Item/Milestone	Deliverable Due
Monthly Progress & Financial Reports	Monthly, by the 15th
Informal Bi-weekly Progress Reports	Bi-weekly by e-mail
Summary Schedules of Task Activities	Monthly, by the 15th
Technical and Managerial Meeting Minutes, Reports, Presentations, and Project Reviews, Document review reports	As required by the Project – NLT 15 days after event
Engineering Analysis Reports	As required by the Project – NLT 15 days after event
Financial and Budget Planning Estimates for Technical Areas of Effort	As required by the Project – NLT 15 days after event
Configuration Change Request (CCR) Materials	As required by the Project
Configuration Management Change Reports	As required by the Project
Final Task Report	Within 15 days of task end date

VII. Travel Required:

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

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VIII. Applicable Documents:

In the performance of this task, the contractor shall comply with the following documents:

- NPR 7150.2A: NASA Software Engineering Requirements
- GPR 7150: Goddard Software Engineering Requirements
- NPR 7123: NASA System Engineering standards

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

Task Order Statement of Work (SOW)

Task Name: GOES-R Mission Support
Task No. / Mod: 14/6
Task Monitor (TM): Gyanesh Chander
Contract Number: NNG17HP02C
Contract SOW: GSMO-2 SOW Reference: 2.1, 2.2, 2.4, 2.4.10

I. Task Order History:

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	04/28/2018	04/26/2019	Extension of the Period of Performance, minimal change to scope, add in Tech Refresh support.
2	12/10/2018		Admin mod.
3	04/01/2019	03/28/2020	Extension of the Period of Performance, add in Ground Data Systems Support
4	04/02/2019	04/02/2019	Administrative Mod to change the TM
5	05/15/2019	03/28/2020	Adds increased GS-PRO Support
6	07/01/2019	03/28/2020	Add GOES-R Cloud SME Support

II. Background:

The National Oceanic and Atmospheric Administration (NOAA) operates a system of Geostationary Operational Environmental Satellites (GOES), providing continuous monitoring from directly above the Earth's equator. GOES satellites provide critical atmospheric, oceanic, climatic and solar products supporting weather forecasting and warnings, climatologic analysis and prediction, ecosystems management, and safe and efficient public and private transportation. The GOES satellites also provide platforms for space environmental observations and communication links for remote data collection, satellite aided search and rescue, and other data services.

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IV. Statement of Work (SOW):

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	waivers. This includes analysis and support for engineering activities relating to Tech Refresh for the GOES-R Series GSP Systems.
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1.1.7	The contractor shall support the performance monitoring and review of all special studies and analyses.
1.1.8	The contractor shall support the Subject Matter Expert processes including monitoring and reviewing performance, actuals, and estimates needed for future planning.

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1.2.2	The contractor shall provide evaluation capability for software quality assurance; support code reviews; conduct software development and process assessments of the development, maintenance and sustainment efforts.

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1.3.4	The contractor shall provide IT Security support to the MOST and interface with the GS Project Information System Security Officer (ISSO) to assist with technical evaluation and trade-off between security requirements and operational needs.
1.3.5	The contractor shall, when IT incidents or discrepancies are encountered, assess problems, ensure they are properly and safely documented, and evaluate proposed solutions to ensure compliance with the NOAA and Federal IT Security Guidelines. Support the GS Project ISSO in selecting solutions.
1.3.6	The contractor shall monitor the implementation and integration of modifications to the operational GS with a focus on IT security

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2.1.11	The contractor shall ensure that the EM/IS delivered to the Project is properly functioning and all artifacts necessary for a successful transition to the maintenance phase are provided.
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2.1.13	The contractor shall support MST for Configuration Management (CM), both on-site at NSOF and at GSFC. Responsibilities include supporting the DOST, GRT and PRO teams in their CM activities, generating weekly WR statistics and metrics for

	reporting to GSP management, and facilitating the weekly Operational Configuration Control Board (OCCB) meeting.
2.1.14	The contractor shall provide oversight of the tools and processes that enable successful auditing of the Ground Segment. This includes the activities for discovery, configuration management integration, reconciliation and remediation. As needed, oversee the development of modifications of the baseline Enhanced Auditing capability.

2.2	**Operations Support Engineering**
2.2.1	The contractor shall assist the Operations Support Teams (DOST and MOST) by providing WRB, DCRB, OCCB, and Algorithm Review Board (ARB) support, and assisting with integration, test, and check-out for software deliveries.
2.2.2	The contractor shall provide management and technical review of Project documents as applicable to MST activities.
2.2.3	The contractor shall support the Operations Support Teams in the revision and finalization of operations concepts and scenarios as they evolve through the implementation, integration and verification phases.
2.2.4	The contractor shall support the Operations Support Teams activities in mission operations end-to-end tests.
2.2.5	The contractor shall engage when required with key stakeholders including NOAA's customers, International community, the Broadcast user community, the Commercial, Defense, and Academic Sectors related to current and future GOES-R Series products and services.
2.2.6	The contractor shall work when required with the Cal/Val community (including AWG, CWG) to ensure successful deployment of current and future GOES-R Series products.
2.2.7	The contractor shall provide technical support for the planning and transition to operations of the GOES-R Series GS, including training, documentation, and process development. Support the development and implementation of data and mission operations products.
2.2.8	The contractor shall prepare artifacts and materials to support multiple system readiness reviews leading to launch and post-launch acceptance reviews.
2.2.9	The contractor shall work with Flight Project, GS Project, Program, government technical support teams, and development contractor teams to ensure that end user needs are met by the GOES-R system.
2.2.10	The contractor shall provide technical support to the design, implementation, and evaluation of all phases of mission solutions for the GOES-R Series missions.

2.3	**Antenna RF Engineering**
2.3.1	The contractor shall support radio frequency (RF) analysis in implementing a spacecraft-to-ground communications design that satisfies the RF requirements and end-users needs. Conduct RF link analyses and RF interference analyses, assist in the RF National Telecommunications and Information Administration (NTIA) and

	International Telecommunications Union (ITU) filings, perform RF tradeoff analyses, and perform miscellaneous RF studies.
2.3.2	The contractor shall support investigation and resolution of technical problems encountered with the antenna stations.

2.4	**Project Support**
2.4.1	The contractor shall provide support in the generation of technical presentation packages and follow up on any Requests for Action as required; GOES-R Series reviews to be supported include but are not limited to Mission Operations Reviews and Operations Readiness Reviews.

3	**GOES-R Ground Data System Science Support:**
3.1	**GOES-R Product Readiness and Operations (PRO) Support:**
3.1.1	The contractor shall work closely with the DE Manager to ensure that all activities are coordinated on the DE
3.1.2	The contractor shall support CM activities on the DE
3.1.3	The contractor shall support Integration Test & Check Out (ITCO) Activities relating to L1 and L2+ algorithms
3.1.4	The contractor shall support the Engineering Release build schedule
3.1.5	The contractor shall work closely with Algorithm Working Group (AWG)/Calibration Working Group (CWG), National Weather Service (NWS) and NOAA Office of Satellite & Product Operations (OSPO) Product Area Leads (PALs) to ensure algorithm quality and implementation issues are identified
3.1.6	The contractor shall provide data from the ground system data stores to the Cal/Val teams for analysis when requested
3.1.7	The contractor shall work with PRO Members to ensure that algorithm updates, Look Up Table (LUT) changes and new algorithms are implemented on the system
3.1.8	The contractor shall support the Work Request (WR) Checkout process relating to algorithm quality issues. This support will not in any way involve performance assessment of Harris or any of their other subcontractors as it regards work performed under Engineering Services for the *Geostationary Operational Environmental Satellites-R (GOES-R) Series for the Ground Segment* Program under Prime Contract DG133E09CN0094
3.1.9	The contractor shall support the PRO tool manager to ensure tools on the ground system are inventoried and assist with updating the tools as necessary
3.1.10	The contractor shall support the Algorithm Action Review Team (AART), and Algorithm Review Board (ARB) activities
3.1.11	The contractor shall lead root cause analysis activities when issues are identified at the AART.
3.1.12	The contractor shall support validation of the GOES-R Series implementation across the NWS user community
3.1.13	The contractor shall support integration of WR management activities across the Ground and Flight projects, including science instrument vendor coordination.

	Synchronizes instruments and science data processing system as corrections and enhancements are applied and verified.

3.2	**Science Product Maturity:**
3.2.1	The contractor shall provide increased support to the PRO Team, particularly in support of the Product Quality Sub-Team
3.2.2	The contractor shall work closely with PSE and the GOES-R Flight Project instrument managers and PLT manager to stay abreast of schedule activities and instrument maturity issues which relate to science product readiness and validation maturity
3.2.3	The contractor shall facilitate Peer Stakeholder – Product Validation Reviews (PS-PVRs) for all validation maturities of each instrument
3.2.4	The contractor shall generate and maintain Readiness and Implementation Management Plans (RIMPs) for the entire L1b and L2+ product science portfolio from all instruments

3.3	**User Readiness Coordination:**
3.3.1	The contractor shall support the development, coordination and delivery of GOES-R training courses. Work with GOES-R and OSPO SMEs to accumulate and present training content on GOES-R ground segment product generation and distribution.
3.3.2	The contractor shall support the GOES-R Ground Segment Product Readiness & Operations Team's GOES-R User Services Coordinator in assembling training packages and conducting training sessions
3.3.3	The contractor shall coordinate with GOES-R Handover and Transition working groups to ensure post-launch operations training is progressing and on track with margin to complete readiness.
3.3.4	The contractor shall provide training forecasts, periodic tracking, and accomplishment summary metrics.
3.3.5	The contractor shall perform assessment of existing training materials and provide suggested improvements, module creation, and target audience analysis.

3.4	**Science Community Support**
3.4.1	The contractor shall support coordination efforts with the science community (e.g. CWG/AWG, OSPO, NWS, PDA, CLASS) regarding first public image release, data distribution schedules, and system configuration tests which impact data availability.

3.5	**GOES-17 ABI Loop Heat Pipe Anomaly Resolution**
3.5.1	The contractor shall support algorithm integration, promotion, and sustainment activities associated with the ABI L2+ SCH mitigations to the same degree as the existing baseline ABI L2+ algorithms stated previously. The mitigations include logic to ingest temperature driven data quality flags, channel swapping, and

	integration of new enterprise algorithms with improved flexibility of channel swapping and tolerance of varied saturation.

4	**GOES-R Cloud Ground System Support**
4.1	**GOES-R Cloud SME Support**
4.1.1	The contractor shall document and provide high level diagrams of the NESDIS Common Cloud Framework based on the work of both the NESDIS Cloud Integrated Project Team (IPT) and Industry and Government Best Practices. Initially this will be for the inclusion of the Himawari 8 mission, but will be extensible to other satellite missions and datasets.
4.1.2	The contractor shall provide full life cycle cost estimation for operating the cloud framework (described in Section 4.1.1) within NESDIS. Initially this will be for the inclusion of the Himawari 8 mission, but will be extensible to other satellite missions and datasets.
4.1.3	The contractor shall perform an Analysis of Alternatives comparing the cloud framework (described in Section 4.1.1) to the on-premises systems of today. Initially this will be for the inclusion of the Himawari 8 mission, but will be extensible to other satellite missions and datasets.
4.1.4	The contractor shall provide cloud security expertise and guidance for operating the framework (described in Section 4.1.1) in a FedRAMP environment. Initially this will be for inclusion of the Himawari-8 mission, but will be extensible to satellite missions and datasets.

V. Period Of Performance:

The period during which the work for this task shall be performed is from task award, May 15, 2019 thru March 31, 2020**.**

VI. Task Deliverables:

All deliverables shall be accepted by the Task Monitor, or his representative. If the deliverable is deemed unacceptable or incomplete, the task monitor will state the reason and the deliverable shall be corrected by the contractor and resubmitted for acceptance. At a minimum, the contractor shall deliver the items specified below

Deliverable Item/Milestone	Deliverable Due
Monthly Progress & Financial Reports	Monthly, by the 15th
Informal Bi-weekly Progress Reports	Bi-weekly by e-mail
Summary Schedules of Task Activities	Monthly, by the 15th
Technical and Managerial Meeting Minutes, Reports, Presentations, and Project Reviews, Document review reports	As required by the Project – NLT 15 days after event
Engineering Analysis Reports	As required by the Project – NLT 15

	days after event
Financial and Budget Planning Estimates for Technical Areas of Effort	As required by the Project – NLT 15 days after event
Configuration Change Request (CCR) Materials	As required by the Project
Configuration Management Change Reports	As required by the Project
Final Task Report	Within 15 days of task end date

VII. Travel Required:

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]
[redacted]

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VIII. Applicable Documents:

In the performance of this task, the contractor shall comply with the following documents:

- NPR 7150.2A: NASA Software Engineering Requirements
- GPR 7150: Goddard Software Engineering Requirements
- NPR 7123: NASA System Engineering standards

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

Task Order Statement of Work (SOW)

Task Name: GOES-R Mission Support
Task No. / Mod: 14/7
Task Monitor (TM): Gyanesh Chander
Contract Number: NNG17HP02C
Contract SOW: GSMO-2 SOW Reference: 2.1, 2.2, 2.4, 2.4.10

I. Task Order History:

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	04/28/2018	04/26/2019	Extension of the Period of Performance, minimal change to scope, add in Tech Refresh support.
2	12/10/2018		Admin mod.
3	04/01/2019	03/28/2020	Extension of the Period of Performance, add in Ground Data Systems Support
4	04/02/2019	04/02/2019	Administrative Mod to change the TM
5	05/15/2019	03/28/2020	Adds increased GS-PRO Support
6	07/01/2019	03/28/2020	Add GOES-R Cloud SME Support
7	10/11/2019	03/28/2020	Add GOES-R MOST/GRT Support

II. Background:

The National Oceanic and Atmospheric Administration (NOAA) operates a system of Geostationary Operational Environmental Satellites (GOES), providing continuous monitoring from directly above the Earth's equator. GOES satellites provide critical atmospheric, oceanic, climatic and solar products supporting weather forecasting and warnings, climatologic analysis and prediction, ecosystems management, and safe and efficient public and private transportation. The GOES satellites also provide platforms for space environmental observations and communication links for remote data collection, satellite aided search and rescue, and other data services.

The program is a collaborative development and acquisition effort between the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). The GOES-R satellites provide continuous imagery and atmospheric measurements of the Earth's Western Hemisphere and provide space weather monitoring. GOES-R shall be the primary tool for the detection and tracking of hurricanes and severe weather and provide new and improved applications and products for fulfilling NOAA's goals of Water and Weather, Climate, Commerce, and Ecosystem. The GOES-R Program is managed by NOAA with an integrated NOAA-NASA program office organization, staffed with personnel from NOAA and NASA, and supported by industry contractors. The Program is located at NASA's Goddard Space Flight Center. GOES-R series satellite and science data operations are conducted from the NOAA Satellite Operations Facility (NSOF) in Suitland, Maryland; the Wallops Command and Data Acquisition Station (WCDAS) in Wallops, Virginia; the National

Climate and Weather Prediction Center (NCWCP) in College Park, Maryland; and the Consolidated Backup (CBU) in Fairmont, West Virginia.

III. Task Overview:

The GOES-R Mission Support task provides Technical and Program Support in the form of identification and resolution of issues as well as preparation of plans, briefings, and documents in the areas of program planning and scheduling, technical services, program advocacy, and capital asset planning and data management services for NOAA/NESDIS Geostationary Operational Environmental Satellite (GOES) R-Series Program. The task also provides support for the GOES- R Ground System Project (GSP) by performing operations and sustainment engineering tasks.

In addition, this task also support the GOES-R Program by providing Product Algorithm and Science Support. The task also supports a technology refresh of the ground segment software and hardware. This work includes the technical and management activities described in this Statement of Work (SOW). Support the GOES-R Ground Segment (GS) Technology and Server Refresh (TR) effort that will analyze both software and hardware tools, standards and COTS, to ensure the hardware and software systems that process and distribute the science data will maintain science mission continuity and where feasible, improve the efficiency and/or cost of science data capture. This shall include data processing and product distribution, address subsystem obsolescence, and optimize ground system sustainment and flight operations. Tech refresh trades and Special Studies shall be co-led by the government. Trades and studies shall include helping to evaluate previous results, support the development of a Tech Refresh support plan and implementation schedule, as well as include identifying potential areas of conflict with GOES-R mission activities.

IV. Statement of Work (SOW):

1	**GOES-R Ground Project Office Support:**
1.1	**Engineering Support**
1.1.1	The contractor shall provide satellite ground system engineering support to the GOES-R Program and GOES-R Series Ground Segment (GS) Project (GSP) on technical management, schedule, architecture assessment, requirements, verification, and validation of the full GOES-R Series GS, including Antenna System, and all GS interfaces.
1.1.2	The contractor shall provide support for interface meetings between the spacecraft, GS and instrument contractors to reduce implementation risk and ensure verification of all system interfaces.
1.1.3	The contractor shall provide technical assistance to risk reduction efforts, including enterprise and communications studies.0
1.1.4	The contractor shall provide general and systems engineering support, including corporate ad hoc “reach-back” capability for special topics as requested.
1.1.5	The contractor shall provide impact analysis for the GOES-R Series Program, Project, and contractor-derived requirements change requests, deviations, and

	waivers. This includes analysis and support for engineering activities relating to Tech Refresh for the GOES-R Series GSP Systems.
1.1.6	The contractor shall provide SE support for engineering process generation, management and coordination including technical support to the Engineering Change Review Board (ECRB).
1.1.7	The contractor shall support the performance monitoring and review of all special studies and analyses.
1.1.8	The contractor shall support the Subject Matter Expert processes including monitoring and reviewing performance, actuals, and estimates needed for future planning.

1.2	**Integration and Test**
1.2.1	The contractor shall provide technical support for the management, analysis, design, integration and test, deployment, operations, and maintenance of GOES-R Series Ground Segment hardware and software.
1.2.2	The contractor shall provide evaluation capability for software quality assurance; support code reviews; conduct software development and process assessments of the development, maintenance and sustainment efforts.

1.3	**IT Security**
1.3.1	The contractor shall provide technical support to the design, implementation, and evaluation of all phases of mission security and information assurance solutions for GOES-R series.
1.3.2	The contractor shall provide technical support for the planning and implementation of NIST FIPS and NOAA IT security policies and requirements.
1.3.3	The contractor shall support planning and execution of Assessment and Authorization work, including activities to achieve and maintain Authority to Operate. Information System Security Officer (ISSO) services shall only be provided by persons who possess and maintain a Department of Commerce-required professional certification, such as Certified Information System Security Professional (CISSP).
1.3.4	The contractor shall provide IT Security support to the MOST and interface with the GS Project Information System Security Officer (ISSO) to assist with technical evaluation and trade-off between security requirements and operational needs.
1.3.5	The contractor shall, when IT incidents or discrepancies are encountered, assess problems, ensure they are properly and safely documented, and evaluate proposed solutions to ensure compliance with the NOAA and Federal IT Security Guidelines. Support the GS Project ISSO in selecting solutions.
1.3.6	The contractor shall monitor the implementation and integration of modifications to the operational GS with a focus on IT security

1.4	**Technical Communications**
1.4.1	The contractor shall provide technical communications support, including meeting facilitation, management briefing development, process improvement, status reporting,

	Work Request (WR) management, Risk management, and other activities identified by Project or Program management.

2	**GOES-R Series Operations Engineering Support:**
2.1	**Ground System and Antenna Sustainment Engineering**
2.1.1	The contractor shall support the GS Project Maintenance, Sustainment and Training (MST) team during various Project meetings, Program meetings, and working group meetings.
2.1.2	The contractor shall support the MST team in the review and finalization of operations and maintenance concepts, scenarios, and procedures as they evolve through the implementation, integration, and verification phases.
2.1.3	The contractor shall support the coordination of efforts between MST and other GOES-R Series groups, including the Mission Operation Support Team (MOST), the Flight Project, the Data Operations Support Team (DOST), the Ground Readiness Team (GRT), the Product Readiness and Operations (PRO) team, and the Antenna team. This requires contributing system engineering input and mission operations knowledge to find solutions to various operational and system sustainability issues.
2.1.4	The contractor shall provide technical review of GS Project documents as applicable to maintenance and sustainment.
2.1.5	The contractor shall support the Work Request Review Board (WRB) process: maintain the WR database, and produce meeting agenda and minutes as required.
2.1.6	The contractor shall support the Delivery Content Review Board (DCRB) process and produce meeting agenda and minutes as required.
2.1.7	The contractor shall support Core Ground System, Antenna System, and operations test planning and execution (e.g., end-to-end tests, mission operations simulations and rehearsals, antenna site acceptance tests), tech refresh analysis & support as required.
2.1.8	The contractor shall support the establishment by NOAA of an Enterprise-level Configuration Management tool useable for GOES-R as well as heritage missions.
2.1.9	The contractor shall support resources scheduling and tracking: monitor hardware and commercial licenses, warranties, life cycle, and replacement approach; manage periodic status reports, maintain resource calendar for maintenance and sustainment activities, installations, and tests.
2.1.10	The contractor shall support the deployment and integration of GOES-R Series subsystem deliveries, including the Enterprise Management (EM) and Infrastructure System (IS) subsystem.
2.1.11	The contractor shall ensure that the EM/IS delivered to the Project is properly functioning and all artifacts necessary for a successful transition to the maintenance phase are provided.
2.1.12	The contractor shall support Communication Network engineering for the GOES-R Series GS, including intra-site, cross-site and external network communications, and interaction with the GOES-R Series IT security specialists to ensure that IT security goals and requirements are met.
2.1.13	The contractor shall support MST for Configuration Management (CM), both on-site at NSOF and at GSFC. Responsibilities include supporting the DOST, GRT and PRO teams in their CM activities, generating weekly WR statistics and metrics for

	reporting to GSP management, and facilitating the weekly Operational Configuration Control Board (OCCB) meeting.
2.1.14	The contractor shall provide oversight of the tools and processes that enable successful auditing of the Ground Segment. This includes the activities for discovery, configuration management integration, reconciliation and remediation. As needed, oversee the development of modifications of the baseline Enhanced Auditing capability.

2.2	**Operations Support Engineering**
2.2.1	The contractor shall assist the Operations Support Teams (DOST and MOST) by providing WRB, DCRB, OCCB, and Algorithm Review Board (ARB) support, and assisting with integration, test, and check-out for software deliveries.
2.2.2	The contractor shall provide management and technical review of Project documents as applicable to MST activities.
2.2.3	The contractor shall support the Operations Support Teams in the revision and finalization of operations concepts and scenarios as they evolve through the implementation, integration and verification phases.
2.2.4	The contractor shall support the Operations Support Teams activities in mission operations end-to-end tests.
2.2.5	The contractor shall engage when required with key stakeholders including NOAA's customers, International community, the Broadcast user community, the Commercial, Defense, and Academic Sectors related to current and future GOES-R Series products and services.
2.2.6	The contractor shall work when required with the Cal/Val community (including AWG, CWG) to ensure successful deployment of current and future GOES-R Series products.
2.2.7	The contractor shall provide technical support for the planning and transition to operations of the GOES-R Series GS, including training, documentation, and process development. Support the development and implementation of data and mission operations products.
2.2.8	The contractor shall prepare artifacts and materials to support multiple system readiness reviews leading to launch and post-launch acceptance reviews.
2.2.9	The contractor shall work with Flight Project, GS Project, Program, government technical support teams, and development contractor teams to ensure that end user needs are met by the GOES-R system.
2.2.10	The contractor shall provide technical support to the design, implementation, and evaluation of all phases of mission solutions for the GOES-R Series missions.

2.3	**Antenna RF Engineering**
2.3.1	The contractor shall support radio frequency (RF) analysis in implementing a spacecraft-to-ground communications design that satisfies the RF requirements and end-users needs. Conduct RF link analyses and RF interference analyses, assist in the RF National Telecommunications and Information Administration (NTIA) and

	International Telecommunications Union (ITU) filings, perform RF tradeoff analyses, and perform miscellaneous RF studies.
2.3.2	The contractor shall support investigation and resolution of technical problems encountered with the antenna stations.

2.4	**Project Support**
2.4.1	The contractor shall provide support in the generation of technical presentation packages and follow up on any Requests for Action as required; GOES-R Series reviews to be supported include but are not limited to Mission Operations Reviews and Operations Readiness Reviews.

3	**GOES-R Ground Data System Science Support:**
3.1	**GOES-R Product Readiness and Operations (PRO) Support:**
3.1.1	The contractor shall work closely with the DE Manager to ensure that all activities are coordinated on the DE
3.1.2	The contractor shall support CM activities on the DE
3.1.3	The contractor shall support Integration Test & Check Out (ITCO) Activities relating to L1 and L2+ algorithms
3.1.4	The contractor shall support the Engineering Release build schedule
3.1.5	The contractor shall work closely with Algorithm Working Group (AWG)/Calibration Working Group (CWG), National Weather Service (NWS) and NOAA Office of Satellite & Product Operations (OSPO) Product Area Leads (PALs) to ensure algorithm quality and implementation issues are identified
3.1.6	The contractor shall provide data from the ground system data stores to the Cal/Val teams for analysis when requested
3.1.7	The contractor shall work with PRO Members to ensure that algorithm updates, Look Up Table (LUT) changes and new algorithms are implemented on the system
3.1.8	The contractor shall support the Work Request (WR) Checkout process relating to algorithm quality issues. This support will not in any way involve performance assessment of Harris or any of their other subcontractors as it regards work performed under Engineering Services for the *Geostationary Operational Environmental Satellites-R (GOES-R) Series for the Ground Segment* Program under Prime Contract DG133E09CN0094
3.1.9	The contractor shall support the PRO tool manager to ensure tools on the ground system are inventoried and assist with updating the tools as necessary
3.1.10	The contractor shall support the Algorithm Action Review Team (AART), and Algorithm Review Board (ARB) activities
3.1.11	The contractor shall lead root cause analysis activities when issues are identified at the AART.
3.1.12	The contractor shall support validation of the GOES-R Series implementation across the NWS user community
3.1.13	The contractor shall support integration of WR management activities across the Ground and Flight projects, including science instrument vendor coordination.

	Synchronizes instruments and science data processing system as corrections and enhancements are applied and verified.

3.2	**Science Product Maturity:**
3.2.1	The contractor shall provide increased support to the PRO Team, particularly in support of the Product Quality Sub-Team
3.2.2	The contractor shall work closely with PSE and the GOES-R Flight Project instrument managers and PLT manager to stay abreast of schedule activities and instrument maturity issues which relate to science product readiness and validation maturity
3.2.3	The contractor shall facilitate Peer Stakeholder – Product Validation Reviews (PS-PVRs) for all validation maturities of each instrument
3.2.4	The contractor shall generate and maintain Readiness and Implementation Management Plans (RIMPs) for the entire L1b and L2+ product science portfolio from all instruments

3.3	**User Readiness Coordination:**
3.3.1	The contractor shall support the development, coordination and delivery of GOES-R training courses. Work with GOES-R and OSPO SMEs to accumulate and present training content on GOES-R ground segment product generation and distribution.
3.3.2	The contractor shall support the GOES-R Ground Segment Product Readiness & Operations Team's GOES-R User Services Coordinator in assembling training packages and conducting training sessions
3.3.3	The contractor shall coordinate with GOES-R Handover and Transition working groups to ensure post-launch operations training is progressing and on track with margin to complete readiness.
3.3.4	The contractor shall provide training forecasts, periodic tracking, and accomplishment summary metrics.
3.3.5	The contractor shall perform assessment of existing training materials and provide suggested improvements, module creation, and target audience analysis.

3.4	**TOWR-S Risk Reduction for NWS**
3.4.1	The contractor shall provide staffing of the NWS Total Operational Weather Readiness for Satellites (TOWR-S) Team embedded with NWS staff in Silver Spring, MD.
3.4.2	The contractor shall enable risk reduction of NWS with software support, engineering design, and customer interaction to achieve NWS readiness for data ingest, distribution, and integration; as well as exploitation of GOES-R product and service capabilities.

3.5	**Science Community Support**
3.5.1	The contractor shall support coordination efforts with the science community (e.g. CWG/AWG, OSPO, NWS, PDA, CLASS) regarding first public image release, data

	distribution schedules, and system configuration tests which impact data availability.

3.6	**GOES-17 ABI Loop Heat Pipe Anomaly Resolution**
3.6.1	The contractor shall support algorithm integration, promotion, and sustainment activities associated with the ABI L2+ SCH mitigations to the same degree as the existing baseline ABI L2+ algorithms stated previously. The mitigations include logic to ingest temperature driven data quality flags, channel swapping, and integration of new enterprise algorithms with improved flexibility of channel swapping and tolerance of varied saturation.

4	**GOES-R Cloud Ground System Support**
4.1	**GOES-R Cloud SME Support**
4.1.1	The contractor shall document and provide high level diagrams of the NESDIS Common Cloud Framework based on the work of both the NESDIS Cloud Integrated Project Team (IPT) and Industry and Government Best Practices. Initially this will be for the inclusion of the Himawari 8 mission, but will be extensible to other satellite missions and datasets.
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4.1.4	The contractor shall provide cloud security expertise and guidance for operating the framework (described in Section 4.1.1) in a FedRAMP environment. Initially this will be for inclusion of the Himawari-8 mission, but will be extensible to satellite missions and datasets.

5	**GOES-R Ground Readiness Team (GRT) Support**
5.1	**GOES-R GRT Support**
5.1.1	The contractor shall provide overall ground operations management and staffing for the ongoing operations of the GOES-16/17 satellite as well as the GOES-T/U mission. The GRT will reside primarily at the NSOF in Suitland Maryland and GSFC to provide operations and launch support to the GSP and Flight project. The GRT will be responsible for coordinating activities with the mission operations and communicate any issues to the GSP/Flight.
5.1.2	The contractor shall manage and provide leadership for GRT, Ground Readiness Manager (GRM) and Deputy GRM, Mission Operations Support Team (MOST) Lead Ground systems engineer, Integration Test and Checkout (ITCO) leads. Lead engineering support for MOST and Data Operations Support Team (DOST) teams.

5.1.3	The contractor shall participate in and provide oversite and review of ground system architectural and system changes. The contractor shall assure changes are understood and in line with mission operational concepts, support the mission need. The contractor shall assure training and documentation is updated as needed.
5.1.4	The contractor shall coordinate and support ground pre-launch testing and preparation. This would include but not be limited to support for Mission Rehearsals, Ground Readiness Exercises, Data Operations Exercises, Operational Readiness Checkout activities, and End to End tests.
5.1.5	The contractor shall lead ground systems anomaly and resolution efforts. The contractor shall coordinate anomaly teams, document steps, prioritize troubleshooting steps, coordinate ground resources and tasking to assure rapid resolution and minimize operational impact.
5.1.6	The contractor shall manage the ground systems Operational Configuration Control Board (OCCB). The contractor shall serve as chair for ground Operational Configuration Change Request (OCCR) Board OCCR approval, run weekly meetings, report issues as needed to program management. The contractor shall assure program Configuration Management (CM) policies are followed.
5.1.7	The contractor shall lead engineering support for GOES-R series data and product operations. The contractor shall manage the Data Operations Support Team (DOST), assure proper staffing, coordinate activities with OSPO, communicate/document issues, and workarounds for the operations team. The contractor shall troubleshoot issues as needed to support the OSPO product operations team.
5.1.8	The contractor shall manage Enterprise Management Operations Controllers (EMOCs) and Product Operators (during PLT) for the new mission. The contractor shall communicate staffing needs to project, create shift schedules, and manage daily operations.
5.1.9	The contractor shall support efforts to integrate systems into the cloud. Support engineering efforts to assist in defining transition methods, testing methods, update needed SOPs, and identify training needs. The contractor shall evaluate technical designs for operational suitability and impacts develop and refine/update OPSCONs.
5.1.10	The contractor shall support activities as needed at Flight and ground factory sites. The contractor shall support onsite and offsite reviews, workshops, conferences as needed.
5.1.11	The contractor shall participate in hand-over and transition of Mission Ground Operations from the newly launched GOES-R Program satellites to NOAA Operations at the conclusion of PLT(s).
5.1.12	The contractor shall assist as requested in trade studies, cloud development, enterprise level implementations, design reviews and other tasks as requested by the ground of flight leads.
5.1.13	The contractor shall coordinate daily/weekly ground system activities to minimize operational impacts. The contractor shall run/manage daily/weekly meetings to assure ground resources and teams are de-conflicted and assure continuity of mission.

V. Period Of Performance:

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

The period during which the work for this task shall be performed is from task award, October 11, 2019 thru March 28, 2020.

VI. Task Deliverables:

All deliverables shall be accepted by the Task Monitor, or his representative. If the deliverable is deemed unacceptable or incomplete, the task monitor will state the reason and the deliverable shall be corrected by the contractor and resubmitted for acceptance. At a minimum, the contractor shall deliver the items specified below

Deliverable Item/Milestone	Deliverable Due
Monthly Progress & Financial Reports	Monthly, by the 15th
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Engineering Analysis Reports	As required by the Project – NLT 15 days after event
Financial and Budget Planning Estimates for Technical Areas of Effort	As required by the Project – NLT 15 days after event
Configuration Change Request (CCR) Materials	As required by the Project
Configuration Management Change Reports	As required by the Project
Final Task Report	Within 15 days of task end date

VII. Travel Required:

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]
[redacted]

.

VIII. Applicable Documents:

In the performance of this task, the contractor shall comply with the following documents:

- NPR 7150.2A: NASA Software Engineering Requirements
- GPR 7150: Goddard Software Engineering Requirements
- NPR 7123: NASA System Engineering standards

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 15
Modification: 4
Task Name: SSMO Integrated Multi-Spacecraft Analysis Tools

GSMO-2 SOW Reference: 3.6, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/26/2017	11/24/2017	Update staffing profile based on available skill set.
2	11/25/2017	11/23/2018	Extend task through Nov 2018.
3	11/24/2018	11/23/2019	Extend task through Nov 2019.
4	11/24/2019	11/28/2020	Extend task through Nov 2020.

II. Task Overview

The SSMO Integrated Multi-Spacecraft Analysis Tools task provides scope to develop tools in support of the Space Science Mission Operations (SSMO) organization and its missions. These tools primarily include the Integrated Multi-Spacecraft Operations Dashboard and the SSMO Telemetry as a Service (TaaS) tool.

III. Requirements

1	**SSMO Integrated Multi-Spacecraft Analysis Tools**
1.1	**Integrated Multi-Spacecraft Operations Dashboard**
1.1.1	The contractor shall proactively elicit, document, analyze and prioritize Dashboard requirements.
1.1.2	The contractor shall maintain and evolve the Dashboard architecture.
1.1.3	The contractor shall investigate the availability and use of pre-existing SSMO hardware.
1.1.4	The contractor shall acquire appropriate software to implement the Dashboard design.
1.1.5	The contractor shall implement a capability to receive, archive, ingest and visualize event types (e.g. AOS/LOS).
1.1.6	The contractor shall plan for system security based on access control and role based capabilities.
1.1.7	The contractor shall maintain the Dashboard as a secure rich internet application that leverages a web services approach.
1.1.8	The contractor shall maintain the Dashboard using an open architecture, leveraging open source languages, open standards, open specifications and open protocols.

1.1.9	The contractor shall leverage the use of a secure open source web application framework, with configurable and granular role based authentication and authorization levels for users and groups.
1.1.10	The Contractor shall ensure that the Dashboard remains useable with a federated authentication and authorization system.
1.1.11	The contractor shall ensure that the Dashboard is operating system independent.
1.1.12	The contractor shall ensure that the Dashboard is maintainable, scalable and extensible.
1.1.13	The contractor shall ensure that the Dashboard can autonomously and manually ingest specified spacecraft and ground based events.
1.1.14	The contractor shall ensure that the Dashboard logs user and system activities.
1.1.15	The contractor shall collaborate with external parties (e.g., JPL) as appropriate.
	The contractor shall develop a generic user interface display template for key telemetered values, then customize the template for each SSMO mission to be displayed on the Dashboard.
1.1.16	The contractor shall implement the capability to receive up-to-date key telemetered values for each spacecraft and to visualize the values on the Dashboard.
1.1.17	The contractor shall evaluate a web services capability for General Mission Analysis Toolkit (GMAT) and further enhance GMAT capabilities within the Dashboard.
1.1.18	The contractor shall integrate SatCam and Space Weather data and further enhance those capabilities within the Dashboard.
1.1.19	The contractor shall evaluate FreeSpace as an addition to the Dashboard.
1.1.20	The contractor shall schedule and hold mission specific presentations and demonstrate Dashboard capabilities.
1.2	**Telemetry as a Service (TaaS)**
1.2.1	The contractor shall proactively elicit, document, analyze and prioritize TaaS requirements.
1.2.2	The contractor shall lead, organize, and coordinate all necessary interfaces between the MOCs and TaaS.
1.2.3	The contractor shall identify the key spacecraft-specific telemetered values to be provided by TaaS (through collaboration with Mission Directors and MOC interface SMEs).
1.2.4	The contractor shall plan for system security based on access control and role based capabilities.
1.2.5	The contractor shall integrate LaunchPad authentication with TaaS.
1.2.6	The contractor shall elicit and incorporate stakeholder feedback, including project sponsors and FOT, on needed enhancements to TaaS' user interface and user experience.
1.2.7	The contractor shall evaluate TaaS' architecture for usability, portability, reliability, scalability and extensibility.
1.2.8	The contractor shall evaluate the technical challenges of using AWS's Glacier for storage and data retrieval.

1.2.9	The contractor shall enhance and optimize TaaS' infrastructure on AWS GovCloud.
1.2.10	The contractor shall schedule and hold mission specific presentations and demonstrate TaaS capabilities.
1.3	**Data Access Toolkit (DAT)**
1.3.1	The contractor shall support the DAT system until it is properly phased out.
1.3.2	The contractor shall support the closeout of the DAT system ensuring all data and capabilities are transferred to the TaaS.
1.4	**System Administration**
1.4.1	The contractor shall provide system administration support for the tools maintained in this task order.
1.4.2	The contractor shall provide for Amazon Web Services (AWS) acquisition on a monthly basis.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
SSMO Dashboard (NASA/GSFC Code 444)	
General Mission Analysis Toolkit (GMAT) (NASA/GSFC Code 595)	GSC-17177-1
Satellite Camera (SatCam) (NASA/GSFC Code 591)	
Satellite Situational Update (SSUP) (NASA/GSFC Code 591)	
Data Access Toolkit (DAT) (NASA/GSFC Code 583)	GSC-17291-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 16
Modification: 3
Task Name: LCRD Project and Systems Engineering Support

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	03/30/2018	Initial task order statement of work.
1	12/19/2017		Admin mod
2	03/31/2018	03/29/2019	Task extension, remove subtask 1 scope
3	03/30/2019	03/28/2020	Task extension

II. Task Overview

The LCRD Project and Systems Engineering Support task provides Project Management Support, Systems Engineering Support, Lasercom Technology and Architecture Support, IT Security Support, and Risk Management for the LCRD Project.

Subtask 1: LCRD Payload Systems Engineering Support
Subtask 2: LCRD Ground Systems Engineering Support
Subtask 3: IT Security Support

III. Requirements

For all support, the contractor shall implement Organization Conflict of Interest (OCI) Mitigation Plan and sign a Non-Disclosure Agreement due to potential conflict of interest regarding LCRD support.

1	LCRD Payload I&T Support
	Subtask removed in last task modification

2	Ground Systems Engineering Support
2.1	The contractor shall support Ground Segment Development, Integration and Test efforts. Specifically, the contractor shall be familiar with the GS architecture, inter and intra network connectivity, IT Security posture, ability to write Inter connection security agreements, ICD, and secure payload commanding. The contractor shall hold or obtain a Top Secret / Sensitive Compartmented Information (TS-SCI) clearance
2.2	The contractor shall provide Ground Systems Engineering. Specifically, the contractor shall support space and ground segment system engineering, data

	processing, real-time on-orbit operations and monitoring, payload command/control, telemetry procedure development, payload T&C database development/maintenance, space systems communications, software test/command script development, training and operations procedure development.
2.3	The contractor shall support mission systems integration and test (I&T) between various space, nominal ground elements and ground support equipment.
2.4	The contractor shall participate in the development and verification of ground segment architecture and operations plans and procedures. Assist the project in proactively identifying, analyzing, resolving, and managing risks in current and future ground segment architecture and operations. Participation in the operational validation of the ground segment, including interface tests, end-to-end tests and mission simulations.
2.5	The contractor shall support the resolution and prevention of facility and operational anomalies and mitigate potential risks.
2.6	The contractor shall support ground and mission system reviews, engineering peer reviews, and specific hardware and software reviews on the Implementation contractor approach and design.
2.7	The contractor shall provide focused technical insight to assist the LCRD Technical Manager in monitoring contractor performance in the design, fabrication, and test of ground equipment. Analyze the performance to determine compliance with NASA specifications and provide written results of the analysis. Support includes implementation monitoring, test procedure review, test witnessing, test results analysis.
2.8	The contractor shall support schedule progress review each month after delivery of IMS from the LCRD implementation activities. Evaluation and observations should be provided to the LCRD Technical manager and LMOC Lead.
2.9	The contractor shall evaluate trades and technical memos generated by the implementation contract in the ground systems network area .
2.10	The contractor shall evaluate COTS SW and HW selection and technologies being planned by the implementation contractor(s).
2.11	The contractor shall provide development integration engineering support focusing on planning for and supporting monitoring of integration and testing activities. The support will include reviewing integration and test procedures, reviewing test processes, defects handling, and verification activities. The position will also include reviewing test schedules and providing feedback to the LCRD project development manager and supporting the LCRD Risk Management Process.
2.12	The contractor shall support development of the Ground Segment network architecture including network and IA hardware/software, voice connectivity, and interfaces to GS elements.

3	**IT Security Support**

3.1	The contractor shall provide Integration and Test (I&T) IT Security support throughout the IT Security System Development Life Cycle (SDLC) of those assets and information within the LCRD authorization boundary.
3.2	The contractor shall complete information categorization and validation with tailoring as appropriate.
3.3	The contractor shall perform selection, scoping and implementation of appropriate IT Security controls.
3.4	The contractor shall perform recurring assessment and update of IT Security control implementations to comply with continuous monitoring requirements.
3.5	The contractor shall provide input for the Project Security Plan (required by NPR 7120.5), System Security Plan (SSP), Risk Assessment Report (RAR) and Contingency Plan (CP).
3.6	The contractor shall coordinate IT Security documentation management and FISMA reporting within the NASA Security Assessment and Authorization Repository (NSAAR).
3.7	The contractor shall develop artifacts and support interviews and System Test and Evaluations (STE) for annual, third-party assessments.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]
[redacted]

VI. Material Procurement

The Contractor shall propose material necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 17
Modification: 2
Task Name: GOES-R IT Security Support

GSMO-2 SOW Reference: 3.7.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	01/26/2018	Initial task order statement of work.
1	01/27/2018	01/25/2019	Extend task for one year.
2	01/26/2019	01/25/2020	Extend task for one year.

II. Task Overview

The GOES-R IT Security Support task provides IT security support to the GOES-R in the form of review of IT security documentation, IT security system assessment with regard to compliance to all applicable standards, update of all plans and security controls as necessary, and participation in Authorization and Accreditation audit activities.

III. Requirements

1	GOES-R IT Security Support
1.1	The contractor shall provide independent review of existing GOES-R Information Technology (IT) Security documentation (System Security Plan, Risk Assessment, Contingency Plan, POAMs and supporting documentation in the RMS database).
1.2	The contractor shall conduct a system assessment for IT Security control compliance with NIST SP 800-53 Revision 4 and NASA IT policies directives of the OCIO ITS-HBK IT security policy handbooks.
1.3	The contractor shall develop new IT Security control implementations as required. Develop Plans of Actions & Milestones (POAMS) as required for any control that does not meet NIST SP800-53 Revision 4 compliance.
1.4	The contractor shall update RMS database System Security Plan, Risk Assessment, Contingency Plan, POAMs and supporting documentation in the RMS database POAM records with implementation changes as needed to document item 1.3 above.
1.5	The contractor shall participate in Authorization & Accreditation (A&A) meetings with Code 700 auditors during the Task Order performance term.
1.6	The contractor shall assist in resolution of findings identified during the 2018 (A&A) assessment.

1.7	The contractor shall review Splunk logs on a weekly basis and report identified abnormalities. The contractor will document the completion of this recurring activity in the GOES Gemini ConMon application.
1.8	The contractor shall aid in the development of GOES-R Standard Operating Procedures and Local Operating Procedures that align the GOES IT system with its Code 400 counterparts as their necessity becomes apparent during Directorate-level interface meetings.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 18
Modification: 5
Task Name: SSMO Centralized Operations

GSMO-2 SOW Reference: 2.2, 2.3, 2.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/26/2017	11/24/2017	Update staffing profile based on available skill set.
2	11/25/2017	11/23/2018	Extend task through 2018.
3	11/25/2017	11/23/2018	Replanning modification.
4	11/24/2018	11/23/2019	Extend task through 2019.
5	03/18/2019	11/23/2019	Add Requirements to Subtask 1 and Subtask 3

II. Task Overview

The SSMO Centralized Operations task provides mission operations facilities and services in support of the Space Science Mission Operations (SSMO) organization and its missions.

Subtask 1: Covers work associated with Multi-Mission MOC infrastructure.
Subtask 2: Covers work associated with SSMO Multi-mission Orbit Determination.
Subtask 3: Covers work associated with the OSIRIS REx sMSA vMMOC.

III. Requirements

1	Multi-Mission MOC infrastructure
1.1	The contractor shall maintain a Virtual Machine (VM) Infrastructure capable of supporting multiple SSMO Mission Operations Centers (MOC).
1.2	The contractor shall provision VMs to SSMO mission Systems Administrators (SA); and provide technical support to the MOC SAs to establish IONET connectivity and for effective utilization of VMs in their environment.
1.3	The contractor shall provide 12 thin clients for Multi-Mission MOC to provide console access to planned SSMO-VM Virtual Machines.
1.4	The contractor shall provide infrastructure and administrative support to the SSMO wiki. This support includes maintaining the Atlassian Confluence software with required patches and latest versions along with appropriate extensions and tools needed by SSMO users.
1.5	The contractor shall properly manage SSMO wiki data in accordance with the Access to Sensitive Information clause in the basic contract, including

	safeguarding sensitive information and not using it to improve its competitive position for other procurements.
1.6	The contractor shall create and maintain vMMOC system documentation covering design and as built details, local operating procedures, maintenance information, equipment inventory, configuration management information, security information and mission integration and implementation documentation.
1.6	**IT Tools and Services**
1.6.1	The contractor shall expand the capabilities of the SSMO VM infrastructure by building/providing IT tools and services to be used by all tenants of the environment.
1.6.2	The contractor shall provide backup services for all file systems and virtual machines in the environment.
1.6.3	The contractor shall provide versioning services to track different copies of process, procedures, applications, etc.
1.6.4	The contractor shall provide issue tracking services to track action items, error reporting and assignments.
1.6.5	The contractor shall provide content management publishing and configuration control services.
1.6.6	The contractor shall provide collaboration tools such as Wiki's and notification systems.
1.6.7	The contractor shall provide automated workflow management tools and security services.
1.6.8	The contractor shall provide new product evaluations and trades.
1.7	**SSMO Mission Support**
1.7.1	The contractor shall provide Fermi-Unique materials (e.g. hardware, software, licenses) necessary to support transition to VM, and hardware refresh for systems that will not be migrated to VMs, as identified from the Fermi Refresh Testbed. Multi-Mission-Unique materials have not yet been identified, and will be funded separately.
1.7.2	The contractor shall expand the capabilities of the SSMO VM infrastructure by providing and building additional nodes to the existing cluster and create a parallel cluster in Building 32. This parallel cluster will be used as a redundant/backup to the prime cluster and will allow for the migration of the SDO and LRO MOC environments into these VM clusters.
1.7.3	The contractor shall coordinate customer engagement meetings covering topics such as operating status, coordinate and schedule outages, provide optimization recommendations, and resolve customer issues and concerns.
1.7.4	The contractor shall provide periodic vMMOC utilization metrics covering key vMMOC system measures (per customer and as a whole system) such as network performance, storage utilization, processor utilization, and memory utilization.
1.7.5	For new missions, the contractor shall support mission phase B-D activities by providing input for requirements derivation, preliminary design, critical design, mission integration and implementation.

1.7.6	The contractor shall provide and maintain a baseline operations environment as a prototype, optimized for new missions with selected applications.
1.8	**vMMOC Techincal Leadership**
1.8.1	The contractor shall provide technical leadership and set recommendations and priorities for the future vMMOC capabilities, mapping out priorities for new missions, articulation of vMMOC capabilities for the purpose of soliticing new mission support.
1.8.2	The contractor shall support new mission proposals by providing vMMOC marketing presentation material, cost modelling, and proposed designs.
1.8.3	For major infrastructure changes the contractor shall create, manage, and report on schedule progress.
1.8.4	The contractor shall provide cost forecasts accounting for tech refresh, maintaince renewals, expansions and new capabilities.
1.8.5	The contractor shall support weekly engineering and status meetings.

2	**SSMO Multi-mission Orbit Determination**
2.1	The contractor shall develop a ~~Space Science Multi-mission Orbit Determination (SSMOD)~~ Navigation as a Service (NaaS) capability to be hosted in the Space Science Mission Operations (SSMO) Multi-Mission Operations Center (MMOC). The system shall use the Orbit Determination Toolsuite (ODT) based on the General Mission Analysis Tool (GMAT) to perform OD using two-way range and Doppler data from the Deep Space Network (DSN) and the Near Earth Network (NEN).
2.2	The contractor shall investigate the options available to SSMO for routing DSN and NEN tracking and monitor data into the MMOC, including, but not necessarily limited to, directly over IONet via FEDS, the Flight Dynamics Facility (FDF) Customer Interface Layer, and via file transfer protocol (FTP) from JPL's OscarX server.
2.3	The contractor shall investigate tracking data format options available for SSMOD, including, but not necessarily limited to, CCSDS Tracking Data Messages (TDM), DSN Standard Format Data Unit (SFDU) TRK-2-34, and NEN Universal Tracking Data Format (UTDF).
2.4	The contractor shall conduct shadow OD operations for ACE and WIND, using the prototypes developed during CY16 and any subsequent enhancements, which mirror all FDF OD deliveries. This activity shall continue until such time as ACE and WIND OD services have been fully transitioned from FDF to vMMOC, or the SSMOD effort has been curtailed.
2.5	The contractor shall investigate whether the scripting capabilities of the current prototype can be utilized to produce products delivered by FDF that are not currently produced by the prototype. Where feasible, the contractor shall develop prototypes of such scripting enhancements. Where infeasible, the contractor shall develop draft specifications for necessary modifications to the OD prototype core tool.
2.6	The contractor shall engage with the ACE and WIND FOT to develop a plan for operationalizing the OD prototype for ACE and WIND using the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option

	identified during CY16. The plan shall document licenses that must be procured in FY17 to support full transition of ACE and WIND OD services from FDF to vMMOC by ~~end~~ October of CY17.
2.7	The contractor shall provide SA support as required to maintain IT resources necessary to this effort.
2.8	The contractor shall investigate and address critical system engineering elements including hardware and software configuration management, automation, training, redundancy, and responsibilities that are necessary to support full transition of ACE and WIND OD services from FDF to vMMOC by ~~end~~ October of CY17.
2.9	The contractor shall develop and implement tools and methodologies to perform automated OD quality assurance using metrics including residual data, overlap comparisons, convergence status, observation editing, etc. The tools shall provide automated notifications of OD results using graphical and statistical summaries, with QA violations highlighted, and provide features for users to investigate, promote and/or reject OD results and products.
2.10	The contractor shall develop enhancements to the SSMO Dashboard that support the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option, supporting, at minimum, manual and automated OD processes, product generation, and cataloguing of tracking data into TaaS ("TTaaS"), with the following features: a. An Operational OD Products tab that accesses the final promoted OD output products for specified missions, including QA artifacts described above, and on-going trending. b. An Operational OD tab that permits configuration-controlled management of the automated, operational OD string. c. An analysis OD tab for manual OD runs that supports retrospective processing and statistical analysis of archived tracking data as well as simulation studies. d. A tab that allows users to deploy operational and analysis OD strings, and allocate data storage, across cloud-based resources. e. The system shall be fully accessible from within the vMMOC as well as from the CNE, either directly or via VPN.
2.11	The contractor shall support transition of vMMOC systems to be used for OD to RH7.
2.12	The contractor shall participate in the vMMOC Architecture Study to communicate the vMMOC recommendations developed during CY16.
2.13	The contractor shall engage with the ACE and Wind MMOC FOT to transition nominal OD and maneuver planning functions to the FOT by March of 2018.
2.14	The contractor shall develop a prototype conjunction assessment system to support a conjunction assessment pilot program that focuses on non-maneuverable SSMO missions and Fermi.

3	**OSIRIS REx sMSA vMMOC**
3.1	The contractor shall complete and maintain all necessary OS and application level patches necessary.

3.2	The contractor shall coordinate regular IT security scanning and implement updates as necessary.
3.3	The contractor shall coordinate with OSIRIS REx personnel to establish software functionality.
3.4	The contractor shall coordinate with IONet, vMMOC, and OSIRIS REx personnel to establish connectivity to the Lockheed test environment.
3.5	The contractor shall conduct updates as necessary to stay in synch with the OSIRIS REx MSA at Lockheed.
3.6	The contractor shall make the sMSA available for use by OSIRIS REx personnel including user accounts.
3.7	The contractor shall facilitate periodic (as much as quarterly) sMSA proficiency testing.
3.8	The contractor shall ensure availability of sMSA necessary computational and data allocation resources in order to support operations from the sMSA by conducting periodic system checks in coordination with the MSA at LM.
3.9	The contractor shall participate in IT systems-level troubleshooting to identify and resolve issues with the sMSA as they arise
3.10	The contractor shall provide weekly status updates at weekly meetings where applicable concerning task status and open sMSA issues.
3.11	The contractor shall make purchases as necessary to support command and telemetry operations.
3.12	The contractor shall support hardware and software updates required to operate the sMSA as command-capable back up to the MSA
3.13	The contractor shall support the migration from hardware to virtual machines in the vMMOC where applicable
3.14	The contractor shall provide and support necessary networking infrastructure to support operations from the sMSA.
3.15	The contractor shall provide cost estimates as applicable for upgrading the sMSA to be a full back up to the MSA for ORX earth return.
3.16	The contractor shall support mitigation and closing of POAMs and their required actions.
3.18	The contractor shall support on call off nominal working hours to asist troubleshooting ground system anomalies to make the sMSA available during critical spacecraft activities.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 18
Modification: 6
Task Name: SSMO Centralized Operations

GSMO-2 SOW Reference: 2.2, 2.3, 2.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/26/2017	11/24/2017	Update staffing profile based on available skill set.
2	11/25/2017	11/23/2018	Extend task through 2018.
3	11/25/2017	11/23/2018	Replanning modification.
4	11/24/2018	11/23/2019	Extend task through 2019.
5	03/18/2019	11/23/2019	Add Requirements to Subtask 1 and Subtask 3
5	07/01/2019	11/23/2019	Add new system administration requirements to Subtask 3

II. Task Overview

The SSMO Centralized Operations task provides mission operations facilities and services in support of the Space Science Mission Operations (SSMO) organization and its missions.

Subtask 1: Covers work associated with Multi-Mission MOC infrastructure.
Subtask 2: Covers work associated with SSMO Multi-mission Orbit Determination.
Subtask 3: Covers work associated with the OSIRIS REx sMSA vMMOC.

III. Requirements

1	Multi-Mission MOC infrastructure
1.1	The contractor shall maintain a Virtual Machine (VM) Infrastructure capable of supporting multiple SSMO Mission Operations Centers (MOC).
1.2	The contractor shall provision VMs to SSMO mission Systems Administrators (SA); and provide technical support to the MOC SAs to establish IONET connectivity and for effective utilization of VMs in their environment.
1.3	The contractor shall provide 12 thin clients for Multi-Mission MOC to provide console access to planned SSMO-VM Virtual Machines.
1.4	The contractor shall provide infrastructure and administrative support to the SSMO wiki. This support includes maintaining the Atlassian Confluence software with required patches and latest versions along with appropriate extensions and tools needed by SSMO users.

1.5	The contractor shall properly manage SSMO wiki data in accordance with the Access to Sensitive Information clause in the basic contract, including safeguarding sensitive information and not using it to improve its competitive position for other procurements.
1.6	The contractor shall create and maintain vMMOC system documentation covering design and as built details, local operating procedures, maintenance information, equipment inventory, configuration management information, security information and mission integration and implementation documentation.
1.6	**IT Tools and Services**
1.6.1	The contractor shall expand the capabilities of the SSMO VM infrastructure by building/providing IT tools and services to be used by all tenants of the environment.
1.6.2	The contractor shall provide backup services for all file systems and virtual machines in the environment.
1.6.3	The contractor shall provide versioning services to track different copies of process, procedures, applications, etc.
1.6.4	The contractor shall provide issue tracking services to track action items, error reporting and assignments.
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1.6.6	The contractor shall provide collaboration tools such as Wiki's and notification systems.
1.6.7	The contractor shall provide automated workflow management tools and security services.
1.6.8	The contractor shall provide new product evaluations and trades.
1.7	**SSMO Mission Support**
1.7.1	The contractor shall provide Fermi-Unique materials (e.g. hardware, software, licenses) necessary to support transition to VM, and hardware refresh for systems that will not be migrated to VMs, as identified from the Fermi Refresh Testbed. Multi-Mission-Unique materials have not yet been identified, and will be funded separately.
1.7.2	The contractor shall expand the capabilities of the SSMO VM infrastructure by providing and building additional nodes to the existing cluster and create a parallel cluster in Building 32. This parallel cluster will be used as a redundant/backup to the prime cluster and will allow for the migration of the SDO and LRO MOC environments into these VM clusters.
1.7.3	The contractor shall coordinate customer engagement meetings covering topics such as operating status, coordinate and schedule outages, provide optimization recommendations, and resolve customer issues and concerns.
1.7.4	The contractor shall provide periodic vMMOC utilization metrics covering key vMMOC system measures (per customer and as a whole system) such as network performance, storage utilization, processor utilization, and memory utilization.

1.7.5	For new missions, the contractor shall support mission phase B-D activities by providing input for requirements derivation, preliminary design, critical design, mission integration and implementation.
1.7.6	The contractor shall provide and maintain a baseline operations environment as a prototype, optimized for new missions with selected applications.
1.8	**vMMOC Techincal Leadership**
1.8.1	The contractor shall provide technical leadership and set recommendations and priorities for the future vMMOC capabilities, mapping out priorities for new missions, articulation of vMMOC capabilities for the purpose of soliticing new mission support.
1.8.2	The contractor shall support new mission proposals by providing vMMOC marketing presentation material, cost modelling, and proposed designs.
1.8.3	For major infrastructure changes the contractor shall create, manage, and report on schedule progress.
1.8.4	The contractor shall provide cost forecasts accounting for tech refresh, maintaince renewals, expansions and new capabilities.
1.8.5	The contractor shall support weekly engineering and status meetings.

2	**SSMO Multi-mission Orbit Determination**
2.1	The contractor shall develop a Navigation as a Service (NaaS) capability to be hosted in the Space Science Mission Operations (SSMO) Multi-Mission Operations Center (MMOC). The system shall use the Orbit Determination Toolsuite (ODT) based on the General Mission Analysis Tool (GMAT) to perform OD using two-way range and Doppler data from the Deep Space Network (DSN) and the Near Earth Network (NEN).
2.2	The contractor shall investigate the options available to SSMO for routing DSN and NEN tracking and monitor data into the MMOC, including, but not necessarily limited to, directly over IONet via FEDS, the Flight Dynamics Facility (FDF) Customer Interface Layer, and via file transfer protocol (FTP) from JPL's OscarX server.
2.3	The contractor shall investigate tracking data format options available for SSMOD, including, but not necessarily limited to, CCSDS Tracking Data Messages (TDM), DSN Standard Format Data Unit (SFDU) TRK-2-34, and NEN Universal Tracking Data Format (UTDF).
2.4	The contractor shall conduct shadow OD operations for ACE and WIND, using the prototypes developed during CY16 and any subsequent enhancements, which mirror all FDF OD deliveries. This activity shall continue until such time as ACE and WIND OD services have been fully transitioned from FDF to vMMOC, or the SSMOD effort has been curtailed.
2.5	The contractor shall investigate whether the scripting capabilities of the current prototype can be utilized to produce products delivered by FDF that are not currently produced by the prototype. Where feasible, the contractor shall develop prototypes of such scripting enhancements. Where infeasible, the contractor shall develop draft specifications for necessary modifications to the OD prototype core tool.

2.6	The contractor shall engage with the ACE and WIND FOT to develop a plan for operationalizing the OD prototype for ACE and WIND using the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option identified during CY16. The plan shall document licenses that must be procured in FY17 to support full transition of ACE and WIND OD services from FDF to vMMOC by ~~end~~ October of CY17.
2.7	The contractor shall provide SA support as required to maintain IT resources necessary to this effort.
2.8	The contractor shall investigate and address critical system engineering elements including hardware and software configuration management, automation, training, redundancy, and responsibilities that are necessary to support full transition of ACE and WIND OD services from FDF to vMMOC by ~~end~~ October of CY17.
2.9	The contractor shall develop and implement tools and methodologies to perform automated OD quality assurance using metrics including residual data, overlap comparisons, convergence status, observation editing, etc. The tools shall provide automated notifications of OD results using graphical and statistical summaries, with QA violations highlighted, and provide features for users to investigate, promote and/or reject OD results and products.
2.10	The contractor shall develop enhancements to the SSMO Dashboard that support the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option, supporting, at minimum, manual and automated OD processes, product generation, and cataloguing of tracking data into TaaS ("TTaaS"), with the following features: a. An Operational OD Products tab that accesses the final promoted OD output products for specified missions, including QA artifacts described above, and on-going trending. b. An Operational OD tab that permits configuration-controlled management of the automated, operational OD string. c. An analysis OD tab for manual OD runs that supports retrospective processing and statistical analysis of archived tracking data as well as simulation studies. d. A tab that allows users to deploy operational and analysis OD strings, and allocate data storage, across cloud-based resources. e. The system shall be fully accessible from within the vMMOC as well as from the CNE, either directly or via VPN.
2.11	The contractor shall support transition of vMMOC systems to be used for OD to RH7.
2.12	The contractor shall participate in the vMMOC Architecture Study to communicate the vMMOC recommendations developed during CY16.
2.13	The contractor shall engage with the ACE and Wind MMOC FOT to transition nominal OD and maneuver planning functions to the FOT by March of 2018.
2.14	The contractor shall develop a prototype conjunction assessment system to support a conjunction assessment pilot program that focuses on non-maneuverable SSMO missions and Fermi.

3	OSIRIS REx sMSA vMMOC
3.1	The contractor shall complete and maintain all necessary OS and application level patches necessary.
3.2	The contractor shall coordinate regular IT security scanning and implement updates as necessary.
3.3	The contractor shall coordinate with OSIRIS REx personnel to establish software functionality.
3.4	The contractor shall coordinate with IONet, vMMOC, and OSIRIS REx personnel to establish connectivity to the Lockheed test environment.
3.5	The contractor shall conduct updates as necessary to stay in synch with the OSIRIS REx MSA at Lockheed.
3.6	The contractor shall make the sMSA available for use by OSIRIS REx personnel including user accounts.
3.7	The contractor shall facilitate periodic (as much as quarterly) sMSA proficiency testing.
3.8	The contractor shall ensure availability of sMSA necessary computational and data allocation resources in order to support operations from the sMSA by conducting periodic system checks in coordination with the MSA at LM.
3.9	The contractor shall participate in IT systems-level troubleshooting to identify and resolve issues with the sMSA as they arise
3.10	The contractor shall provide weekly status updates at weekly meetings where applicable concerning task status and open sMSA issues.
3.11	The contractor shall make purchases as necessary to support command and telemetry operations.
3.12	The contractor shall support hardware and software updates required to operate the sMSA as command-capable back up to the MSA
3.13	The contractor shall support the migration from hardware to virtual machines in the vMMOC where applicable
3.14	The contractor shall provide and support necessary networking infrastructure to support operations from the sMSA.
3.15	The contractor shall provide cost estimates as applicable for upgrading the sMSA to be a full back up to the MSA for ORX earth return.
3.16	The contractor shall support mitigation and closing of POAMs and their required actions.
3.18	The contractor shall support on call off nominal working hours to asist troubleshooting ground system anomalies to make the sMSA available during critical spacecraft activities.
3.19	The contractor shall support ongoing development efforts for OSIRIS-REx in the secondary mission support area (sMSA) at GSFC and associated virtual multi-mission operations center (vMMOC) needs.
3.20	The contractor shall provide support to systems administrators and engineers as needed to troubleshoot ASIST and FEDS related infrastructure (hardware, software, network etc).
3.21	The contractor shall advise SSMO engineers as needed for sMSA procurements where relevant.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 18
Modification: 7
Task Name: SSMO Centralized Operations

GSMO-2 SOW Reference: 2.2, 2.3, 2.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/26/2017	11/24/2017	Update staffing profile based on available skill set.
2	11/25/2017	11/23/2018	Extend task through 2018.
3	11/25/2017	11/23/2018	Replanning modification.
4	11/24/2018	11/23/2019	Extend task through 2019.
5	03/18/2019	11/23/2019	Add Requirements to Subtask 1 and Subtask 3
6	07/01/2019	11/23/2019	Add new system administration requirements to Subtask 3
7	11/24/2019	11/28/2020	Extend task through 2020 (all 3 subtasks).

II. Task Overview

The SSMO Centralized Operations task provides mission operations facilities and services in support of the Space Science Mission Operations (SSMO) organization and its missions.

Subtask 1: Covers work associated with Multi-Mission MOC infrastructure.
Subtask 2: Covers work associated with SSMO Multi-mission Orbit Determination.
Subtask 3: Covers work associated with the OSIRIS REx sMSA vMMOC.

III. Requirements

1	Multi-Mission MOC infrastructure
1.1	The contractor shall maintain a Virtual Machine (VM) Infrastructure capable of supporting multiple SSMO Mission Operations Centers (MOC).
1.2	The contractor shall provision VMs to SSMO mission Systems Administrators (SA); and provide technical support to the MOC SAs to establish IONET connectivity and for effective utilization of VMs in their environment.
1.3	The contractor shall provide 12 thin clients for Multi-Mission MOC to provide console access to planned SSMO-VM Virtual Machines.
1.4	The contractor shall provide infrastructure and administrative support to the SSMO wiki. This support includes maintaining the Atlassian Confluence software with required patches and latest versions along with appropriate extensions and tools needed by SSMO users.

1.5	The contractor shall properly manage SSMO wiki data in accordance with the Access to Sensitive Information clause in the basic contract, including safeguarding sensitive information and not using it to improve its competitive position for other procurements.
1.6	The contractor shall create and maintain vMMOC system documentation covering design and as built details, local operating procedures, maintenance information, equipment inventory, configuration management information, security information and mission integration and implementation documentation.
1.6	**IT Tools and Services**
1.6.1	The contractor shall expand the capabilities of the SSMO VM infrastructure by building/providing IT tools and services to be used by all tenants of the environment.
1.6.2	The contractor shall provide backup services for all file systems and virtual machines in the environment.
1.6.3	The contractor shall provide versioning services to track different copies of process, procedures, applications, etc.
1.6.4	The contractor shall provide issue tracking services to track action items, error reporting and assignments.
1.6.5	The contractor shall provide content management publishing and configuration control services.
1.6.6	The contractor shall provide collaboration tools such as Wiki's and notification systems.
1.6.7	The contractor shall provide automated workflow management tools and security services.
1.6.8	The contractor shall provide new product evaluations and trades.
1.7	**SSMO Mission Support**
1.7.1	The contractor shall provide Fermi-Unique materials (e.g. hardware, software, licenses) necessary to support transition to VM, and hardware refresh for systems that will not be migrated to VMs, as identified from the Fermi Refresh Testbed. Multi-Mission-Unique materials have not yet been identified, and will be funded separately.
1.7.2	The contractor shall expand the capabilities of the SSMO VM infrastructure by providing and building additional nodes to the existing cluster and create a parallel cluster in Building 32. This parallel cluster will be used as a redundant/backup to the prime cluster and will allow for the migration of the SDO and LRO MOC environments into these VM clusters.
1.7.3	The contractor shall coordinate customer engagement meetings covering topics such as operating status, coordinate and schedule outages, provide optimization recommendations, and resolve customer issues and concerns.
1.7.4	The contractor shall provide periodic vMMOC utilization metrics covering key vMMOC system measures (per customer and as a whole system) such as network performance, storage utilization, processor utilization, and memory utilization.

1.7.5	For new missions, the contractor shall support mission phase B-D activities by providing input for requirements derivation, preliminary design, critical design, mission integration and implementation.
1.7.6	The contractor shall provide and maintain a baseline operations environment as a prototype, optimized for new missions with selected applications.
1.8	**vMMOC Techincal Leadership**
1.8.1	The contractor shall provide technical leadership and set recommendations and priorities for the future vMMOC capabilities, mapping out priorities for new missions, articulation of vMMOC capabilities for the purpose of soliticing new mission support.
1.8.2	The contractor shall support new mission proposals by providing vMMOC marketing presentation material, cost modelling, and proposed designs.
1.8.3	For major infrastructure changes the contractor shall create, manage, and report on schedule progress.
1.8.4	The contractor shall provide cost forecasts accounting for tech refresh, maintaince renewals, expansions and new capabilities.
1.8.5	The contractor shall support weekly engineering and status meetings.

2	**SSMO Multi-mission Orbit Determination**
2.1	The contractor shall develop and maintain a Navigation as a Service (NaaS) capability to be hosted in the Space Science Mission Operations (SSMO) Multi-Mission Operations Center (MMOC). The system shall use the Orbit Determination Toolsuite (ODT) based on the General Mission Analysis Tool (GMAT) to perform OD using two-way range and Doppler data from the Deep Space Network (DSN) and the Near Earth Network (NEN). Maintenance releases shall be aligned with task year boundaries.
~~2.2~~	~~The contractor shall investigate the options available to SSMO for routing DSN and NEN tracking and monitor data into the MMOC, including, but not necessarily limited to, directly over IONet via FEDS, the Flight Dynamics Facility (FDF) Customer Interface Layer, and via file transfer protocol (FTP) from JPL's OsearX server.~~
2.3	The contractor shall investigate tracking data format options available for SSMOD, including, but not necessarily limited to, CCSDS Tracking Data Messages (TDM), DSN Standard Format Data Unit (SFDU) TRK-2-34, and NEN Universal Tracking Data Format (UTDF).
~~2.4~~	~~The contractor shall conduct shadow OD operations for ACE and WIND, using the prototypes developed during CY16 and any subsequent enhancements, which mirror all FDF OD deliveries. This activity shall continue until such time as ACE and WIND OD services have been fully transitioned from FDF to vMMOC, or the SSMOD effort has been curtailed.~~
~~2.5~~	~~The contractor shall investigate whether the scripting capabilities of the current prototype can be utilized to produce products delivered by FDF that are not currently produced by the prototype. Where feasible, the contractor shall develop prototypes of such scripting enhancements. Where infeasible, the contractor shall develop draft specifications for necessary modifications to the OD prototype core tool.~~

~~2.6~~	~~The contractor shall engage with the ACE and WIND FOT to develop a plan for operationalizing the OD prototype for ACE and WIND using the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option identified during CY16. The plan shall document licenses that must be procured in FY17 to support full transition of ACE and WIND OD services from FDF to vMMOC by end October of CY17.~~
2.7	The contractor shall provide SA support as required to maintain IT resources necessary to this effort.
~~2.8~~	~~The contractor shall investigate and address critical system engineering elements including hardware and software configuration management, automation, training, redundancy, and responsibilities that are necessary to support full transition of ACE and WIND OD services from FDF to vMMOC by end October of CY17.~~
2.9	The contractor shall develop and implement tools and methodologies to perform automated OD quality assurance using metrics including residual data, overlap comparisons, convergence status, observation editing, etc. The tools shall provide automated notifications of OD results using graphical and statistical summaries, with QA violations highlighted, and provide features for users to investigate, promote and/or reject OD results and products.
~~2.10~~	~~The contractor shall develop enhancements to the SSMO Dashboard that support the "vMMOC + Cloud Storage + Full vMMOC Service Duplication" architecture option, supporting, at minimum, manual and automated OD processes, product generation, and cataloguing of tracking data into TaaS ("TTaaS"), with the following features:~~ ~~a. An Operational OD Products tab that accesses the final promoted OD output products for specified missions, including QA artifacts described above, and on-going trending.~~ ~~b. An Operational OD tab that permits configuration-controlled management of the automated, operational OD string.~~ ~~c. An analysis OD tab for manual OD runs that supports retrospective processing and statistical analysis of archived tracking data as well as simulation studies.~~ ~~d. A tab that allows users to deploy operational and analysis OD strings, and allocate data storage, across cloud-based resources.~~ ~~e. The system shall be fully accessible from within the vMMOC as well as from the CNE, either directly or via VPN.~~
2.11	The contractor shall support transition of vMMOC systems to be used for OD to RH7.
~~2.12~~	~~The contractor shall participate in the vMMOC Architecture Study to communicate the vMMOC recommendations developed during CY16.~~
2.13	The contractor shall engage with the ACE and Wind MMOC FOT to develop and follow a plan, including all necessary training and documentation, for full transition of nominal OD, inclusive of tracking data evaluation that is performed integrally with the OD process, and maneuver planning functions to the FOT ~~by March of 2018~~.

~~2.14~~	~~The contractor shall develop a prototype conjunction assessment system to support a conjunction assessment pilot program that focuses on non-maneuverable SSMO missions and Fermi.~~

3	OSIRIS REx sMSA vMMOC
3.1	The contractor shall complete and maintain all necessary OS and application level patches necessary.
3.2	The contractor shall coordinate regular IT security scanning and implement updates as necessary.
3.3	The contractor shall coordinate with OSIRIS REx personnel to establish software functionality.
3.4	The contractor shall coordinate with IONet, vMMOC, and OSIRIS REx personnel to establish connectivity to the Lockheed test environment.
3.5	The contractor shall conduct updates as necessary to stay in synch with the OSIRIS REx MSA at Lockheed.
3.6	The contractor shall make the sMSA available for use by OSIRIS REx personnel including user accounts.
3.7	The contractor shall facilitate periodic (as much as quarterly) sMSA proficiency testing.
3.8	The contractor shall ensure availability of sMSA necessary computational and data allocation resources in order to support operations from the sMSA by conducting periodic system checks in coordination with the MSA at LM.
3.9	The contractor shall participate in IT systems-level troubleshooting to identify and resolve issues with the sMSA as they arise
3.10	The contractor shall provide weekly status updates at weekly meetings where applicable concerning task status and open sMSA issues.
3.11	The contractor shall make purchases as necessary to support command and telemetry operations.
3.12	The contractor shall support hardware and software updates required to operate the sMSA as command-capable back up to the MSA
3.13	The contractor shall support the migration from hardware to virtual machines in the vMMOC where applicable
3.14	The contractor shall provide and support necessary networking infrastructure to support operations from the sMSA.
3.15	The contractor shall provide cost estimates as applicable for upgrading the sMSA to be a full back up to the MSA for ORX earth return.
3.16	The contractor shall support mitigation and closing of POAMs and their required actions.
3.18	The contractor shall support on call off nominal working hours to asist troubleshooting ground system anomalies to make the sMSA available during critical spacecraft activities.
3.19	The contractor shall support ongoing development efforts for OSIRIS-REx in the secondary mission support area (sMSA) at GSFC and associated virtual multi-mission operations center (vMMOC) needs.

3.20	The contractor shall provide support to systems administrators and engineers as needed to troubleshoot ASIST and FEDS related infrastructure (hardware, software, network etc).
3.21	The contractor shall advise SSMO engineers as needed for sMSA procurements where relevant.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 19
Modification: 5
Task Name: JPSS IDPS Ground System Support

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	02/12/2018		Admin mod for Branch Head change
2	04/28/2018	04/26/2019	Extend POP
3	09/17/2018	04/26/2019	Add subtask 2
4	02/28/2019		Administrative changes
5	04/27/2019	04/25/2020	Extend POP

II. Task Overview

The JPSS IDPS Ground System Support task provides support services described in the Requirements section.

Subtask 1: JPSS IDPS Ground System Support
Subtask 2: JPSS Ground Segment Systems Engineering Support

III. Subtask Description

a. Subtask 1 Requirements:

1	JPSS IDPS Ground System Support
1.1	The contractor shall provide systems engineering support for maintenance of the Ground System Interface Data Processing Segment OAs with ESPC, CLASS, and GRAVITE.
1.2	The contractor shall provide engineering support for the DSWG and GPRM (as required).
1.3	The contractor shall support the internal IDPS staff meeting as well as the risk meeting – develop/distribute agendas, summaries and track action items.
1.4	The contractor shall provide a list of COTS updates to IDPS members for timely evaluation.
1.5	The contractor shall coordinate response time of the JPSS Interface Data Processing Segment (IDPS) team inputs for the MIS CCR reviews.
1.6	The contractor shall develop and provide IDPS and SEIT (if requested) weekly and monthly status report to the Ground Project.

1.7	The contractor shall support biweekly and biannual DSWG and weekly GPRM meeting (as required).

b. Subtask 2 Requirements:

2	JPSS Ground Segment Systems Engineering Support
2.1	The contractor shall provide systems engineering support for Ground Segment for C3S oversight
2.2	The contractor shall provide engineering support for interface support with spacecraft, instruments, space segment, and ground segment.
2.3	The contractor shall support the system testing activities.
2.4	The contractor shall support document reviews, preparation for proper implementation and verification of systems
2.5	The contractor shall identify risks/issues and assist in the effort to mitigate concerns, especially for operations
2.6	The contractor shall develop, maintain the tools necessary to assist in anomaly evaluation and resolution

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 19
Modification: 6
Task Name: JPSS IDPS Ground System Support

Mod Summary: Remove Subtask 2

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1			Admin mod for Branch Head change
2	04/28/2018	04/26/2019	Extend POP
3	08/27/2018	04/26/2019	Add subtask 2
4			Administrative changes
5	04/27/2019	04/25/2020	Extend POP
6	07/12/2019	04/25/2020	Remove Subtask 2

II. Task Overview

The JPSS IDPS Ground System Support task provides support services described in the Requirements section.

Subtask 1: JPSS IDPS Ground System Support
~~**Subtask 2**: JPSS Ground Segment Systems Engineering Support~~

III. Subtask Description

a. Subtask 1 Requirements:

1	JPSS IDPS Ground System Support
1.1	The contractor shall provide systems engineering support for maintenance of the Ground System Interface Data Processing Segment OAs with ESPC, CLASS, and GRAVITE.
1.2	The contractor shall provide engineering support for the DSWG and GPRM (as required).
1.3	The contractor shall support the internal IDPS staff meeting as well as the risk meeting – develop/distribute agendas, summaries and track action items.
1.4	The contractor shall provide a list of COTS updates to IDPS members for timely evaluation.
1.5	The contractor shall coordinate response time of the JPSS Interface Data Processing Segment (IDPS) team inputs for the MIS CCR reviews.

1.6	The contractor shall develop and provide IDPS and SEIT (if requested) weekly and monthly status report to the Ground Project.
1.7	The contractor shall support biweekly and biannual DSWG and weekly GPRM meeting (as required).

~~**b. Subtask 2 Requirements:**~~

~~2~~	~~**JPSS Ground Segment Systems Engineering Support**~~
~~2.1~~	~~The contractor shall provide systems engineering support for Ground Segment for C3S oversight~~
~~2.2~~	~~The contractor shall provide engineering support for interface support with spacecraft, instruments, space segment, and ground segment.~~
~~2.3~~	~~The contractor shall support the system testing activities.~~
~~2.4~~	~~The contractor shall support document reviews, preparation for proper implementation and verification of systems~~
~~2.5~~	~~The contractor shall identify risks/issues and assist in the effort to mitigate concerns, especially for operations~~
~~2.6~~	~~The contractor shall develop, maintain the tools necessary to assist in anomaly evaluation and resolution~~

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 21
Modification: 8
Task Name: Satellite Servicing Projects Division Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	07/27/2018	Initial task order statement of work.
1	11/01/2017	07/27/2018	Add an additional requirement
2	01/09/2018		Administrative Mod
3	02/01/2018	07/27/2018	Add requirements for Restore-L Ground System
4	06/01/2018	07/27/2019	Add Requirement for Network and Security Support; De-Scope (1.5, 1.6 and 1.7)
5	07/18/2018		Administrative Mod
6	12/01/2018	07/27/2019	Replan modification from vendor
7	03/08/2019		Administrative Mod
8	07/28/2019	07/25/2020	Period of Performance extension

II. Task Overview

The Satellite Servicing Projects Division Support task provides facilities engineering support for the SSPDS.

III. Requirements

1	Satellite Servicing Projects Division Support
1.1	The contractor shall provide facilities engineering support for the SSPDS developmental, operational, and administrative offices.
1.2	The contractor shall propose the staffing levels and materials required to perform the following: Design changes, Maintainability, upgrade, maintenance of the SSPDS and IT security support. Support activities include: • Work with customer to define console and administrative workspace requirements • Interface with building engineers and FMD to modify power, lighting and physical security elements such as keycard readers and cameras • Removal and upgrade of existing infrastructure including floor tiles and cabling • Installation and maintainability of video and multimedia devices
1.3	The contractor shall propose the staffing levels and materials required to continue performing the following: General design changes, implementation

	and maintainability of the GSSC and recently expanded areas. Support activities include: • Work with customer to define console and administrative workspace requirements • Perform general console and furniture assembly/disassembly and/or relocation • Interface with building engineers and FMD to perform minor power, network and lighting changes • Perform minor removal and upgrade of existing infrastructure including floor tiles and cabling • Install and maintain video and multimedia devices including screens and whiteboards
1.4	Contractor shall provide IT security expertise assistance in support of the SSPD ISSO for meetings; assessment; and update of documentation with Annual Continuous Monitoring by the third-party assessors. These activities include: -Preparing for the next A&A continuous monitoring assessment late spring or early summer by performing a self-assessment including updating IT security controls to comply with NIST SP800-53 Rev 5 when required -Attending future A&A continuous monitoring proceedings -Assisting in addressing findings from third-party assessment including support activities for POA&M closure or develop risks recommended for acceptance to the Authorizing Official (AO). -Assisting in developing IT Security SOPs and IT Security waivers when required. -Supporting Agency, GSFC or FPD data calls for information. - Vulnerability scanning support using the recently deployed Nessus local presence built specific to the GSSCC/PIP network boundary. - Baseline OS configuration management (CM) - Guidance for continued development of system management (Linux/Windows/MacOS/OS X) under the FPDM and FPDSS security plans
~~1.5~~	~~Contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~

	~~The candidate shall have a strong technical base in the following areas:~~
	• ~~Leadership skills for software development teams.~~
	• ~~System design for a combination of new development with legacy infrastructure~~
	• ~~Requirements definition for a space mission ground system~~
	  ○ ~~Overall understanding of requirement development phases~~
	  ○ ~~Guide requirement formulation process~~
	• ~~Understanding how different components interface with each other in requirements and design space~~
	  ○ ~~Telemetry & Command~~
	  ○ ~~Data processing and distribution, including imagery and video~~
	  ○ ~~Mission Planning/Scheduling~~
	  ○ ~~Monitoring & Notification~~
	  ○ ~~Data Analysis~~
	  ○ ~~IT Infrastructure and Security~~
	• ~~Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~
	• ~~Overall expertise to guide a team in life-cycle development~~
	  ○ ~~Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~
	  ○ ~~Software CM and unit test automation~~
	• ~~Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~
	• ~~Previous experience leading ground software development efforts required.~~
	• ~~Experience managing integrated mission schedules~~

~~1.6~~	~~Contactor shall provide ITPS and MPS in support of Restore-L Ground System including:~~
	• ~~Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms~~
	• ~~Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including~~
	  ○ ~~Sizing for hardware platforms (CPU, memory, disk, network)~~
	  ○ ~~Performance estimation given Restore data rates and Concept of Operations~~
	• ~~Hands on training for RGE development and IT support staff for installation, configuration and operation of the products~~
	• ~~Estimation of required hours for modifications to the products to meet Restore specific requirements~~
	• ~~An initial tranche of hours to use for modifications to the products~~
	• ~~Product support on-call during business hours~~
	• ~~Delivery and upgrade support for future versions of the products on request during the Restore mission~~
	•

~~1.7~~	~~Contractor shall provide Ground System peer review board support as required.~~
1.8	Contactor shall provide SSPD Network Support including: • Management and configuration of SSPD Robotics and GSSCC (PIP network) routers and switches. • Virtual LAN (VLAN) management within the Robotics network. • Access control list (ACL; for all intents and purposes the firewall) implementations within the Robotics network. • FPD security implementations to all network hardware (for example, making certain all routers and switches are reporting log data and/or time synchronization to NASA systems/services). • Acting as POC to NICS when Robotics and GSSCC projects request/require network extensions and/or implementations. • Installing new network hardware in their respective locations/facilities. • Ensuring network hardware maintenance (such as, updates/patches to Cisco IOS) are performed timely and within scope as to not impact services and/or mitigate significant downtime. • Working with SSPD IT to recommend network hardware required for implementation within the existing network infrastructure when procurement has been required. • Guidance and implementation as necessary for Restore-L lab space.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 22
Modification: 7
Task Name: Office of Communications Multimedia Support

GSMO-2 SOW Reference: 2.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/31/2018	Initial task order statement of work.
1	06/01/2017	05/31/2018	Replanning
2	12/01/2017	05/25/2018	Critical Studio & Infrastructure Upgrade #1
3	01/18/2018		CO Administrative Changes
4	05/26/2018	05/24/2019	Extend the contract period of performance and the contractor shall procure additional infrastructure upgrades.
5	08/13/2018	05/24/2019	Contractor shall procure critical studio and video infrastructure upgrades #2.
6	05/02/2019		Administrative MOD changing RA
7	05/25/2019	05/23/2020	Extend the contract period of performance. Subtask 5 becomes a no-cost mod to extend the period of performance through 05/25/2020. Create subtask #6 for CM&O work.

II. Task Overview

The Office of Communications Multimedia Support task provides the Goddard Space Flight Center's (GSFC's) Office of Communications (OC) the highest quality media and related support for, but not limited to, television, multimedia and the web, in keeping with NASA's statutory obligation to provide for the widest and most practicable dissemination of information.

Subtask 1: Covers all work associated with OC Multimedia Support.
Subtask 2: Covers all work associated with MAVEN Multimedia Support.
Subtask 3: Covers all work associated with OSIRIS-REx Multimedia Support.
Subtask 4: Covers all work associated with LRO Multimedia Support.
Subtask 5: Covers all work associated with Wallops Launch Support.
Subtask 6: Covers all work associated with Center Support.

III. Requirements

The requirements table below, with the ID starting with "X", refers to scope associated with subtasks 1, 2, 3, 4, and 6. The subtask number can substituted for "X" signifying four copies of the set of applicable requirements. The last table, for subtask 5, is unique to the Wallops support requirements.

X	**Multimedia Support**
X.1	Video production. The contractor shall plan, write treatments and scripts, create storyboards, operate lights and camera equipment, direct, edit, record audio, and produce multimedia products. These products include finished video content formatted for distribution through NASA-TV, NASA.gov, and NASA social media channels, video news releases, music videos, training classes, lectures and presentations, satellite media tours, press conferences, live streams and educational programming.
X.2	Documentation. The contractor shall operate cameras to document activities and programs. Safely operates cameras in sensitive areas such as engineering labs and clean rooms.
X.3	Video editing. The contractor shall provide video editing support using workstations and laptops. The contractor shall ensure all edited videos comply with closed captioning requirements.
X.4	Studio and control room management. The contractor shall manage, operate, and maintain Goddard's television studio and control room facilities. Provides engineering support for live television programs and satellite media tours.
X.5	Media management. The contractor shall operate and manage Goddard's video media asset management (MAM) system to ensure producers are able to log, tag, and archive original camera material. Archives edited content and provides regular backups of all Goddard video products. Coordinate support for media MAM and editing workstations with IT Systems Administrator.
X.6	Animation. The contractor shall produce animation and motion graphics products. Manages animation workstations, rendering, and archiving hardware for the Conceptual Image Laboratory. Archives models and animation assets.
X.7	Production management. The contractor shall maintain schedules for the video studio, Conceptual Image Laboratory, editing facilities, and the video cameras. The contractor's video producers and animation leads shall create monthly work plans and project reports detailing production schedule, deliverables, and costs. The contractor shall provide monthly updates of labor, equipment purchase, travel and other ODCs.
X.8	**Equipment Purchases**
X.8.1	The contractor will provide equipment recommendations, cost estimates, and purchase equipment and supplies as requested. This equipment may include cameras, video and audio recording equipment, lights, video editing and animation workstations, hardware and video/image editing software to support producers and communications team members, specialized video editing laptops, rendering licenses, hardware and software to support the Conceptual Image Lab animation group, video control room, hardware, monitors, and video storage systems.

X.8.2	Music library. The contractor shall utilize a music library service and purchase music licenses.
X.8.3	Property management. The contractor shall maintain property records in accordance with NASA PP&E System procedures for all controlled equipment assigned to their property account. This includes: acquisition, receipt, utilization, and disposal. Equipment Management includes the following general tasks for the proper account and safeguard of NASA's property: a. Identify personal property b. Record assets in the PP&E System and properly assign them c. Maintaining records relating to the assets d. Monitor the movement of assets e. Record changes in physical condition of the asset(s) f. Conduct physical inventories g. Reconcile the results of the inventories h. Report all losses, thefts, and damages of assets i. Reutilize assets when possible j. Dispose of assets properly
X.8.4	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to conduct interviews with the media via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.
X.9	**Management and Administrative Support**
X.9.1	The contractor shall provide all necessary management and administrative support required to execute this task. At a minimum this shall include a Project Manager (PM), who shall be the point of contact of all contractor services and products and the supervisor for technical and administrative work performed under this task.
X.9.2	The contractor shall provide management and administrative support for the objectives of the NASA Goddard's OC as described in more detail under requirements, above, which are as follows: video production, video acquisition and camera operation, video editing, studio management, media SAN, animation and motion graphics, and production management, equipment purchases, equipment management and satellite media tours.

5	**Wallops Launch Support**
5.1	The contractor shall provide multimedia and television support for video recording and live broadcast of two Antares launches. This includes support for documentation, broadcast press conferences, social media activities, media events, and launch commentary.
5.2	The contractor will provide equipment recommendations, cost estimates, and purchase equipment to support Wallops Flight Facility's required launch broadcasts. This equipment may include cameras, camera control hardware and software, video and audio recording equipment, lights, control room hardware and software, monitors and microphones.
5.3	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to distribute launch coverage and video products via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 22
Modification: 8
Task Name: Office of Communications Multimedia Support

GSMO-2 SOW Reference: 2.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/31/2018	Initial task order statement of work.
1	06/01/2017	05/31/2018	Replanning
2	12/01/2017	05/25/2018	Critical Studio & Infrastructure Upgrade #1
3	01/18/2018		CO Administrative Changes
4	05/26/2018	05/24/2019	Extend the contract period of performance and the contractor shall procure additional infrastructure upgrades.
5	08/13/2018	05/24/2019	Contractor shall procure critical studio and video infrastructure upgrades #2.
6	05/02/2019		Administrative MOD changing RA
7	05/25/2019	05/23/2020	Extend the contract period of performance. Subtask 5 becomes a no-cost mod to extend the period of performance through 05/25/2020. Create subtask #6 for CM&O work.
8	10/1/2019	10/31/2019	Add subtask 7 for Navigation and Mission Design Branch Multimedia Support.

II. Task Overview

The Office of Communications Multimedia Support task provides the Goddard Space Flight Center's (GSFC's) Office of Communications (OC) the highest quality media and related support for, but not limited to, television, multimedia and the web, in keeping with NASA's statutory obligation to provide for the widest and most practicable dissemination of information.

Subtask 1: Covers all work associated with OC Multimedia Support.
Subtask 2: Covers all work associated with MAVEN Multimedia Support.
Subtask 3: Covers all work associated with OSIRIS-REx Multimedia Support.
Subtask 4: Covers all work associated with LRO Multimedia Support.
Subtask 5: Covers all work associated with Wallops Launch Support.
Subtask 6: Covers all work associated with Center Support.
Subtask 7: Covers all work associated with Navigation and Mission Design Branch Multimedia Support.

III. Requirements

The requirements table below, with the ID starting with "X", refers to scope associated with subtasks 1, 2, 3, 4, and 6. The subtask number can substituted for "X" signifying four copies of the set of applicable requirements. The last table, for subtask 5, is unique to the Wallops support requirements.

X	**Multimedia Support**
X.1	Video production. The contractor shall plan, write treatments and scripts, create storyboards, operate lights and camera equipment, direct, edit, record audio, and produce multimedia products. These products include finished video content formatted for distribution through NASA-TV, NASA.gov, and NASA social media channels, video news releases, music videos, training classes, lectures and presentations, satellite media tours, press conferences, live streams and educational programming.
X.2	Documentation. The contractor shall operate cameras to document activities and programs. Safely operates cameras in sensitive areas such as engineering labs and clean rooms.
X.3	Video editing. The contractor shall provide video editing support using workstations and laptops. The contractor shall ensure all edited videos comply with closed captioning requirements.
X.4	Studio and control room management. The contractor shall manage, operate, and maintain Goddard's television studio and control room facilities. Provides engineering support for live television programs and satellite media tours.
X.5	Media management. The contractor shall operate and manage Goddard's video media asset management (MAM) system to ensure producers are able to log, tag, and archive original camera material. Archives edited content and provides regular backups of all Goddard video products. Coordinate support for media MAM and editing workstations with IT Systems Administrator.
X.6	Animation. The contractor shall produce animation and motion graphics products. Manages animation workstations, rendering, and archiving hardware for the Conceptual Image Laboratory. Archives models and animation assets.
X.7	Production management. The contractor shall maintain schedules for the video studio, Conceptual Image Laboratory, editing facilities, and the video cameras. The contractor's video producers and animation leads shall create monthly work plans and project reports detailing production schedule, deliverables, and costs. The contractor shall provide monthly updates of labor, equipment purchase, travel and other ODCs.
X.8	**Equipment Purchases**
X.8.1	The contractor will provide equipment recommendations, cost estimates, and purchase equipment and supplies as requested. This equipment may include cameras, video and audio recording equipment, lights, video editing and animation workstations, hardware and video/image editing software to support producers and communications team members, specialized video editing

	laptops, rendering licenses, hardware and software to support the Conceptual Image Lab animation group, video control room, hardware, monitors, and video storage systems.
X.8.2	Music library. The contractor shall utilize a music library service and purchase music licenses.
X.8.3	Property management. The contractor shall maintain property records in accordance with NASA PP&E System procedures for all controlled equipment assigned to their property account. This includes: acquisition, receipt, utilization, and disposal. Equipment Management includes the following general tasks for the proper account and safeguard of NASA's property: a. Identify personal property b. Record assets in the PP&E System and properly assign them c. Maintaining records relating to the assets d. Monitor the movement of assets e. Record changes in physical condition of the asset(s) f. Conduct physical inventories g. Reconcile the results of the inventories h. Report all losses, thefts, and damages of assets i. Reutilize assets when possible j. Dispose of assets properly
X.8.4	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to conduct interviews with the media via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.
X.9	**Management and Administrative Support**
X.9.1	The contractor shall provide all necessary management and administrative support required to execute this task. At a minimum this shall include a Project Manager (PM), who shall be the point of contact of all contractor services and products and the supervisor for technical and administrative work performed under this task.
X.9.2	The contractor shall provide management and administrative support for the objectives of the NASA Goddard's OC as described in more detail under requirements, above, which are as follows: video production, video acquisition and camera operation, video editing, studio management, media SAN, animation and motion graphics, and production management, equipment purchases, equipment management and satellite media tours.

5	**Wallops Launch Support**
5.1	The contractor shall provide multimedia and television support for video recording and live broadcast of two Antares launches. This includes support for documentation, broadcast press conferences, social media activities, media events, and launch commentary.
5.2	The contractor will provide equipment recommendations, cost estimates, and purchase equipment to support Wallops Flight Facility's required launch broadcasts. This equipment may include cameras, camera control hardware and software, video and audio recording equipment, lights, control room hardware and software, monitors and microphones.

5.3	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to distribute launch coverage and video products via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.

7	**Navigation and Mission Design Branch Multimedia Support**
7.1	The contractor shall provide multimedia products in support of the International Astronautical Federation (IAF).
7.2	The contractor shall produce IAC TV at the 70th Annual Congress, held in Washington DC, 21st - 25th October 2019.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 22
Modification: 9
Task Name: Office of Communications Multimedia Support

GSMO-2 SOW Reference: 2.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/31/2018	Initial task order statement of work.
1	06/01/2017	05/31/2018	Replanning
2	12/01/2017	05/25/2018	Critical Studio & Infrastructure Upgrade #1
3	01/18/2018		CO Administrative Changes
4	05/26/2018	05/24/2019	Extend the contract period of performance and the contractor shall procure additional infrastructure upgrades.
5	08/13/2018	05/24/2019	Contractor shall procure critical studio and video infrastructure upgrades #2.
6	05/02/2019		Administrative MOD changing RA
7	05/25/2019	05/23/2020	Extend the contract period of performance. Subtask 5 becomes a no-cost mod to extend the period of performance through 05/25/2020. Create subtask #6 for CM&O work.
8	10/1/2019	10/31/2019	Add subtask 7 for Navigation and Mission Design Branch Multimedia Support.
9	10/28/2019	05/23/2020	Under subtask 1 contractor shall identify and procure equipment to support the Earth Science News Team. This mod also adds provision for the contractor to support additional Antares launches; specifically, the next Antares launch (NG12) at the Wallops Flight Facility.

II. Task Overview

The Office of Communications Multimedia Support task provides the Goddard Space Flight Center's (GSFC's) Office of Communications (OC) the highest quality media and related support for, but not limited to, television, multimedia and the web, in keeping with NASA's statutory obligation to provide for the widest and most practicable dissemination of information.

Subtask 1: Covers all work associated with OC Multimedia Support.
Subtask 2: Covers all work associated with MAVEN Multimedia Support.

Subtask 3: Covers all work associated with OSIRIS-REx Multimedia Support.
Subtask 4: Covers all work associated with LRO Multimedia Support.
Subtask 5: Covers all work associated with Wallops Launch Support.
Subtask 6: Covers all work associated with Center Support.
Subtask 7: Covers all work associated with Navigation and Mission Design Branch Multimedia Support.

III. Requirements

The requirements table below, with the ID starting with "X", refers to scope associated with subtasks 1, 2, 3, and 4. The subtask number can be substituted for "X" signifying four copies of the set of applicable requirements. The last table, for subtask 5, is unique to the Wallops support requirements.

X	Multimedia Support
X.1	Video production. The contractor shall plan, write treatments and scripts, create storyboards, operate lights and camera equipment, direct, edit, record audio, and produce multimedia products. These products include finished video content formatted for distribution through NASA-TV, NASA.gov, and NASA social media channels, video news releases, music videos, training classes, lectures and presentations, satellite media tours, press conferences, live streams and educational programming.
X.2	Documentation. The contractor shall operate cameras to document activities and programs. Safely operates cameras in sensitive areas such as engineering labs and clean rooms.
X.3	Video editing. The contractor shall provide video editing support using workstations and laptops. The contractor shall ensure all edited videos comply with closed captioning requirements.
X.4	Studio and control room management. The contractor shall manage, operate, and maintain Goddard's television studio and control room facilities. Provides engineering support for live television programs and satellite media tours.
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X.6	Animation. The contractor shall produce animation and motion graphics products. Manages animation workstations, rendering, and archiving hardware for the Conceptual Image Laboratory. Archives models and animation assets.
X.7	Production management. The contractor shall maintain schedules for the video studio, Conceptual Image Laboratory, editing facilities, and the video cameras. The contractor's video producers and animation leads shall create monthly work plans and project reports detailing production schedule,

	deliverables, and costs. The contractor shall provide monthly updates of labor, equipment purchase, travel and other ODCs.
X.8	**Equipment Purchases**
X.8.1	The contractor will provide equipment recommendations, cost estimates, and purchase equipment and supplies as requested. This equipment may include cameras, video and audio recording equipment, lights, video editing and animation workstations, hardware and video/image editing software to support producers and communications team members, specialized video editing laptops, rendering licenses, hardware and software to support the Conceptual Image Lab animation group, video control room, hardware, monitors, and video storage systems.
X.8.2	Music library. The contractor shall utilize a music library service and purchase music licenses.
X.8.3	Property management. The contractor shall maintain property records in accordance with NASA PP&E System procedures for all controlled equipment assigned to their property account. This includes: acquisition, receipt, utilization, and disposal. Equipment Management includes the following general tasks for the proper account and safeguard of NASA's property: a. Identify personal property b. Record assets in the PP&E System and properly assign them c. Maintaining records relating to the assets d. Monitor the movement of assets e. Record changes in physical condition of the asset(s) f. Conduct physical inventories g. Reconcile the results of the inventories h. Report all losses, thefts, and damages of assets i. Reutilize assets when possible j. Dispose of assets properly
X.8.4	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to conduct interviews with the media via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.
X.9	**Management and Administrative Support**
X.9.1	The contractor shall provide all necessary management and administrative support required to execute this task. At a minimum this shall include a Project Manager (PM), who shall be the point of contact of all contractor services and products and the supervisor for technical and administrative work performed under this task.
X.9.2	The contractor shall provide management and administrative support for the objectives of the NASA Goddard's OC as described in more detail under requirements, above, which are as follows: video production, video acquisition and camera operation, video editing, studio management, media SAN, animation and motion graphics, and production management, equipment purchases, equipment management and satellite media tours.

5	**Wallops Launch Support**

5.1	The contractor shall provide multimedia and television support for video recording and live broadcast of two Antares launches. This includes support for documentation, broadcast press conferences, social media activities, media events, and launch commentary.
5.2	The contractor will provide equipment recommendations, cost estimates, and purchase equipment to support Wallops Flight Facility's required launch broadcasts. This equipment may include cameras, camera control hardware and software, video and audio recording equipment, lights, control room hardware and software, monitors and microphones.
5.3	The contractor shall coordinate the use of NASA TV and NASA.gov infrastructure to distribute launch coverage and video products via broadcast satellite and internet. The contractor shall purchase satellite time when necessary.

7	**Navigation and Mission Design Branch Multimedia Support**
7.1	The contractor shall provide multimedia products in support of the International Astronautical Federation (IAF).
7.2	The contractor shall produce IAC TV at the 70th Annual Congress, held in Washington DC, 21st - 25th October 2019.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 23
Modification: 3
Task Name: Terra Spacecraft Sustaining Engineering

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	06/30/2018	06/29/2019	CY2
2	09/13/2018		Admin Mod
3	06/30/2019	06/27/2020	CY3; Added travel section and clarification for retrograde and passivation preparations

II. Task Overview

The Terra Spacecraft Sustaining Engineering task provides Terra Spacecraft Engineering expertise to ESMO and the Terra Flight Operations Team in support of Terra Operations and Anomaly Resolution.

III. Requirements

1	Terra Sustaining Engineering
1.1	The contractor shall provide support and conduct analysis of Terra spacecraft anomalies and special spacecraft activities.
1.2	The contractor shall participate in Anomaly Review Boards when requested by the Terra Mission Director, review and advise on proposed recovery activities, and may be asked to provide other discipline experts as needed to support anomaly investigation and resolution.
1.3	The contractor shall review Terra Inclination Maneuvers and subsystem performance.
1.4	The contractor shall provide consultation to Terra Flight Operations Team Subsystem Engineers in the areas of Guidance, Navigation and Control; Thermal Control; Flight Software; Command and Data Handling; Communications; and Electrical Power.
1.5	The contractor shall support the Flight Software Maintenance Team to evaluate flight software code modifications, review code modifications planned for implementation, and results of tests and simulations.
1.6	The contractor shall provide consultation for Terra Simulator issues.
1.7	The contractor shall support End of Life Planning and Preparation Activities including retrograde maneuver capabilities and passivation.

1.8	The contractor shall ensure availability and competency of the work force necessary to execute the management and technical activities required to support the Terra mission.
1.9	The contractor shall improve plume impingement model as needed. This is to improve understanding of propulsive maneuver stability with the solar array at various positions.
1.10	The contractor shall support weekly Mission Director Top Ten Status meetings.
1.11	The contractor shall support and provide recommendations on Battery Management.
1.12	The contractor shall support the Flight Operation Team in providing Automation recommendations regarding Solid State Recorder.
1.13	The contractor shall support the Flight Operation Team and developing concepts and providing recommendations regarding Drag Make-Up Maneuver streamlining as requested. Streamlining the maneuver process is critical improve response time for High Interest Events regarding Conjunction Assessment.
1.14	The contractor shall review, with specific knowledge of the Ball CT-601 Star Tracker, Star Tracker performance and provide additional information about how the star trackers work, validation of root cause investigation conclusions and recommended recovery and/or enhancement actions as requested.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The contractor shall propose travel that they identify as necessary to perform the work associated with this task order.

The proposed travel should include:

Travel Description	**Approximate Time Frame**
Onsite Visit – Greenbelt, MD (3 days meeting with FOT and MD) 1 Terra Spacecraft Subject Matter Expert (SME)	Sept-Oct 2019
Onsite Visit – Greenbelt, MD (3 days meeting with FOT and MD) 1 Terra Spacecraft Subject Matter Expert (SME)	March-April 2020

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Technical report summarizing support provided to FOT subsystem engineers, and flight software maintenance team. (Last day of August and Last day of February)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 24
Modification: 2
Task Name: SARLab IT Security Engineering

GSMO-2 SOW Reference: 2.4.9

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	08/25/2018	08/24/2019	Continuation of task for another performance period.
2	08/25/2019	08/29/2020	Continuation of task for another performance period, and adds tasking to assist the project with trade studies involving operational SARSAT assets. The task is thus divided into two separate subtasks representing the continuation of current work and separately trade studies.

II. Task Overview

The SARLab IT Security Engineering task provides expert assistance with interpreting and implementing IT Security for the Search and Rescue Laboratory (SARLab), and provides system administration of all systems, interfacing as needed with developers and other project staff to ensure security and integrity of systems and processes.

III. Requirements

	Subtask 1: SARLab IT Security Engineering
1	**SARLab IT Security**
1.1	The contractor shall assist with interpreting and implementing IT Security changes that are frequently received (i.e. SP 800-53 Rev 4, NPR 2810.1A, NITRs, NCAD, NATT, NAMS, Data at Rest Encryption, etc.)
1.2	The contractor shall provide continuous monitoring analysis/reporting.
1.3	The contractor shall provide vulnerability scanning, risk mitigations and maintain POA&M updates/monthly reporting.
1.4	The contractor shall support contingency plan testing and documentation.
1.5	The contractor shall attend required meetings: • Bi-Weekly FPD IT Management and Security meeting. • Agency/Center IT related meetings.

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1.6	The contractor shall update the SARLab IT Security documentation (SAIV, Risk Assessment and Contingency Plan) to comply with the most current NIST SP 800-53 Revision.
1.7	The contractor shall build a vulnerability scanner on project-provided hardware, and establish and document a SARLab SOP for quarterly scans.
1.8	The contractor shall collect, review, and close GEMINI tickets for the visitor log and keycard access log on a monthly basis.
	SARLab IT System Administration and Engineering
1.9	The contractor shall provide Senior System Administrator support with familiarity of satellite tracking ground stations, to include but not limited to: i. System Audit and Event Log Monitoring. ii. Splunk monitoring and configuration management. iii. Backups and / or disk Images. iv. General patching and SOC-MAR notification patching Vulnerability mitigation. v. Transition systems with an end of life operating system on a case-by-case basis as the project provides replacement systems. vi. Continue to enhance the security posture within the lab. vii. Replace the network switches and continue to clean up existing network wiring, document, color code, and label cables. viii. Deploy a new system admin file share to store backups. ix. Maintain SARLab IT standard operating procedure(s) as processes change. x. Assist in integrating new MEOLUT and new antenna equipment into the existing SARLab IT security infrastructure. ~~xi.~~ Support the new Federal IT security Continuous Diagnostic Monitoring (CDM) effort. xii. Evaluate and establish the use of a local WSUS server to better implement Windows updates. xiii. Per ITS-HBK-2810-07.01, monitor the ongoing compliance of GPO baselines, to which SARLab information systems are built in a manner consistent with organizationally defined values. Document any and all deviations from baseline configurations, as defined by the Agency Security Configuration Standards (ASCS). This may include collaborating with NOAA and the MEOLUT vendor to apply a common solution consistent with NASA baselines. xiv. Review firewall rules annually, or after significant changes, with the NetOps team and report recommendations. xv. Maintain elevated privileges training xvi. Maintain the most current Symantec on all managed workstations. Verify weekly scanning and document any waivers. Evaluate the use of the managed client.

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1.10	The contractor shall provide domain administration within the SARLab, including managing accounts, access level permissions, permission groups, the local DNS and IP Address allocation. Domain Administration is a task that is to be managed locally, in-house by the system administrator.
1.11	The contractor shall attend required meetings:. - SAR Project weekly staff meetings (occasional, as requested) - Monthly SARLab Ground System tag-up
1.12	Provide IT quality control across all SARlab systems, working with other contractors and ground system developer to ensure secure systems and protection.
1.13	The contractor shall provide Network Engineering support for firewall changes, equipment upgrades, and firewall change requests upon request by SAR Mission Office.
	Subtask 2: SARSAT Operations Trade Studies
2.1	The contractor shall provide IT System and Security expertise as part of a study on the requirements, risks, and benefits associated with transitioning U.S. SARSAT operational assets to the NASA SAR Office.
2.2	As part of a transition team, the contractor shall review Operational SAR system documentation, from a NASA point of view, and work with the transition team to assess the feasibility of bringing SARSAT operations to NASA Goddard Space Flight Center.
2.3	The contractor shall provide summaries of current NOAA systems to the transition lead, through meetings and reviews with NOAA system administrators and engineers.
2.4	The contractor shall assist in developing a set of IT Security and ground system requirements for incorporating a U.S. SARSAT Mission Control Center (USMCC) at GSFC.
2.5	The contractor shall develop and assess risks and schedules for transitioning assets from NOAA and the U.S. Coast Guard to NASA.
2.6	The contractor shall work with ground system personnel in the Building 13 Network Integration Center to understand the facility and create plans for hosting the USMCC.
2.7	The contractor shall assist the transition team lead in developing a Transition Plan for this effort.

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IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The Government will provide the facilities and the facility services for the SARLab.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose local travel that they identify as necessary to perform the work associated with this Task Order. It is anticipated that his travel will only include local travel to, for example, Suitland, MD to discuss trade studies with NOAA personnel.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order. In addition, the contractor will provide a weekly technical summary to the Project describing work accomplished, issues and anomalies, and plans for the following week.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Ref#	Deliverables	Due Date
1	Monthly Status Report a) Accomplishments - Details of all work accomplished on each item for the reporting period. - Include percentage of work accomplished on each item b) Action Item Status - From previous meetings including the McMurdo the SARLab weekly status meetings c) Program Issues and Status - Status of each trouble ticket item submitted by SAR. - Detailed list of all repairs or modifications made to the system hardware or software. - Network Operational and IT System status, and any impacts to the LEO/GEO or MEOLUTs, RCCNet, MCCNet and associated McMurdo systems.	Monthly- report to cover full previous month, due on 5th of next month.

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	- Work performed, resolution of problems and status of fixes for any IT security vulnerabilities. - Issues that require government action d) Maintenance Record (see attached spreadsheet) e) Schedule - Changes from last month's report shall be clearly identified - One month look-ahead planning calendar – Work planned for the next reporting period	
2	Weekly Technical Summary	Weekly – report to cover the previous week, due every Friday.
3	Annual SARLab Assessment and Authorization (A&A) Documentation (DRAFT)	45 days following request
4	Annual SARLab A&A Documentation (FINAL)	Due 15 days after SARLab IT Security documentation draft completion
5	Updates and Patching - Windows Updates - NASA SOC-MAR notifications - Java Updates acrossed all systems - Browser (Firefox) Updates - Symantec Full Scans	 - Monthly or biweekly (as required) - Weekly - As required - As required - Weekly
6	NOAA system summary report, to include (but not limited to) the following pieces of information: - NOAA IT Security plans, policies and procedures, - NOAA system architecture and security boundaries, - USMCC system boundaries and administration requirements - US LEO/GEO/MEO LUT system architecture, boundaries and administration requirements	December 15, 2019 Ref. requirement 2.3
7	NASA USMCC IT Security Requirements input (Draft)	April 1, 2020
8	NASA USMCC Ground System Requirements input (Draft)	June 1, 2020
9	Transition schedules	As requested by Transition Lead
10	Transition risk assessment – monthly input	Monthly, beginning October 1, 2019
11	Transition Plan input	As requested by Transition Lead

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Maintenance Records / hardware & software												
				Information System Components			Contact Info for Maintenance		Offsite Maintenance Information			
Date	Time	System Administrator Name	Detailed description of Maintenance	Software component	Hardware property tag	part/model/serial numbers	Name/ Company	Phone	RMA	Shipping address	Tracking No.	Case No.

Provide the attached spreadsheet on a monthly basis in addition to the monthly report.

- Hardware property tag – enter property tag of system being worked on if onsite, enter "RDP" plus computer hostname if it was remote maintenance
- RMA – return merchandise authorization for equipment that was return to a vendor for service, for example return to "HP or Dell", enter McMurdo if hardware was moved to McMurdo facility for repair.
- Enter N/A if not applicable

* See NASA Directive SARL-ITS-SOP-002 for descriptions of the elements in this table.

End of Task Order Statement of Work

Page 3: [1] Deleted **Foster, Anthony W. (GSFC-4503)** **8/1/19 12:27:00 PM**

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 27
Modification: 3
Task Name: SET Mission Operations

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GSMO-2 SOW Reference: 3.1, 3.2, 3.3

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	06/26/2017	08/24/2018	Revise proposed scope resulting from the SET launch delay to NET April 30, 2018.
2	08/25/2018	08/24/2019	Revise proposed scope resulting from the SET launch delay to NET November 30, 2018.
3	08/25/2019	08/29/2020	Extend by one year.

II. Task Overview

The SET Mission Operations task provides mission operations preparation support, systems engineering support, and documentation support for the SET Project in the interim period following SET-1 delivery to the DSX Program, launch, and one-year of operations.

III. Requirements

1	SET Mission Operations
1.1	The contractor shall support testing of Ground Data Systems as directed by the Ground Data Systems Manager.
1.2	The contractor shall participate in Fault Tree Analysis (FTA) and Failure Modes and Effects Analysis (FMEA) generation.
1.3	The contractor shall conduct a pre-launch simulation and training program. The DSX Program will be responsible for scheduling mission simulations.
1.4	The contractor shall support the maintenance of programmatic documents and quality records for the SET Project.
1.5	The contractor shall provide engineering support for meetings including, but not limited to, Test Conductor meetings, and Operations Working Group meetings, as needed.
1.6	The contractor shall support the Mission Operations Readiness Review (MORR) in October 2018 and Mission Readiness Review (MRR) in November 2018.
1.7	The contractor shall provide analytical support to ensure that the SET Project requirements are verified and met for operations activities.
1.8	The contractor shall provide support to the SET Science Data website to distribute science /ancillary data products and provide maintenance.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 28
Modification: 4
Task Name: Fermi Spacecraft Sustaining Engineering and Anomaly Support

GSMO-2 SOW Reference: 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	02/22/2018	Initial task order statement of work.
1	02/24/2018	02/22/2019	1 year extension, no change to SOW
2	03/16/2018	05/31/2018	Add support for Fermi -Y SADA anomaly under Subtask 2
3	06/18/2018	09/15/2018	Extend support for Fermi -Y SADA anomaly under Subtask 2 for 3 months
4	02/23/2019	02/22/2020	One year extension

II. Task Overview

The Fermi Spacecraft Sustaining Engineering and Anomaly Support task provides system engineering for the spacecraft bus and all of the spacecraft subsystems in the analysis and resolution identification of problems encountered.

Subtask 1: Covers all work associated with Monitoring of Spacecraft Bus and Subsystems Support.
Subtask 2: Covers all work associated with Anomaly Analysis and Resolution Support.
Fermi -Y SADA anomaly: 03/16/2018 – 09/15/2018 COMPLETED

III. Requirements

1	Monitoring of Spacecraft Bus and Subsystems Support
1.1	The contractor shall monitor the spacecraft bus and subsystems utilizing ITPS or ITPS trending reports generated by the FOT to look at long term component performance.
1.2	The contractor shall support the identification and characterization of existing and emerging system levels risks, and participate in the development and implementation of mitigation plans.
1.3	The contractor shall use ITPS or ITPS trending reports generated by the FOT to respond to inquiries from the FOT, the Project Scientist, the MD, or other team members.
1.4	The contractor shall advise the Mission Director and the Project Scientist of any observed performance trends of concern.

2	Anomaly Analysis and Resolution Support
2.1	The contractor shall immediately support anomaly analysis and resolution as determined in the negotiated task modification.
2.2	The contractor shall advise the MD and the FOT regarding the impact of the identified anomaly on the affected system, systems, or the performance of the Observatory.
2.3	The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Observatory.
2.4	The contractor shall also participate in the determination of root cause as related to the spacecraft bus.
2.5	The contractor shall submit or contribute to an anomaly report containing spacecraft anomaly conditions, insights on root cause related to the spacecraft, and corrective or preventive actions for each anomaly.
2.6	The contractor shall closely coordinate efforts through all phases of Anomaly Resolution with the MD and the FOT.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 29
Modification: 2
Task Name: cFS Software Development

GSMO-2 SOW Reference: 2.4.7, 2.4.10

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	8/25/2018	08/24/2019	One year task extension with additional funds
2	8/1/2019	08/29/2020	One year task extension with additional funds

II. Task Overview

The Contractor shall develop flight and ground software along with associated development tools for the core Flight Systems (cFS) as directed. The work includes application, operating system and device driver software with a focus on real-time embedded Linux (Xenomai), multi-core, networking, and deterministic cFS enhancements.

III. Requirements

1	cFS Software Development
1.1	The contractor shall develop software consistent with the relevant software classification level in NPR 7150.2B.
1.2	The contractor shall assist in installing and configuring development and ground system tools.
1.3	The contractor shall deliver all source code, test procedures and software artifacts developed under this SOW.

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment or software associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
The contractor will use software development workstations and associated hardware located primarily in the Building 23 flight software technology lab.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

All source code, test procedures, install scripts, tools and software artifacts developed under this SOW. (End of task)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 29
Modification: 3
Task Name: cFS Software Development

GSMO-2 SOW Reference: 2.4.7, 2.4.10

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	8/25/2018	08/24/2019	One year task extension with additional funds
2	8/1/2019	08/29/2020	One year task extension with additional funds
3	12/15/2020	08/29/2020	Add funds, clarify prototyping nature of software

II. Task Overview

The Contractor shall develop flight and ground software along with associated development tools for the core Flight Systems (cFS) as directed. The work includes applications, operating systems, device drivers, and software with a focus on real-time embedded Linux (Xenomai), multi-core, networking, and deterministic cFS enhancements. This software is prototyping code and provided only as a reference implementation for external flight and ground projects.

III. Requirements

1	cFS Software Development
1.1	The contractor shall develop prototype software consistent with the relevant software classification level in NPR 7150.2C.
1.2	The contractor shall assist in installing and configuring development and ground system tools.
1.3	The contractor shall deliver all source code, test procedures and software artifacts developed under this SOW.

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment or software associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description

The contractor shall have use of software development workstations and associated hardware located primarily in the Building 23 flight software technology lab.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

All source code, test procedures, install scripts, tools and software artifacts developed under this SOW. (End of task)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 30
Modification: 4
Task Name: SSMO Multi-Mission MOC

GSMO-2 SOW Reference: 3, 3.3, 3.7.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	02/23/2018	Initial task order statement of work.
1	02/24/2018	02/23/2019	1 Year Extension, no changes to SOW
2	10/01/2018	02/23/2019	Assume NaaS OD support
3	10/01/2018	02/22/2019	Administrative Change. Change of Task Monitor.
4	02/23/2019	02/22/2020	1 Year Extension. Perform NaaS maneuver support.

II. Task Overview

The SSMO Multi-Mission MOC task provides mission operations for the SSMO Multi-Mission MOC (ACE, WIND, and Geotail).

Subtask 1: Covers all work associated with ACE Flight Operations support.
Subtask 2: Covers all work associated with ACE DSN Scheduling support.
Subtask 3: Covers all work associated with ACE System administration and IT Security support.
Subtask 4: Covers all work associated with ACE HW/SW/Configuration Management support
Subtask 5: Covers all work associated with WIND Flight Operations support.
Subtask 6: Covers all work associated with WIND DSN Scheduling support.
Subtask 7: Covers all work associated with WIND System administration and IT Security support.
Subtask 8: Covers all work associated with WIND HW/SW/Configuration Management support
Subtask 9: Covers all work associated with Geotail Flight Operations support.
Subtask 10: Covers all work associated with Geotail DSN Scheduling support.
Subtask 11: Covers all work associated with Geotail System administration and IT Security support.
Subtask 12: Covers all work associated with Geotail HW/SW/Configuration Management support

III. Requirements

The 4 requirements tables below are divided into principle areas of support for each mission. Requirements that apply to only 1 or 2 of the missions are clearly noted.

Subtasks 1/5/9	**Flight Operations support-ACE, WIND, and Geotail**
w.1	The contractor shall perform mission operations and mission support service in support of the on-orbit ACE, WIND, and Geotail spacecraft and the instrument teams.
w.2	The contractor shall meet minimum data recovery requirements as defined by the mission and will make every effort to achieve the data recovery goal set by the mission.
w.3	The contractor shall maintain documentation, plans and procedures as required to support mission operations and mission support activities.
w.4	The contractor shall interface with DSN for requesting Data Capture Delivery (DCD) data as required.
w.5	The contractor shall support ground system interface testing as necessary.
w.6	The contractor shall document mission level anomalies in a Government approved anomaly reporting system.
w.7	The contractor shall identify, analyze, resolve, and track anomalies. The contractor shall notify the Mission Director of significant or critical anomalies within 24 hours.
w.8	The contractor shall provide a Root Cause & Corrective Analysis (RCCA) for operator induced anomalies within 5 business days.
w.9	The contractor shall support risk identification, analysis, and resolution, including supporting the SSMO annual risk assessment questionnaire.
w.10	The contractor shall maintain a list of all hardware that resides in the MOC and provide an updated list annually.
w.11	The contractor shall manage all hardware and shall support the SSMO logging of hardware in N-PROP.
w.12	The contractor shall provide all office supplies and consumables needed.
w.13	The contractor shall participate in Configuration Control Boards as appropriate.
w.14	The contractor shall maintain and adhere to all appropriate documentation ie; Interface Control Documents (ICDs), Project Service Level Agreement (PSLAs), Configuration Management Plan, Flight Operations Procedures, red/yellow limit checks, RTS trip responses, etc.
w.15	The contractor shall maintain Configuration Management over all operations products including the T&C Database, Display Page Definitions, STOL Procedures, Flight Ops Procedures FOPs, and baseline configuration files for the MOC subsystems.
w.16	The contractor shall manage all configuration changes via the Mission Operations Change Request (MOCR) system.

w.17	The contractor shall provide a Flight Operations Team (FOT) that is able to support a 8 x 5 nominal shift but also support lights-out operation 24 x 7.
w.18	The contractor shall provide appropriate classroom and on-the-job training for all new FOT members.
w.19	The contractor shall provide a FOT certification process and maintain certification records.
w.20	The contractor shall update and maintain FOT training and certification material as needed.
w.21	The contractor shall ensure all FOT members are cross trained in all operations and shall rotate operations responsibilities semi-annually.
w.22	The contractor shall support SSMO initiatives including Data Archive Tool (DAT), Telemetry as a Service (TaaS), Navigation as a Service (NaaS) and SSMO Orbit Determination (OD), Dashboard, and Configuration Management Audit/Alignment.
Subtasks 1/5	**Flight Operations support-ACE and WIND**
w.23	The contractor shall assume NaaS OD support (ACE) and train in and perform NaaS Maneuver support (ACE and Wind).
w.24	The contractor shall plan and execute daily operations, including telemetry downlink; health and safety monitoring; command load generation, verification, and uplink; onboard table and memory load/dump operations; management of the on-board recorders; and management of the spacecraft clock as per the Flight Operations Plan.
w.25	The contractor shall perform spacecraft maneuvers as required, including weekly attitude maneuvers, regular Station Keeping maneuvers, periodic Spin Down maneuvers and quarterly Mid-Course Correction maneuvers.
w.26	The contractor shall collect and store housekeeping and health and safety data.
w.27	The contractor shall interface with other organizations/systems to acquire all required mission engineering data, including the PWG Data Processor for WIND engineering data.
w.28	The contractor shall process, trend, analyze, and report housekeeping and health and safety data on a short-term, long-term, and periodic basis.
w.29	The contractor shall present trend data at Quarterly Reviews. The contractor shall identify parameters that are showing performance degradation over time.
w.30	The contractor shall provide off-line engineering support for the ACE and WIND spacecraft and their instruments for all special engineering activities and contingency operations.
w.31	The contractor shall execute pre-approved procedures for known spacecraft anomalies.
w.32	The contractor shall work with the Mission Director, the Project Scientist, the system engineers, and other team members to develop and test a response to new anomalies. The contractor shall support Anomaly Review Boards, as required.

w.33	The contractor shall plan, rehearse, simulate, perform and assess in real-time any special or contingency operations.
w.34	The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.
w.35	The contractor shall maintain analysis tools as required for off-line engineering support of normal and special flight operations activities and contingency analysis activities.
w.36	The contractor shall support SSMO annual contingency failover exercise.
Subtasks 5 and 9	**Flight Operations support-WIND and Geotail**
w.37	The contractor shall provide Level Zero Processing (LZP) and data distribution.

Subtasks 2/6/10	**DSN Scheduling support-ACE, WIND, and Geotail**
x.1	The contractor shall secure adequate communications services through the Deep Space Network (DSN) for the delivery of S/C and instrument telemetry to the ground and the commanding and tracking of the S/C.
x.2	The contractor shall plan, provide, and implement a conflict-free DSN schedule of activities for all S/C contacts, S/C special event activities, and instrument operations.
Subtasks 2	**DSN Scheduling support-ACE only**
x.3	The contractor shall secure additional communications services through the Space Network (SN) WS-1 to supplement DSN services when necessary to meet mission downlink requirements. **(Subtask 2 ONLY)**

Subtasks 3/7/11	**System Administration and IT Security Support-ACE, WIND, and Geotail**
y.1	The contractor shall provide system administration support for all systems within the MMOC.
y.2	The contractor shall comply with all GSFC/SSMO IT Security policies, including annual contingency failover exercise; system level scanning; and patching requirements.
y.3	The contractor shall provide system administration support for all ground system configuration changes
y.4	The contractor shall manage all configuration changes via the Mission Operations Change Request (MOCR) system.

Subtasks 4/8/12	HW/SW/Configuration Management Support-ACE, WIND, and Geotail
z.1	The contractor shall maintain and execute a MOC Configuration Management (CM) Plan for operational products.
z.2	The contractor shall operate and maintain a Government approved CM system. This system shall be used to manage change requests for space and ground hardware and software as well as technical/procedural operations changes and the documentation necessary for the operation and maintenance of the ACE, WIND, and Geotail spacecraft and the ground-based mission operations systems.
z.3	The contractor shall follow all procedures and guidelines specified in the MMOC CM Plan in proposing, analyzing, implementing and recording HW/SW changes to systems associated with the MMOC.
z.4	The contractor shall support HW upgrades and/or changes as required including those required to maintain critical mission interfaces.
z.5	The contractor shall support SW upgrades and/or changes as required including those required to maintain critical mission interfaces.
z.6	The contractor shall document all HW/SW changes in the MOCR system.
z.7	The contractor shall ensure that all configuration changes are appropriately tested and documented prior to installation within the operational environment.
z.8	The contractor shall maintain a library of current operating documents and reports for the ACE, WIND, and Geotail missions. This library, located in Building 3, shall serve for • Repository of the mission history files • Reference library for flight operations training • On-console reference library for flight operations activities • Repository of flight operations procedures, pass plans, engineering reports, special reports and daily reports • Repository for manufacturer provided documentation

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The Government will provide the facilities and the facility services for the primary Multi-Mission MOC including all networks, hardware and system software necessary to support Multi-Mission MOC activities and interfaces.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID

Integrated Test and Operations System (ITOS) (NASA/GSFC Code 583)	GSC-16025-1
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) (NASA/GSFC Code 595)	GSC-15811-1
Command Management System (CMS)	
Level Zero Processor (LZP)	
Trending and Plotting System (TAPS)	
Multi-Mission Spin-Axis Stabilized Spacecraft (MSASS)	
Multi-User Space Link Extension (SLE) (MUS)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 031
Modification: 4
Task Name: GPM GMI Instrument Sustaining Engineering

GSMO-2 SOW Reference: 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	09/14/2017		RA change
2	06/30/2018	06/29/2019	Task Mod Extension for 2018-2019
3	11/01/2018	06/29/2019	(b) (4) [redacted]
4	06/30/2019	06/27/2020	Task Mod Extension for 2019-2020

II. Task Overview

The GPM GMI Instrument Sustaining Engineering task provides GPM Microwave Imager (GMI) instrument engineering expertise to ESMO and the GPM Flight Operations Team in support of GMI Operations, Anomaly Resolution and long term trending of critical parameters.

III. Requirements

1	GPM GMI Instrument Sustaining Engineering
1.1	The contractor shall provide support and conduct analysis of GMI instrument anomalies and special spacecraft/instrument activities.
1.2	The contractor shall participate in Anomaly Review Boards when requested by the GPM Mission Director, review and advise on proposed recovery activities, and may be asked to provide other discipline experts as needed to support anomaly investigation and resolution.
1.3	The contractor shall ensure availability and competency of the work force necessary to execute the management and technical activities required to support the GMI operations.
1.4	The contractor shall review any special GPM maneuvers or GMI special activities and instrument performance.
1.5	The contractor shall support monthly FOT-led Monthly Status Reviews, not Project Status Reviews (PSRs), to stay current on GPM and GMI operations.
1.6	The contractor shall support GMI Performance review meetings three (3) times per year to review instrument trending and life limiting items.
1.7	The contractor shall provide review of all new, updated or altered GMI command procedures to ensure correct execution, as requested.

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1.8	The contractor shall provide for research and inquiry requests pertaining to the residual GPM hardware at Ball.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 032
Modification: 5
Task Name: GPM Mission Operations Support

GSMO-2 SOW Reference: 3.3, 3.4, 3.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	08/31/2017		Administrative Mod for RA
2	03/12/2018	06/29/2018	Addition of 1.2.62 & 1.2.63 requirements for FDS.
3	06/30/2018	06/29/2019	Contract Extension for 2018-2019 Moved requirement 1.2.63 to 1.2.62 (ISS Spt) Rewrote requirement 1.2.63 (CARA Transition) Updated Deliverable 1 due date to 12pm from 2pm
4	10/30/2018	06/29/2019	Replan modification from vendor
5	06/30/2019	06/27/2020	Contract Extension for 2019-2020 Added Requirement 1.2.64 (CARA Devolution) Updated Requirement 1.3.3 from GSIM to MOWG

II. Task Overview

The GPM Mission Operations Support task provides support to the ESMO Mission Director (MD) to complete all required activities associated with the GPM Mission Operations effort.

III. Requirements

1	**GPM Mission Operations**
1.1	**Spacecraft Operations**
1.1.1	The contractor shall coordinate all activities related to the Dual Precipitation Radar (DPR) science data acquisition and instrument activities.
1.1.2	The contractor shall inform the Mission Director regarding any instrument team (DPR or GMI) request to perform special or non-nominal activities.
1.1.3	The contractor shall support instrument teams in testing and checking of new or modified procedures.
1.1.4	The contractor shall perform testing (via FlatSat or other necessary methods) to the extent possible prior to the uplink of any new commands/procedures for the DPR or GMI instruments.
1.1.5	The contractor shall coordinate with the Mission Director with any activity requiring the concurrence of the instrument teams and/or Project Scientists.

1.1.6	The contractor shall inform and coordinate any specific payload activities with the instrument operation team. This includes analysis, consultation and resolution of any anomalous events or out of limit conditions observed during analysis and real-time events.
1.1.7	The contractor shall coordinate communications services through the Near Earth Network (NEN) and Space Network (SN), or other government provided communications networks for the delivery of spacecraft and instrument telemetry to the ground and the commanding and tracking of GPM Core spacecraft.
1.1.8	The contractor shall work with the SN and NEN to resolve schedule conflicts for activities for all spacecraft contacts, spacecraft activities, and instrument operations that is consistent with the overall GPM Core spacecraft mission operations requirements.
1.1.9	The contractor shall support all real-time operations of the GPM Core spacecraft from both ground and space networks, as necessary to meet mission objectives. Real-time operations consist of those activities that are necessary to support direct communication with the spacecraft and include: telemetry, tracking and command activities, health and safety monitoring, orbital maintenance maneuvers, system configuration, housekeeping telemetry processing, command load uplink and verification, onboard table and memory load/dump operations, and management of the Solid State Recorder (SSR) to capture and downlink all science and spacecraft engineering data. Support operations are those offline activities that are necessary to support the safe and nominal operation of the spacecraft and include, but not limited to: planning and scheduling, stored command load generation, maneuver planning support, and any spacecraft maintenance activity.
1.1.10	The contractor shall provide a dedicated online staff of experts to monitor and maintain the health of the GPM Core spacecraft, collect telemetry data and process all health and status telemetry data to assess the performance of each spacecraft subsystem and instrument.
1.2	**Spacecraft Engineering**
1.2.1	The contractor shall provide a dedicated staff of experts to monitor and maintain the health of the GPM Core spacecraft, collect telemetry data and process all health and status telemetry data to assess the performance of each spacecraft subsystem and instrument.
1.2.2	The contractor shall provide off-line engineering staff for technical leadership of the Flight Operations Team (FOT) and be responsible for ensuring all aspects of spacecraft performance and safety.
1.2.3	The contractor shall monitor and maintain the health of the GPM Core spacecraft by collecting telemetry data and processing all health and status telemetry data and assess the performance of each spacecraft subsystem and instrument.
1.2.4	Anomalies The contractor shall note that an anomaly is defined as the occurrence of any event that causes the spacecraft, its instruments, or any of the ground-based

	support systems to perform in a non-standard manner during any normal or special operation. An anomaly may occur in either on-orbit or ground-based elements of the mission operations system.
1.2.5	The contractor shall, in response to any deviation to normal spacecraft operations, issue an Event Report (ER) to document the deviation. ERs are to be issued upon detection, within operational constraints, as a quick notification to the team and to ESMO (not as a full report).
1.2.6	The contractor shall issue Event Reports that contain the following information (as applicable): • Time of Anomaly • Pass information • Service information • Problem and impact description • Spacecraft Lat/Lon • Location of failure • Cause if known • Action taken
1.2.7	The contractor shall generate and track ERs that are deemed to be Operator Errors. ER is an informational notification, and not a problem report or other discrepancy report to be tracked to full closure, and are meant to be issued quickly for dissemination of anomalous information. However, some ERs will necessarily lead to ground system, spacecraft or other problem report to be tracked in the respective process.
1.2.8	The contractor shall, in response to any spacecraft anomaly, execute government pre-approved standard operating procedures and/or spacecraft commands.
1.2.9	The contractor shall, in response to spacecraft anomalies that do not have a pre-approved response and the spacecraft is not in imminent danger of loss of mission, defer sending corrective action spacecraft commands without the approval of the Mission Director. The Mission Director may require the Contractor to conduct anomaly investigations as needed to assess on-orbit problems and formulate a response using the appropriate in-house and corporate expertise.
1.2.10	The contractor shall perform testing (via FlatSat or other necessary methods) to the extent possible prior to the uplink of any new spacecraft commands/procedures.
1.2.11	The contractor shall be responsible for support of anomaly resolution activities as defined in this section.
1.2.12	The contractor shall report to the Mission Director all anomalies that occur to the spacecraft, the instruments, the mission operations facilities, or other areas that impact the operation or safety of personnel and equipment.
1.2.13	The contractor shall submit anomaly reports in accordance with NASA/GSFC's Code 400 Flight Programs and Projects Directorate Anomaly Notification Procedures and Guidelines and ESMO's Anomaly Management Procedures.

1.2.14	The contractor shall provide a summary of the anomaly via e-mail within one business day. If the anomaly is mission threatening, the Mission Director shall be notified immediately. The definition of an anomaly for the operational phase of the mission is as follows: • Any spacecraft or ground system component not operating or functioning as expected does not perform as expected, or exhibits behavior considered being different than normal. • Any flight operations procedure, or stored command activity, that produces unexpected results or fails to produce its desired results. • Any yellow or red limit violation on any telemetry parameter, or status flags in telemetry, which indicate an error has occurred, or abnormal trends in telemetry data. • Any configuration or state of the spacecraft that is unexpected or potentially harmful to the health and safety of the spacecraft or instruments. • Any other abnormal event or behavior that could potentially indicate a malfunction of the flight or ground system hardware or software.
1.2.15	The contractor shall work all anomalies to resolution, and document closure within the Anomaly Reporting system. The Mission Director, or designee, is responsible for generation of all formal NASA Anomaly Reports.
1.2.16	The contractor shall provide reports that describe how the anomaly was discovered, what were the results of the anomaly investigation, the impact of the anomaly, any interim work-around (if required), and the final resolution of the anomaly.
1.2.17	The contractor shall provide an Anomaly Closeout Report to the Mission Director within 10 business days of resolution of the anomaly.
1.2.18	The contractor shall maintain a database of all spacecraft and ground-based flight operations anomalies.
1.2.19	The contractor shall report on the status of all open anomaly investigations at all monthly status reviews or as requested by the Mission Director.
1.2.20	The contractor shall, as required, enter spacecraft anomalies on a case-by-case basis into the GSFC Spacecraft Orbital Anomaly Reporting System (SOARS). The ESMO MD will determine which anomalies require SOARS entry.
1.2.21	The contractor shall participate in Anomaly Support Team (AST) meetings as requested by the Mission Director.
1.2.22	The contractor shall implement corrective actions as determined by the Mission Director.
1.2.23	The contractor shall, under the oversight of the Mission Director, have responsibility for analysis and resolution of anomalies that are determined to be the result of performance or failure of a ground-based system or subsystem, or a result of procedural error.
1.2.24	The contractor shall collect and store the housekeeping data (which includes all health and safety data) and from the GPM Core spacecraft.
1.2.25	The contractor shall process, trend and analyze these data on a short-term, long-term and periodic basis depending on the specific parameters and objectives.

1.2.26	The contractor shall identify any parameters that might demonstrate unacceptable performance degradation with time and trends that could lead to future performance loss or degradation of flight hardware in the Weekly Spacecraft Performance Report. Data Capture Statistics and Latency Performance (for data delivery to the MOC, but not ETE latency) shall also be reported in the Weekly Spacecraft Performance Report.
1.2.27	The contractor shall generate special activity reports as needed to support anomaly investigations, maneuver planning, and any special activity reports requested by the Mission Director.
1.2.28	The contractor shall provide off-line engineering support for the spacecraft and its instruments for all special engineering activities and contingency operations.
1.2.29	The contractor shall perform off-line, in-depth analysis in order to validate spacecraft subsystem and instrument performance as well as to investigate any anomalies or trends that may occur.
1.2.30	The contractor shall support investigations of any instrument anomalies.
1.2.31	The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.
1.2.32	The contractor shall maintain and update documentation, plans and procedures as required supporting mission operations and mission support activities.
1.2.33	The contractor shall maintain and update flight team training plans and provide the necessary training as classroom training, training exercises, and simulations.
1.2.34	The contractor shall develop and maintain spacecraft models and analysis tools as required for off-line engineering support of normal and special flight operations activities and contingency analysis activities.
1.2.35	The contractor shall maintain, on an annual basis, all End of Mission materials, including the GPM Interim End of Mission Plan, End of Mission operational products.
1.2.36	The contractor shall participate and provide support to all activities related to ground system changes or technology refresh activities.
1.2.37	The contractor shall assess the potential level of impacts and risk to normal mission operations activities for all ground system changes.
1.2.38	The contractor shall raise any issues of concerns and risk to the Mission Director as results of changes to the ground system.
1.2.39	The contractor shall support all on-line instruments and sciences activities related to calibrations, anomaly resolution, reconfiguration and planning of instrument sciences activities.
1.2.40	The contractor shall follow configuration management processes for all FOT products including documentation of new or updated products, peer review and internal sign off.
1.2.41	The contractor shall present products to the Configuration Manager at the in-house Configuration Control Board meeting prior to being finalized.

1.2.42	The contractor shall conduct all automation development and ground system implementation activities, and recommend any additional automation that could reduce operator error, streamline operations, reduce operator effort without impacting spacecraft safety and performance.
1.2.43	The contractor shall support at least one annual simulation of a recovery from a safe mode. Exercising of the team, system and products is essential to maintain readiness, if needed.
1.2.44	The contractor shall support at least one simulation of Controlled Reentry every two (2) years.
1.2.45	The contractor shall maintain a library of current operating documents and reports for the GPM Core spacecraft mission. This library shall serve as a repository for: • The mission history as captured in the weekly, monthly and anomaly reports • Flight operations training materials and certification records • On-console reference materials for flight operations activities
1.2.46	The contractor shall maintain an archive of all flight operations procedures, activity plans, timelines, and Command Authorization Meeting (CAM) presentations.
1.2.47	The contractor shall maintain updates to the existing end-of-mission plan which describes all activities which must be performed at the end of the GPM Core spacecraft mission lifetime to decommission and terminate the mission via safe ocean disposal, as required.
1.2.48	The contractor shall maintain the existing plan, which describes in detail the operational activities to operate the GPM Core Observatory.
1.2.49	The contractor shall maintain the GPM constraints and restrictions database, which identifies all known mission constraints and restrictions which must be observed when operating the GPM Core observatory, through the addition/deletion/modification of constraint information based on weekly Operations or other ESMO meetings/activities as warranted. The contractor shall track the testing of all operations constraints and restrictions and document results of testing within the database.
1.2.50	The contractor shall maintain existing version of the GPM FOT Training and Certification plan, which describes the methods to be employed to fully train and certify GPM operations team personnel for mission operations support. The contractor shall track training and certification for all flight operations team members within the guidelines of the Training and Certification Plan.
1.2.51	The contractor shall maintain Configuration Managed STOL procedures and Local Operations Procedures (LOPs) to perform routine operations scenarios, required to operate the GPM ground system and observatory.
1.2.52	The contractor shall maintain Configuration Managed STOL procedures and LOPs to recover from known operations contingencies which may occur during normal mission operations.
1.2.53	The contractor shall produce operations procedure that provide step-by-step instructions, detailing the specific activities that must be performed by the FOT to accomplish the operations scenario described by the procedure.

1.2.54	The contractor shall organize and document these procedures using the established LOP and Mission Operations Change Request (MOCR) processes.
1.2.55	The contractor shall test modifications to these procedures using appropriate flight hardware resources, including the GPM Flatsat.
1.2.56	The contractor shall produce status reports which summarize the operational products in revision.
1.2.57	The contractor shall deliver STOL Procedures and LOPs as needed to the ESMO Project.
1.2.58	The contractor shall maintain the Core S/C user manual which describes the as-built design of the Core observatory for each observatory subsystem, and describes the operating characteristics of each observatory subsystem under nominal/known anomalous conditions. The contractor shall edit this document via inputs from the GPM Core observatory development team.
1.2.59	The contractor shall assist the ESMO MD in the maintenance of Operations Agreements for the GPM GS external interfaces, including the PPS, the SN, the GN, the FDF, the DSN, the CSO, and JAXA .
1.2.60	The contractor shall assist the ESMO MD by attending regularly scheduled working group meetings with the external interface partners, researching technical issues pertaining to the operations agreement for each external interface as designated by the ESMO MD, and developing written materials for inclusion in the appropriate operations agreement as designated. The government serves as the lead author for each operations agreement indicated, the contractor.
1.2.61	The contractor shall maintain the GPM Automation Transition Plan, including the details of the phases and steps necessary to maintain automated, 8x5 operations. This document shall be updated as new or upgraded components are delivered into the MOC or EMOC.
1.2.62	The contractor shall assist the ESMO MD in the implementation and maintenance of GPM/ISS Operations Agreement and associated Appendix Z.
1.2.63	The contractor shall assist the ESMO MD in the transition of Conjunction Assessment/Collision Avoidance support from institutional Conjunction Assessment Risk Analysis (CARA) to CRMS and direct interaction with JSpOC.
1.2.64	The contractor shall provide expertise in analyzing GPM Orbital Debris Messages (ODMs) and Conjunction Data Messages (CMDs) sent from the Consolidated Space Operations Center (CSpOC) and the Space-Track.org website to the Conjunction Risk Mitigation System (CRMS). The contractor shall possess the subject matter expertise and credentials needed to directly interact with Orbital Safety Analysts (OSAs) and/or the 18th Space Control Squadron (SPCS) at CSpOC at all security levels needed and provide advice to the Mission Director to safely mitigate conjunctions reported. GPM Mission Operations includes on-orbit debris avoidance to ensure the safety of the spacecraft. In this effort, the contractor shall participate in

	technical discussions with CSpOC and the ISS Program. Both programs have TS/SCI data that may be relevant to the safety of the GPM Core Observatory's orbital environment. The CSpOC has TS/SCI data on classified orbital objects that may be relevant to GPM during collision avoidance events. The contractor shall be able to relay GPM orbital and spacecraft technical information to the CSpOC OSAs, and shall participate in discussions utilizing TS/SCI data from classified objects to safely mitigate conjunctions that threaten the safety of the GPM spacecraft.
1.3	**General Support**
1.3.1	The contractor shall attend appropriate meetings and participate in technical discussions as required in support of GPM ground system or Core Spacecraft development activities, as required by the GPM ESMO MD. The contractor shall assume technical interchange with the groups described in this section.
1.3.2	The contractor shall participate in infrequent discussions with the GMI instrument developer (BATC) to discuss GMI instrument design details and operating concepts.
1.3.3	The contractor shall participate in teleconferences/discussions with JAXA to discuss DPR instrument design details and operating concepts, as well as ground system interface and operations issues. The contractor shall participate in NASA/JAXA GPM Mission Operations Working Groups (MOWGs) and peer reviews as requested by the ESMO MD.
1.3.4	The contractor shall attend weekly operations meetings, as well as special activities at the request of the ESMO Project.
1.3.5	The contractor shall participate in occasional discussions with systems and subsystem engineering teams.
1.3.6	The contractor shall attend weekly status meetings, and shall manage and track action items resulting from the meetings.
1.4	**GPM EMOC Maintenance**
1.4.1	The contractor shall maintain the readiness of the GPM Emergency Mission Operations Center (EMOC) housed in GSFC Building 3, Room S025, via coordinated delivery of FOT controlled changes and operational products and routine operational maintenance.
1.4.2	The contractor shall interface with personnel from the Facilities Management Division and the Building Facility Operations Manager as required in the completion of this task.
1.4.3	The contractor shall periodically perform proficiency tests of the EMOC to assure the systems are ready to support emergency operations.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities or equipment associated with this Task Order.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test (ASIST) (NASA/GSFC Code 583)	GSC-16783-1
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
Goddard Mission Services Evolution Center (GMSEC) Suite of tools (NASA/GSFC Code 583)	GSC-17417-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) (NASA/GSFC Code 595)	GSC-15811-1
Flight Dynamics System Executive (XFDS) (NASA/GSFC Code 583)	GSC-15618-1
Portable Spacecraft Simulator / Linux Scalable Integrated Multi-mission Support System (PSS/LSIMSS) (NASA/GSFC Code 581)	
Attitude Ground System (AGS) (NASA/GSFC Code 595)	
Space Network Access System (SNAS) (NASA/GSFC Code 581)	GSC-16844-1
Mission Planning System (MPS) (NASA/GSFC Code 581)	
GPM MOC to PPS Interface Software System (MPISS)	
Front-End Data System (FEDS)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

Specifically, the contractor shall support the travel requirements as described in the table below:

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[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide the following deliverables in support of the Task Order:

1	**Weekly Operations FOT Priorities List** The Contractor shall generate a Weekly list of FOT priorities and status of on-going tasks, anomalies, and investigations. This list will be reviewed with the Mission director at the start of the week to prioritize work assignments and coordinate activities.	12:00pm Monday, Weekly, unless otherwise deferred due to holiday or extenuating circumstances.
2	**Weekly Spacecraft Performance Report** The Contractor shall generate Weekly Status Reports. The report shall include, as a minimum, a summary of the overall status and performance of the spacecraft and its instruments for the week, operational statistics, major upcoming activities, and status, performance, and plans for each spacecraft subsystem, flight software, and all spacecraft instruments.	Tuesday, COB following week ending past Sunday
3	**Monthly Status Report** On a monthly basis, the Contractor shall present a report on the activities of the preceding month. This report shall contain, but is not limited to, a summation of standard operational events, a listing of special activities, an accounting of instrument activities including non-nominal events, issues from the month, Non-nominal events due to FOT errors, science data collection statistics, anomaly metrics, staffing status, training/certification metrics, special initiatives, planned activities and cost/budget status. The Mission Director may require additional items to be addressed on a periodic basis. A softcopy of this report will be provided to the Mission Director and ESMO Management on the day of the presentation.	Normally scheduled the first week of the following month

4	**Annual Operations Status Review** On an annual basis, the Contractor shall present a report on the activities of the preceding year. This report shall contain, but is not limited to, a summary of Monthly Status Report items, as well as status of all operational products with regard to configuration management as well as updates to the Flight Operations Plan that have occurred as a result of events of the past year.	Scheduled in the first quarter of the year following
5	**Command Authorization Meetings** The Contractor shall collect and present technical support data for the preparation and implementation of all special spacecraft engineering activities. All special spacecraft engineering activities will be preceded by a Command Authorization Meeting (CAM). Presentation materials and products relevant to the CAM will be distributed as early as practical prior to the CAM, so that CAM attendees can review them for accuracy and prepare questions and comments in advance of the CAM.	Prior to scheduled activity, nominally the day preceding the activity
6	**Anomaly Reports** For each anomaly, the Contractor shall generate an Anomaly Report. This report shall describe how the anomaly was discovered, what were the results of the anomaly investigation, the impact of the anomaly, any interim work-around (if required), and the final resolution of the anomaly. The Anomaly Report shall be provided to the Mission Director within 10 business days of the resolution of the anomaly.	10 business days following resolution of the anomaly
6	**Event Reports** In response to any deviation to normal spacecraft operations, the Contractor shall immediately issue an Event Report (ER) to document the deviation.	Within 1 orbit of incident, within operational constraints during manned operations (including weekend alerts that require reporting to the MOC), otherwise within 4 hours of
7	**Special Activity Reports** In response to activity, not specifically an anomaly or event, the contractor shall generate a Special Activity Report to document the activity conception, process, work and results.	As requested.

8	**End-of-Mission Plan** The Contractor shall review and update the End-of-Life Plan on a yearly basis or as requested by the Mission Director.	Annually, as requested
9	**Training and Certification Plan** The Contractor shall establish, maintain and execute a formal training and certification program. The objective of this program shall be to assure mission success by cultivating a diverse, competent staff of FOT professionals. This program shall include an active process of progressive skills enhancement, cross-training and contingency operations readiness. The program shall include a matrix of FOT positions and skills with defined certification levels and targeted staff certification goals. The program shall be documented in the Training and Certification Plan. The plan shall identify what positions within the FOT are considered certifiable and what frequency of re-certification is necessary to maintain competency. The plan shall specifically address formal (classroom) training, on-the-job training (OJT), simulations and rehearsal training and cross-training. The plan shall address assumed certifications, post-training certifications, cross-position certifications and the currency of all certifiable positions. The Contractor shall report metrics on training and certification on a monthly basis.	As required and Monthly metrics report
10	**Anomaly Response Plan** The Contractor shall establish, implement and maintain a mission-level Anomaly Response Plan that's consistent with NASA/GSFC's Code 400 Flight Programs and Projects Directorate Anomaly Notification Procedures and Guidelines and ESMO's Anomaly Management Procedures.	As needed, annual review minimum.

11	**Mission Risk Management and Best Practices** The Contractor shall establish, implement and maintain a mission-level Risk Management Plan that's compliant with NPG 7120.5. In addition, the Contractor shall comply with all Agency, Center and ESMO directives regarding Risk Management and Best Practices.	As needed, annual review minimum.
12	**Operations Procedures** The Contractor shall update and revise the Operations Procedures as required to address changes in the procedures and/or operational concepts for the GPM Core spacecraft flight and ground systems.	As required and Monthly metrics report
13	**Test Reports** The Contractor shall provide findings from ground system-related testing activities performed by the FOT. The Test Report shall include Discrepancy Reports (DRs) corrected and verified, new DRs opened, and the FOT recommendation to accept and/or reject the release being tested. Test reports shall be delivered within 10 business days following test completion.	10 business days following test completion
14	**Financial Reports** The Contractor shall provide monthly 533M reports, 533Q reports and any other financial reports required to perform task planning and administrative budget planning.	**533M**: Monthly not later than 10 working days following the close of the contractors' monthly accounting period **Other**: as required
15	**Flight Operations Plan** The Contractor shall update and revise the GPM Core Spacecraft Flight Operations Plan as required to address changes in the procedures and/or operational concepts for the GPM flight and ground systems.	As needed, annual review minimum.
16	**Operations Agreements** The contractor shall update and review all Operations Agreements as required to address changes in the operations of the spacecraft.	Updates as required
17	**Project Database** The contractor shall update and review all changes to the Project Database as required to address changes in the operations of the spacecraft.	Updates as required

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 33
Modification: 05
Task Name: GEDI Ground Systems and Operations

GSMO-2 SOW Reference: 2.1, 2.2, 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
00	07/01/2017	05/25/2018	Initial task order statement of work.
01	09/30/2017	05/25/2018	Project will need increased level of I&T support to meet unique requirements for working with an ISS mission.
02			Administrative mod to change TM
03	05/26/2018	11/23/2018	Task continuation and travel to support POIWG, Safety Review, and pre-launch test campaign.
04	11/24/2018	05/24/2019	Launch Campaign, Commissioning & Nominal Ops
05	05/25/2019	05/23/2020	Nominal Ops and Sustaining Engineering

II. Task Overview

The GEDI Ground Systems and Operations task supports mission operations, ground system sustaining engineering, systems administration, and IT Security for the Global Ecosystem Dynamics Investigation (GEDI) LIDAR instrument operating as an external payload on-board the International Space Station (ISS).

Hitherto, Task 33 supported Systems Engineering and Integration and Test (I&T) Engineering for the GEDI flight segment as well as Ground System Development and Instrument Mission Operations across three (3) separate subtasks during GEDI payload development and the I&T program. This continued during the launch and commissioning phase throughout the transition to nominal operations.

Henceforth, one Government Work Breakdown Structure (WBS) number will be used to fund this task so the use of three separate subtasks may no longer be warranted.

III. Requirements

1	**Flight Operations**
1.1	The contractor shall provide the Flight Operations Team to operate the payload from the GEDI Mission Operations Center (MOC) in GSFC Bldg. 32.
1.2	The contractor's GEDI Flight Operations Team shall interface as required with the GEDI Science Team, Flight Software (FSW) Lab, and Subsystem Engineering team in order to successfully conduct GEDI operations, meet science requirements and troubleshoot and resolve anomalies.
1.3	The contractor's GEDI Flight Operations Team shall interface with personnel at the Huntsville Operations Support Center (HOSC) for ISS operations located at MSFC, and with ISS personnel at JSC as required.

2	**Ground System Software Sustaining Engineering**
2.1	The contractor shall be responsible for the modification of GEDI Ground System software for specific components to implement required new features or resolve ground system issues.
2.2	The contractor shall provide support for the Integrated Trending and Plotting System (ITPS).
2.3	The contractor shall provide support for the Advanced System for Integration and Spacecraft Test (ASIST).

3	**Systems Administration**
3.1	The contractor shall provide Systems Administration support encompassing all Ground System computer and peripheral hardware and software
3.2	The contractor shall initiate network firewall rule requests and arrange regular system scans
3.3	The contractor shall work with GEDI IT Security support personnel and GSFC Code 700 personnel on GEDI ground system security controls and related issues, including issues found in system scanning
3.4	The contractor shall work with GSFC Science and Engineering Network (SEN) personnel and NASCOM personnel as required to perform network maintenance and troubleshooting

4	**IT Security**
4.1	The contractor shall provide IT Security support to GEDI, providing an ISSO (Information Systems Security Officer).
4.2	The contractor shall modify the Distributed Virtual Environment for Secure Test & Operations (DVESTO) IT SSP (System Security Plan) as necessary to incorporate changes applicable to GEDI.
4.3	The contractor shall work with GSFC Code 700 personnel and GEDI Systems Administrators on the annual SA&A (System Assessment & Authorization) process encompassing GEDI systems
4.4	The contractor shall track Plans of Actions & Milestones based on scan and annual SA&A results

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order mod (Mod 05).

The proposed travel shall include:

(b) (4)

[redacted]

VI. Material Procurement

The Contractor may propose to procure material that they identify as necessary to perform the work associated with this Task Order. This may include computer hardware, cabling, and associated peripheral equipment as well as small items such as disks and flash drives.

The following procurements are anticipated by the Government in this Task Order mod (Mod 05):

(b)(4)

[redacted]

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities conducted under this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 34
Modification: 5
Task Name: MMS MOC and Flight Operations Support

GSMO-2 SOW Reference: 3.1, 3.3, 3.4, 3.6, 3.7.2

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	08/24/2018	Initial task order statement of work.
1	08/11/2017		Admin modification
2	11/03/2017		Admin modification
3	03/12/2018	06/29/2018	Support IMAGE recovery efforts
4	08/25/2018	08/24/2019	Task Extension
5	08/25/2019	08/29/2020	Task Extension

II. Task Overview

The MMS MOC and Flight Operations Support task provides support for the Magnetospheric Multi-scale (MMS) mission. Performs flight operations of the MMS constellation through Phase-E task.

III. Requirements

1	**Post-launch MMS Phase-E Support**
1.1	**Systems Engineering**
1.1.1	The contractor shall support the MMS operations Configuration Control Board (CCB) process.
1.1.2	The contractor shall maintain the Mission Operations Change Request (MOCR) database, and provide MOCR technical review and impact assessments as needed.
1.1.3	The contractor shall maintain the Discrepancy Report (DR) database, and provide DR technical review, impact assessments, and resolution support as needed.
1.1.4	The contractor shall provide support to the Mission Director to maintain and update Interface Control Documents (ICDs) and Operations Agreements (OAs) as needed.
1.1.5	The contractor shall provide technical review of documents as applicable to the MMS ground system and/or mission operations.
1.1.6	The contractor shall support the Mission Director in technical meetings as needed.
1.2	**MOC Maintenance and Sustaining Engineering**

1.2.1	The contractor shall maintain configuration control and operational readiness of all MOC subsystems and tools including: • Real-time Telemetry and Command (T&C) System • Mission Planning System (MPS) • Integrated Trending and Plotting System (ITPS) • Data Archive and Distribution System (DADS) • Alert Notification System (ANS) • Internal File Server (IFS) • MOC automation functions • MOC Countdown Displays • Automated Command Authorization Meeting (AutoCAM) tool • Web-based Operations tools
1.2.2	The contractor shall provide software sustaining engineering support for the following systems: • Mission Planning System (MPS) • Integrated Trending and Plotting System (ITPS) • Data Archive and Distribution System (DADS) • Alert Notification System (ANS) • Internal File Server (IFS) • Automated Command Authorization Meeting (AutoCAM) tool • Mission Operations Change Request (MOCR) database • Discrepancy Report (DR) database • Rules & Constraints (R&C) database • Read & Initial (R&I) database • Operations Activity Request (OAR) database • MOC Countdown Clock Displays • Glance tool
1.2.3	The contractor shall maintain configuration control and operational readiness of all MMS systems in the Backup MOC (BMOC) located in GSFC building-32.
1.2.4	The contractor shall maintain configuration control and operational readiness of all systems in the MMS Test Lab located in GSFC building-14, E229. This includes ground support equipment (GSE) configured with the FlatSat.
1.2.5	The contractor shall develop and maintain scripts and procedures as needed to support MOC process improvements and automation functions, including automation and monitoring to support “lights out” operations when the MOC is unstaffed.
1.2.6	The contractor shall maintain MOC automation software and hardware tools and processes including the ANS paging system, remote access to the MOC DMZ, and maintaining service accounts for mobile two-way text messaging capabilities with internet and/or wireless service providers to support on-call FOT.
1.2.7	The contractor shall perform acceptance and regression testing of MOC software (releases and patches) as approved by the MMS Ground Systems CCB.

1.2.8	The contractor shall perform updates, validation, configuration control, and distribution of the MMS Project Database (PDB). Perform the Lead PDB Administrator role for coordinating formal MMS PDB releases with all MMS ground system elements.
1.2.9	The contractor shall provide training of the FOT on MOC system operations as appropriate.
1.2.10	The contractor shall provide general MOC facility support to include running of network and power cables, repair of raised floor tiles, and other basic facility maintenance/repair support.
1.2.11	The contractor shall perform System Administration (SA) and Configuration Management (CM) duties of the MOC hardware, software, databases, network, mission and other operations data. This effort includes maintaining user accounts, performing system backups, performing ground system firewall rule coordination with NISN, installing applications software, and maintaining the required patch level of the operating systems on Linux and Windows platforms.
1.2.12	The contractor shall provide on-call SA support to cover off-hours and weekends to address MOC system contingencies.
1.2.13	The contractor shall provide the FDOA with the following System Administration support services: • Software installations of the Attitude Ground System (AGS), Flight Dynamics Ground Support System (FDGSS), and Constellation High Fidelity (CHiFi) simulator. • Maintenance of the FDOA workstation Operating Systems (OS) including security patches as needed to maintain NASA IT Security compliance. • Software installations of Commercial Off-the-Shelf (COTS) software required by the FDOA including MatLab.
1.2.14	The contractor shall install, configure, and maintain MOC hardware including computer systems, servers, RAIDs, displays, KVM switches, network switches, routers, printers, fax machines, and any other hardware required to sustain MOC operations.
1.2.15	The contractor shall maintain the MOC "As Built" Design Specification.
1.2.16	The contractor shall provide desktop IT support for FOT.
1.3	**Flight Operations Support**
1.3.1	The contractor shall maintain all operations products required for Flight Operations including STOL procedures, display pages, scripts, stored command load templates, MOC System Configuration Files, and Local Operating Procedures (LOPs) for normal and contingency operations.
1.3.2	The contractor shall plan and execute daily operations as per the MMS Flight Operations Plan.
1.3.3	The contractor shall interface with the Deep Space Network (DSN), Near Earth Network (NEN), and Space Network (SN) to coordinate scheduling of TT&C resources and real-time operations as needed to meet MMS mission requirements.

1.3.4	The contractor shall interface with the Science Operations Center (SOC) to coordinate Instrument Suite operations as per the MOC-SOC Operations Agreement.
1.3.5	The contractor shall interface and coordinate with the Flight Dynamics Operations Area (FDOA) to support MMS maneuvers and other flight dynamics function per the MOC-FDOA Operations Agreement.
1.3.6	The contractor shall interface with the SSMO Scheduling Group to coordinate DSN resource scheduling per the MMS FOT-SSMO Scheduling Group Operations Agreement.
1.3.7	The contractor shall document all space and ground segment anomalies and coordinate anomaly resolution with the NASA Mission Director (MD) and AETD Engineers as appropriate.
1.3.8	The contractor shall generate, uplink, and as needed to carry out daily operations and to maximize science data return.
1.3.9	The contractor shall monitor and maintain the health and safety of the MMS constellation housekeeping systems.
1.3.10	The contractor shall detect and respond to observatory anomalies as per approved contingency plans and return the observatory to a state of normal operations in a timely and safe manner.
1.3.11	The contractor shall perform trending and engineering analysis. Compile periodic spacecraft trending products to include key telemetry for all major spacecraft subsystems.
1.3.12	The contractor shall plan and conduct periodic trending reviews.
1.3.13	The contractor shall support the MMS Flight Software Sustaining Engineering (FSSE) CCB, GSFC Code 582, and provide CCR technical review and impact assessments as needed.
1.3.14	The contractor shall coordinate with the SOC telemetry and command database updates to the PDB as necessary to allow the MOC to support Instrument Suite operations per the MOC-SOC Operations Agreement.
1.3.15	The contractor shall perform user acceptance and regression testing of the MOC systems as needed. This includes use of the FlatSat test bed as appropriate.
1.3.16	The contractor shall maintain FOT training and certification materials.
1.3.17	The contractor shall operate and maintain all MOC ground systems as required to meet mission objectives. This includes operation of all MOC T&C Systems, MPS, DADS, ITPS, and ANS for both normal and contingency operations.
1.3.18	The contractor shall provide on-call FOT support to cover off-hours and weekends to respond to MMS ground and space segment anomalies and contingencies.
1.3.19	The contractor shall perform periodic real-time contacts from the BMOC as needed to maintain backup operations and FOT proficiency.
1.3.20	The contractor shall maintain a team of four (4) real-time operators to provide on-console support during normal business hours, spacecraft maneuvers, and other critical spacecraft events that fall outside of normal business hours.

1.3.21	The contractor shall operate and maintain ground systems to identify instances when any MMS spacecraft observes unexpected radio frequency (RF) signals outside of expected contact times. These events will be reported to the Space Asset Protection Program (SAPP).
1.4	**Information Technology (IT) Security**
1.4.1	The contractor shall maintain MOC IT security controls, as necessary to comply with NASA security requirements. This includes the MOC (B14, E249), FDOA (B14, E239A), LSR (B14, E259A-C), Test Lab (B14, E229), and BMOC (B32).
1.4.2	The contractor shall coordinate MOC security audits on a periodic basis.
1.4.3	The contractor shall ensure that systems are kept up to date with latest security patches in accordance with GSFC Code 444/700 direction.
1.4.4	The contractor shall maintain applications designed to manage and perform routine IT security tasks such as monitoring of MOC system logs and error/audit reports.

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for r.

Government Furnished Property/Facilities Description
All computer systems that comprise the MOC, BMOC, and LSR subsystems and associated peripheral equipment will be government furnished. This includes all hardware associated with the MOC T&C System (ASIST/FEDS), MPS, ITPS, ANS, DADS, IFS, servers, printers, and data storage and backup systems. The contractor shall provide property management of these systems.
The contractor shall perform the work specified in this SOW in the MMS Mission Operations Center (MOC) located at GSFC, Building-14. Infrequent work will be necessary in the Backup-MOC (BMOC) located at GSFC, Building-32 in the event of a MOC contingency and to maintain BMOC operations proficiency.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test (ASIST) (NASA/GSFC Code 583)	GSC-16783-1

There are other government furnished services (in some cases, through other government contracts).

Furnished Services
Flight Dynamics functions and operations are provided under a separate Flight Dynamics Support Services (FDSS-II) contract.

MOC will provide the interface between the SOC and the observatories; the SOC performs all Instrument Suite (IS) operations, this includes health and safety monitoring, command and control, science planning and data processing, and resolves all inter-instrument conflicts.
Sustaining engineering support of the Engineering Test Units (ETUs) and other hardware that make up the MMS Spacecraft FlatSat simulator located in the Test Lab (B14, E229) will be provided by AETD and is not within scope of the task order
Flight Software Sustaining Engineering (FSSE) is provided under a separate Software Engineering Support (SES II) contract

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. Specifically, the contractor shall support the travel requirements as described in the table below:

	(b) (4) [redacted]
[redacted]	[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The proposed material list should include:

(b) (4) [redacted]
[redacted]

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Task Deliverables

Monthly CM Report. (First week each month)

End of Task Order Statement of Work

Deleted: ¶

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: **35**
Modification: 6
Task Name: JWST Ground System Support

GSMO-2 SOW Reference: 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/01/2017	11/24/2017	Unsolicited Additional Material
2	11/25/2017	11/24/2018	SOW for FY'18
3	9/24/2018	11/24/2018	Additional requirements including: • Enhancement of the COTS *ScriptEase JavaScript* engine • New development for an electronic *JLAB Database Tool* • Enhancement of STS to support NGAS off-nominal deployment testing • Enhancement of STS to support ISIM, MIRI & FGS simulation • Purchase of additional Red Hat licenses
4	11/26/2018	11/23/2019	**Continued support for Mod 0-3 and IGSS JLAB & JFLT UPGRADE defined as follows:** IGSS Security • The IGSS JLAB upgrade shall provide PIV security IGSS Support for NGAS • The IGSS JLAB upgrade shall include IGSS tools upgrades on NGAS systems; Raytheon shall be responsible for building the NGAS system. • The IGSS JLAB upgrade shall include a new NGAS Test Rack for NGAS I&T containing 1 SWTS; 3 Bus Monitors; each 4U high plus a KVM & UPS JLAB Upgrade • The IGSS JLAB upgrade shall execute a complete data xfer before new integration for Stakeholders data from the Eclipse directory and User data I: Drive to predesignated data storage • The IGSS JLAB upgrade shall include replacement of IGSS domain controllers • The IGSS JLAB upgrade shall include new KVMs with PIV • The IGSS JLAB upgrade shall include replacements of 2960G & 2960S switches and 2851 &2951 routers for IES and IGSS • The IGSS JLAB upgrade shall include replacement of the UPS for IES and IGSS for US and European JLABs • The IGSS JLAB upgrade shall integrate new Raytheon H/W & S/W for their physical domain controller (Server 2016) • The IGSS JLAB upgrade shall integrate new Raytheon Workstations (Win10) & Servers(VM; 2016 OS) + Linux (VM functions as APP60) JFLT Upgrade • The IGSS JLAB upgrade shall provide new JFLT short racks for NIRCam; NIRSpec; MIRI-RAL including a switch, ICDH, SWTS, Bus monitor, KVM, and UPS • The IGSS JLAB upgrade shall upgrade the JFLT racks to have one SWTS and 3 bus monitors. Each would be 4U high • The IGSS JLAB upgrade shall integrate SWTS upgrades (hardware/software) in the JFLT racks • The IGSS JLAB upgrade shall integrate new ICDH upgrades • The IGSS JLAB upgrade shall include of Bus Monitors to Windows 10 • The IGSS JLAB upgrade shall include the upgraded ROSE software that runs on Windows 10 and Server 2016 for NIRSpec; NIRCam; and FGS • The IGSS JLAB upgrade shall include replacement of DSIM/TSIM hardware • The IGSS JLAB upgrade shall include upgrading DSIM and TSIM (superlogics box) to windows 10. RALF CLONE • The IGSS RALF Clone shall be integrated with the IGSS JLAB33 • The IGSS RALF Clone shall include extended data store of at least 11-15 Tbytes
5			**Mod #5 was an admin-CO mod on 11/26/18 which fixed an error in the TOMS header regarding task cost.**

6	5/6/2019	11/23/2019	Additional material and continued support for IGSS JLAB & JFLT UPGRADE and RALF as defined in Mod 4. Note: RALF/RALFx are a unique subset of the architecture for a JLAB but will be referred to as a JLAB is the following paragraphs in this SOW. Additional RALF requirements identified since Mod 4 are defined as follows: <u>RALF2</u> • The IGSS RALF2 shall provide outside access and a duplicate data set that is accessible from critical data. • The duplicate RALF2 system shall be situated at GSFC. Ensure architecture allows for portability to other locations in the future.

II. Task Overview

The JWST Ground System Support task provides development and sustaining support for Observatory I&T; IGSS & COTS; Development/Test; ISIM FSW Development/Test; Certification Labs; SI Development/Test; STScI OSS/FOT; NGAS EC; WC & Denver; Ball; and the ISIM Electrical Simulator (IES); and JFLT Racks.

III. Requirements

1	**JWST Ground System Support**
1.1	**IGSS Integration & Test Support**
1.1.1	The contractor shall provide IGSS Integration & Test Support as specified in this subsection.
1.1.2	The contractor shall provide integration of IGSS component software/hardware in the IGSS Lab.
1.1.3	The contractor shall provide IGSS Software Build Functional Component testing & System Regression testing.
1.1.4	The contractor shall provide IGSS JLAB & JFLT System Regression testing.
1.1.5	The contractor shall provide for the completion of test Configuration Items (CIs) and delivery of CIs to locations identified in the IGSS Data Management List (DML) located on the JWST CM website.
1.1.6	The contractor shall support Code 300 Software Quality Assurance participation in IGSS Test peer reviews and certain IGSS Release testing.
1.1.7	The contractor shall create/sustain IGSS development and test systems which support the fidelity of new functionality and maintenance changes (including I/F with the STS)
1.1.8	The contractor shall provide integration & test of upgraded COTS *ScriptEase JavaScript* engine functions as well as verifying the integrity of baseline functions.
1.1.9	JWST Code 300 QA personnel supporting the IGSS shall provide validation of the *ScriptEase JavaScript* upgrade.
1.1.10	The contractor shall provide integration & test capabilities to verify a new *JLAB Database Tool*
1.2	**Customer Support**
1.2.1	The contractor shall provide Customer Support as specified in this subsection.
1.2.2	The contractor shall provide training and assistance for IGSS customers including all stakeholders listed in Section II as necessary
1.2.3	The contractor shall provide user documentation and training materials.
1.2.4	The contractor shall provide IGSS Help Desk support.
1.2.5	The contractor shall provide on-site support for custom installations as necessary. May require domestic or international travel.
1.2.6	The contractor shall provide users with IGSS tools, configurations, and support.
1.3	**COTS Software Support**
1.3.1	The contractor shall provide procurement of hardware and COTS software as specified in this subsection.
1.3.2	The contractor shall provide IGSS hardware product research, recommendation, and component procurement.
1.3.3	The contractor shall provide COTS product research, recommendation, and procurement (compliant with NPR 7150.2B).
1.3.4	The contractor shall provide monitoring of Vendor license renewals and service agreement documentation plus an impact assessment of the license updates to JLAB systems. (including Win7 EOL Jan 2020, Server 2008 EOL Jan 2020, RedHat, MS Office)
1.3.5	The contractor shall provide JLAB hardware sustaining support including procurement and documentation of appropriate sparing equipment for systems in the field.

1.3.6	The contractor shall provide additional materials required to enable hardware upgrades to all stakeholders listed in Section II as necessary
1.3.7	The contractor shall provide additional materials required to enable hardware upgrades of pertinent JLABs for Windows updates; and RedHat licenses.
1.3.8	The contractor shall provide additional materials and licenses required to support all stakeholders listed in Section II as necessary
1.3.9	The contractor shall update software in keeping with Code 700 & Headquarters security posture (e.g. Big Fix and Win XP elimination)
1.3.10	The contractor shall modify the GFCS ground-based COTS *ScriptEase JavaScript* engine to provide the capability for JavaScript to support pre-compiled JavaScript byte code (.jsb) files. The software development is a non-flight modification of a NASA purchased COTS tool.
1.3.11	The contractor shall deliver the upgraded ground-based COTS *ScriptEase JavaScript* engine including source code to the JWST IGSS Development Manager
1.4	**IGSS Fabrication**
1.4.1	The contractor shall provide fabrication of JLABs; JFLTs; and IGSS PCs as specified in this subsection
1.4.2	The contractor shall provide documentation including elevation drawings; hardware specifications; European CE compliance letters; MSDS for hazardous components; and total weight/power consumption statement for final IGSS unit.
1.4.3	The contractor shall provide fabrication and shipping of JLABs and units supporting all stakeholders listed in Section II as necessary
1.5	**Deployed Systems Support**
1.5.1	The contractor shall provide maintenance/sustaining of deployed systems as specified in this subsection
1.5.2	The contractor shall provide support to all IGSS JLABs; JFLTs; and IGSS PCs.
1.5.3	The contractor shall provide support to JWST-IGSS Lab area reconfigurations necessary to support IGSS development & integration.
1.5.4	The contractor shall provide an electronic *JLAB Database Tool* including access to JLAB parameters such as H/W components (Model #, ECN #, S/N); S/W components (COTS/GOTS Name/Release #); geographic locations; stakeholder POCs (name, location).
1.5.5	The *JLAB Database Tool* shall provide data query report capability including grouping by JLAB or on select item.
1.6	**Systems Engineering Support**
1.6.1	The contractor shall provide Mission Engineering; IGSS System Engineering; IGSS System Development & Integration; and Product Management Support as specified in this subsection
1.6.2	**Mission Engineering Analysis**
1.6.2.1	The contractor shall review and provide comments on the design of various ground system elements.
1.6.2.2	The contractor shall attend reviews to determine impact on IGSS and ground operations.
1.6.2.3	The contractor shall provide analysis for prototype software as needed to demonstrate possible software solutions to problems.
1.6.3	**IGSS System Engineering**
1.6.3.1	The contractor shall review and provide requirements for future IGSS elements to enable synchronization of software supporting the STScI FOS
1.6.3.2	The contractor shall provide analysis for custom software as needed to provide a more user friendly operational IGSS.
1.6.3.3	The contractor shall mature, update, and maintain IGSS Tools Level-4 requirements, IGSS Architecture, IGSS ICDs.
1.6.3.4	The contractor shall provide evaluation and analysis of COTS/GOTS ground system software/hardware components.

1.6.3.5	The contractor shall attend JWST and IGSS meetings, as necessary. Some meetings may require domestic or international travel.
1.6.4	**IGSS System Development & Integration**
1.6.4.1	The contractor shall provide maintenance of Level-5 requirements for the IGSS Tools.
1.6.4.2	The contractor shall upgrade and support documentation/training for the IGSS Tools in support of all stakeholders listed in Section II as necessary
1.6.4.3	The contractor shall support IGSS Tools which include: - Load/dump generation and visualization tools - Database tools which interface with the Common Project Reference Database (PRD) - Eclipse Extension Tools for CECIL scripting use - IES Control interface process - Common Graphical User Interface (GUI) - Lab system configuration and configuration monitor tools - COTS and GOTS Software integration into IGSS - Complete Tool Documentation and delivery to NGIN for appropriate documents listed above under "IGSS Tools"
1.6.4.4	The contractor shall support IGSS Functional Releases for all stakeholders listed in Section II as necessary
1.6.4.5	The contractor shall support IGSS System Environment Maintenance, including: - operating system installation/maintenance - updates of security patches to appropriate systems - new system hardware initialization and configuration - file server maintenance and upgrades for all stakeholders listed in Section II as necessary
1.6.5	**Software Telemetry Simulator (STS)**
1.6.5.1	The contractor shall manage Software Telemetry Simulator (STS) development and test activities including support for meetings with the spacecraft and instrument team. Tasks developed include, but are not limited to: - Retrieving project artifacts; building flight software; launching STS executables; and executing system tests. - Responding to problem and enhancement requests reported by the STS end users. - Providing deliveries and demonstrations to the JWST Space Telescope Science Institute (STScI). - Supporting monthly planning meetings wherein the government shall set the priority of STS team's activities. - Ensuring pertinent documents are delivered to JWST CM (NGIN) with the appropriate ITAR identification.
1.6.5.2	The contractor shall perform maintenance & support for updates and provide new STS releases in support of: 1) JWST spacecraft and ISIM functionality for OSS and FOT-ISIM 2) New Eclipse database updates (PRDs) 3) New NGAS Vehicle Dynamic Simulator (VDS) models and associated hardware models 4) Task approved support to the mission simulation team including: • Ability to start the STS with new configurations, execute pre-launch, early orbit, and pre-commissioning (up to T+20 day) activities. • Capability to change internal simulator variables providing the capability to simulate system faults 5) Deployment of a secure server computer to STScI which meets STScI and NASA IT security requirements

	6) New ISIM simulation capability for Focal Plane Electronics (FPE) data input simulations including: • Process basic exposures • Process exposures that create FPAP file store images • Support ACS closed loop testing 7) STS upgrades in support of the remaining Ground System stakeholders in the Observatory I&T and Post-Launch time frame.
1.6.5.3	The contractor shall provide documentation including (see VII Deliverables for complete list): - Software Development Plan that addresses the software processes, methods, organizational responsibilities, tools, software quality, and other activities related to accomplishment the STS development - Design documents describing the design of individual components - Version Description Document for each release that includes details of the requirements included in the release and any known defects
1.6.5.4	The contractor shall test the Software Telemetry Simulator and provide documentation including: - Test plan that validates the STS system has been implemented in a manner that satisfies the desired functionality - Test Summary Report - User's manual that details the steps required to use the JWST STS environment
1.6.5.5	The contractor shall enhance STS functionality to support NGAS off-nominal testing
1.6.5.6	The contractor shall enhance STS functionality to support ISIM, MIRI, & FGS simulation
1.6.6	**Deployment Electronics Unit (DEU) high fidelity simulator**
1.6.6.1	The contractor shall update the DEU simulator to high fidelity capability
1.6.7	**IGSS Product Management Support**
1.6.7.1	The contractor shall support the IGSS Product Manager in execution of the IGSS SMP/PP as required.
1.6.7.2	The contractor shall provide monthly Financial Summary and Progress Report.
1.7	**IT Security Support**
1.7.1	The contractor shall provide IT Security Expertise Assistance in support of the JWST ISSO for meetings; self-assessment; and update of documentation relative to the Continuous Monitoring/Year 2 Assessment.
1.7.2	The contractor shall assist with putting together the 2018 ATO package that is sent to Code 700 for review and to the Authorizing Official (AO) for signature.
1.7.3	The contractor shall refine the JWST continuous monitoring process including possibly implementing Gemini.
1.7.4	The contractor shall provide updates as required to the following documents in RISCS specifically SSP; RAR and CP
1.7.5	The contractor shall document the Contingency Plan Test
1.7.6	The contractor shall perform a self-assessment in preparation for the 2019 third-party assessment
1.7.7	The contractor shall assist in development and/or collection of artifacts for the 2019 continuous monitoring assessment.
1.7.8	The contractor shall support closing outstanding POA&Ms (number TBD)

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
A JWST GS&O IGSS support facility at GSFC B13 provides an IGSS development lab; staff workspace; and space for storage and fabrication.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Eclipse™ (Raytheon)	
Windows-based ground development platform that includes the COTS *ScriptEase JavaScript* engine embedded in the original COTS *Integrated Software Development Kit (ISDK)*	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]
[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Integrated Ground Support System (IGSS)
Integration & Test Support • Deliver bug fixes & enhancements as required. (Up to 6 releases) • Maintain list of defects and enhancements. (Monthly) • Conduct Build Content Reviews (Major releases) • Update Test Plans and Procedures. (Each release) • Conduct Test Readiness Reviews. (Major releases) • Provide Test Summary Reports. (Each release) • Provide Baseline/Functional/Physical Audits. (Major releases) • Training. (As necessary) • JWST-IGSS Lab area reconfigurations (For up to 2 configurations per Master Schedule)
IGSS & JLAB/JFLT documentation including: • IGSS JLAB/JFLT drawings (~43) • IGSS Hardware Engineering Support QA Plan (JWST-PLAN-017057). (Up to 2 updates) • IGSS Sparing Plan (JWST-PLAN-025353). (Up to 2 updates) • IGSS Architecture Document (JWST-ARCH-025345). (Up to 2 updates) • IGSS External ICD (JWST-ICD-004747). (Up to 2 updates) • IGSS Requirements Document (JWST-RQMT-004608). (Up to 2 updates) • IGSS Tools. (Up to 2 updates) • Updated User's Manual. (Each release) • Version Description Document (VDD). (Each release) • IGSS Requirements Traceability Matrix (RTM). (Major releases) • IGSS Release Functional/Physical Audits. (Major releases) • IGSS Release Test Readiness Review. (Major releases) • IGSS Release Test Summary Report. (Each release) <u>JLAB Database Tool:</u> • Requirements document • Architecture document • Test Readiness Review (TRR) • Test Summary Report • JLAB Database Tool User's Guide
IGSS & COTS S/W Support Renew and/or initially procure necessary software & licenses. (Specified in Vendor's material list) <u>Documentation for COTS *ScriptEase JavaScript* engine enhancement:</u> • Requirements document • User's Guide • Test Readiness Review (TRR) • Test Summary Report
IGSS Fabrication (JLAB & JFLT racks per Master Schedule) • Upgrade pertinent JLABs to RHEL (as required)
Software Telemetry Simulator (STS)
STS documentation including: • JWST-STS Delivery Letter. (Each delivery) • JWST-STS Developer's Guide. (Each delivery) • JWST-STS Installation Guide for Mac OS X. (Each delivery) • JWST-STS Installation Guide for Windows 7 OS. (Each delivery) • JWST-STS Maintenance Guide. (Each delivery) • JWST-STS User's Guide. (Each delivery) • JWST-STS Version Description Document (VDD). (Each delivery)

• Updated Requirements Document. (Each release if applicable) • Updated Requirement Traceability Matrix (RTM). (Each release if applicable) • Updated Test Plan. (Each release if applicable) • Test Summary Report. (Each release)
Deployment Electronics Unit (DEU)
None
IT Security Documentation assistance for JWST ISSO
• Support closing tbd outstanding POA&Ms • Document the Contingency Plan (CP) Test 2019 • Complete self-assessment around 2019 in preparation for the next third-party assessment around 2019. • Provide updates to the following documents in the Risk Information Security Compliance System (RISCS) 2019: - System Security Plan (SSP) - Risk Assessment Report (RAR) - Contingency Plan (CP)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: **35**
Modification: 7
Task Name: JWST Ground System Support

GSMO-2 SOW Reference: 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	06/01/2017	11/24/2017	Unsolicited Additional Material
2	11/25/2017	11/24/2018	SOW for FY'18
3	9/24/2018	11/24/2018	Additional requirements including: • Enhancement of the COTS *ScriptEase JavaScript* engine • New development for an electronic *JLAB Database Tool* • Enhancement of STS to support NGAS off-nominal deployment testing • Enhancement of STS to support ISIM, MIRI & FGS simulation • Purchase of additional Red Hat licenses
4	11/26/2018	11/23/2019	**Continued support for Mod 0-3 and IGSS JLAB & JFLT UPGRADE defined as follows:** IGSS Security • The IGSS JLAB upgrade shall provide PIV security IGSS Support for NGAS • The IGSS JLAB upgrade shall include IGSS tools upgrades on NGAS systems; Raytheon shall be responsible for building the NGAS system. • The IGSS JLAB upgrade shall include a new NGAS Test Rack for NGAS I&T containing 1 SWTS; 3 Bus Monitors; each 4U high plus a KVM & UPS Note: Moved JLAB/JFLT Tech-Refresh detail to Table 1 and Table 2 RALF CLONE • The IGSS RALF Clone shall be integrated with the IGSS JLAB33 • The IGSS RALF Clone shall include extended data store of at least 11-15 Tbytes
5			**Mod #5 was an admin-CO mod on 11/26/18 which fixed an error in the TOMS header regarding task cost.**
6	5/6/2019	11/23/2019	Additional material and continued support for IGSS JLAB & JFLT UPGRADE and RALF as defined in Mod 4. Note: RALF/RALF2 are a unique subset of the architecture for a JLAB but will be referred to as a JLAB is the following paragraphs in this SOW. Additional RALF requirements identified since Mod 4 are defined as follows: RALF (STScI) and RALF2 (GSFC) • RALF shall be on the STScI Sim Lan network • Authorized JWST users shall be able to remotely access RALF via JWST vpn • RALF web03 shall be available on the OTB at TBD timeframe • RALF2 shall be located at GSFC B13 • RALF2 shall be on the TBD network • RALF2 shall provide outside access and a duplicate data set that is accessible from critical data • RALF2 architecture shall ensure portability to other locations in the future
7	11/24/2019	11/28/2020	Continue support for Mod 3, 4 & 6 items including: 1) electronic JLAB Database Tool; 2) JLAB/JFLT Tech Refresh; and RALF/RALF2. See Table 1 and Table 2 for a list of JLAB/JFLT racks and a set of Initial requirements included in the Tech-Refresh Target completion for Tech-Refresh upgrade & deployment is end-September 2020.

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II. Task Overview

The JWST Ground System Support task provides development and sustaining support for Observatory I&T; IGSS & COTS; Development/Test; ISIM FSW Development/Test; Certification Labs; SI Development/Test; STScI OSS/FOT; NGAS EC; WC & Denver; Ball; and the ISIM Electrical Simulator (IES); and JFLT Racks.

III. Requirements

1	**JWST Ground System Support**
1.1	**IGSS Integration & Test Support**
1.1.1	The contractor shall provide IGSS Integration & Test Support as specified in this subsection.
1.1.2	The contractor shall provide integration of IGSS component software/hardware in the IGSS Lab
1.1.3	The contractor shall provide IGSS Software Build Functional Component testing & System Regression testing.
1.1.4	The contractor shall provide IGSS JLAB & JFLT System Regression testing.
1.1.5	The contractor shall provide for the completion of test Configuration Items (CIs) and delivery of CIs to locations identified in the IGSS Data Management List (DML) located on the JWST CM website.
1.1.6	The contractor shall support Code 300 Software Quality Assurance participation in IGSS Test peer reviews and certain IGSS Release testing.
1.1.7	The contractor shall create/sustain IGSS development and test systems which support the fidelity of new functionality and maintenance changes (including I/F with the STS)
1.1.8	The contractor shall provide integration & test of upgraded COTS *ScriptEase JavaScript* engine functions as well as verifying the integrity of baseline functions.
1.1.9	JWST Code 300 QA personnel supporting the IGSS shall provide validation of the *ScriptEase JavaScript* upgrade.
1.1.10	The contractor shall provide integration & test capabilities to verify a new *JLAB Database Tool*
1.2	**Customer Support**
1.2.1	The contractor shall provide Customer Support as specified in this subsection.
1.2.2	The contractor shall provide training and assistance for IGSS customers including all stakeholders listed in Section II as necessary
1.2.3	The contractor shall provide user documentation and training materials.
1.2.4	The contractor shall provide IGSS Help Desk support.
1.2.5	The contractor shall provide on-site support for custom installations as necessary. May require domestic or international travel.
1.2.6	The contractor shall provide users with IGSS tools, configurations, and support.
1.3	**COTS Software Support**
1.3.1	The contractor shall provide procurement of hardware and COTS software as specified in this subsection.
1.3.2	The contractor shall provide IGSS hardware product research, recommendation, and component procurement.
1.3.3	The contractor shall provide COTS product research, recommendation, and procurement (compliant with NPR 7150.2B).
1.3.4	The contractor shall provide monitoring of Vendor license renewals and service agreement documentation plus an impact assessment of the license updates to JLAB systems. (including Win7 EOL Jan 2020, Server 2008 EOL Jan 2020, Red Hat, MS Office)
1.3.5	The contractor shall provide JLAB hardware sustaining support including procurement and documentation of appropriate sparing equipment for systems in the field.
1.3.6	The contractor shall provide additional materials required to enable hardware upgrades to all stakeholders listed in Section II as necessary

1.3.7	The contractor shall provide additional materials required to enable hardware upgrades of pertinent JLABs for Windows updates; and Red Hat licenses.
1.3.8	The contractor shall provide additional materials and licenses required to support all stakeholders listed in Section II as necessary
1.3.9	The contractor shall update software in keeping with Code 700 & Headquarters security posture (e.g. Big Fix and Win XP elimination)
1.3.10	The contractor shall modify the GFCS ground-based COTS *ScriptEase JavaScript* engine to provide the capability for JavaScript to support pre-compiled JavaScript byte code (.jsb) files. The software development is a non-flight modification of a NASA purchased COTS tool.
1.3.11	The contractor shall deliver the upgraded ground-based COTS *ScriptEase JavaScript* engine including source code to the JWST IGSS Development Manager
1.4	**IGSS Fabrication**
1.4.1	The contractor shall provide fabrication of JLABs; JFLTs; and IGSS PCs as specified in this subsection
1.4.2	The contractor shall provide documentation including elevation drawings; hardware specifications; European CE compliance letters; MSDS for hazardous components; and total weight/power consumption statement for final IGSS unit.
1.4.3	The contractor shall provide fabrication and shipping of JLABs and units supporting all stakeholders listed in Section II as necessary
1.4.4	The contractor shall provide fabrication for the FY'20 JLAB/JFLT Tech-Refresh specifically for racks listed in "Table 1. FY'20 Tech-Refresh Perpetual JLAB/JFLT Racks and Components" and "Table 2. FY'20 Tech-Refresh JLAB/JFLT Initial Requirements"
1.5	**Deployed Systems Support**
1.5.1	The contractor shall provide maintenance/sustaining of deployed systems as specified in this subsection
1.5.2	The contractor shall provide support to all IGSS JLABs; JFLTs; and IGSS PCs.
1.5.3	The contractor shall provide support to JWST-IGSS Lab area reconfigurations necessary to support IGSS development & integration.
1.5.4	The contractor shall provide an electronic *JLAB Database Tool* including access to JLAB parameters such as H/W components (Model #, ECN #, S/N); S/W components (COTS/GOTS Name/Release #); geographic locations; stakeholder POCs (name, location).
1.5.5	The *JLAB Database Tool* shall provide data query report capability including grouping by JLAB or on select item.
1.5.6	The contractor shall deploy new IGSS software and patch releases to all stakeholders as defined in the "Master IGSS Software Release Deployment Schedule"
1.5.7	The contractor shall provide shipping and deployment for the FY'20 JLAB/JFLT Tech-Refresh racks and components listed in "Table 1. FY'20 Tech-Refresh Perpetual JLAB/JFLT Racks and Components"
1.6	**Systems Engineering Support**
1.6.1	The contractor shall provide Mission Engineering; IGSS System Engineering; IGSS System Development & Integration; and Product Management Support as specified in this subsection
1.6.2	**Mission Engineering Analysis**
1.6.2.1	The contractor shall review and provide comments on the design of various ground system elements.
1.6.2.2	The contractor shall attend reviews to determine impact on IGSS and ground operations.
1.6.2.3	The contractor shall provide analysis for prototype software as needed to demonstrate possible software solutions to problems.
1.6.3	**IGSS System Engineering**
1.6.3.1	The contractor shall review and provide requirements for future IGSS elements to enable synchronization of software supporting the STScI FOS

1.6.3.2	The contractor shall provide analysis for custom software as needed to provide a more user friendly operational IGSS
1.6.3.3	The contractor shall mature, update, and maintain IGSS Tools Level-4 requirements, IGSS Architecture, IGSS ICDs
1.6.3.4	The contractor shall provide evaluation and analysis of COTS/GOTS ground system software/hardware components
1.6.3.5	The contractor shall attend JWST and IGSS meetings, as necessary. Some meetings may require domestic or international travel.
1.6.4	**IGSS System Development & Integration**
1.6.4.1	The contractor shall provide maintenance of Level-5 requirements for the IGSS Tools.
1.6.4.2	The contractor shall upgrade and support documentation/training for the IGSS Tools in support of all stakeholders listed in Section II as necessary
1.6.4.3	The contractor shall support IGSS Tools which include: - Load/dump generation and visualization tools - Database tools which interface with the Common Project Reference Database (PRD) - Eclipse Extension Tools for CECIL scripting use - IES Control interface process - Common Graphical User Interface (GUI) - Lab system configuration and configuration monitor tools - COTS and GOTS Software integration into IGSS Support includes completion of Tool Documentation and delivery to NGIN.
1.6.4.4	The contractor shall support IGSS Functional Releases for all stakeholders listed in Section II as necessary
1.6.4.5	The contractor shall support IGSS System Environment Maintenance for all stakeholders, including: - operating system installation/maintenance - updates of security patches to appropriate systems - new system hardware initialization and configuration - file server maintenance and upgrades
1.6.5	**Software Telemetry Simulator (STS)**
1.6.5.1	The contractor shall manage Software Telemetry Simulator (STS) development and test activities including support for meetings with the spacecraft and instrument team. Tasks developed include, but are not limited to: - Retrieving project artifacts; building flight software; launching STS executables; and executing system tests. - Responding to problem and enhancement requests reported by the STS end users. - Providing deliveries and demonstrations to the JWST Space Telescope Science Institute (STScI). - Supporting monthly planning meetings wherein the government shall set the priority of STS team's activities. - Ensuring pertinent documents are delivered to JWST CM (NGIN) with the appropriate ITAR identification.
1.6.5.2	The contractor shall perform maintenance & support for updates and provide new STS releases in support of: 1) JWST spacecraft and ISIM functionality for OSS and FOT-ISIM 2) New Eclipse database updates (PRDs) 3) New NGAS Vehicle Dynamic Simulator (VDS) models and associated hardware models 4) Task approved support to the mission simulation team including: • Ability to start the STS with new configurations, execute pre-launch, early orbit, and pre-commissioning (up to T+20 day) activities. • Capability to change internal simulator variables providing the capability to simulate system faults

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	5) Deployment of a secure server computer to STScI which meets STScI and NASA IT security requirements 6) New ISIM simulation capability for Focal Plane Electronics (FPE) data input simulations including: • Process basic exposures • Process exposures that create FPAP file store images • Support ACS closed loop testing 7) STS upgrades in support of the remaining Ground System stakeholders in the Observatory I&T and Post-Launch time frame.
1.6.5.3	The contractor shall provide documentation including (see VII Deliverables for complete list): - Software Development Plan that addresses the software processes, methods, organizational responsibilities, tools, software quality, and other activities related to accomplishment the STS development - Design documents describing the design of individual components - Version Description Document for each release that includes details of the requirements included in the release and any known defects
1.6.5.4	The contractor shall test the Software Telemetry Simulator and provide documentation including: - Test plan that validates the STS system has been implemented in a manner that satisfies the desired functionality - Test Summary Report - User's manual that details the steps required to use the JWST STS environment
1.6.5.5	The contractor shall enhance STS functionality to support NGAS off-nominal testing
1.6.5.6	The contractor shall enhance STS functionality to support ISIM, MIRI, & FGS simulation
1.6.6	**Deployment Electronics Unit (DEU) high fidelity simulator**
1.6.6.1	The contractor shall update the DEU simulator to high fidelity capability
1.6.7	**IGSS Product Management Support**
1.6.7.1	The contractor shall support the IGSS Product Manager in execution of the IGSS SMP/PP as required.
1.6.7.2	The contractor shall provide monthly Financial Summary and Progress Report.
1.7	**IT Security Support**
1.7.1	The contractor shall provide IT Security Expertise Assistance in support of the JWST ISSO for meetings; self-assessment; and assist updating documentation relative to the Continuous Monitoring/Year 2 Assessment.
1.7.2	The contractor shall assist with putting together the 2020 ATO package that is sent to Code 700 for review and to the Authorizing Official (AO) for signature.
1.7.3	The contractor shall assist refining the JWST continuous monitoring process including possibly implementing Gemini.
1.7.4	The contractor shall assist in providing updates as required to the following documents in RISCS specifically SSP; RAR and CP
1.7.5	The contractor shall assist with document the Contingency Plan Test
1.7.6	The contractor shall assist with performing a self-assessment in preparation for the 2020 third-party assessment
1.7.7	The contractor shall assist in development and/or collection of artifacts for the 2020 continuous monitoring assessment.

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IGSS Dev & Test Lab	Certification - FSM – NGAS Labs	SI Dev & Test Labs
JLAB10 (IGSS GSFC, MD) • Domain Controller • KVM • 1 UPS	**JLAB32** (ISIM FSW GSFC, MD) • 3 UPS? • 5 SWTS • FGSES? • DSIM/TSIM	**JLAB80** (MIRI JPL) • 2 UPS (JLAB; COOLEST) • 1 SWTS • Laptop/USB 1553 DSIM
JLAB33 (IGSS GSFC, MD) • 1 UPS • STS	**JLAB36** (IGSS GSFC, MD) • 1 UPS • 5 SWTS • FGSES • DSIM/TSIM	**JLAB83 & JFLT83** (MIRI RAL) • 3 UPS • 1 SWTS
JLAB51 (IGSS GSFC, MD) • 1 UPS • STS	**JLAB40** (ISIM FSW Maintenance GSFC MD) • 1 UPS • 5 SWTS • FGSES? • DSIM/TSIM	**JLAB84 & JFLT84** (NIRCam Palo Alto) • 2 UPS • 1 SWTS • Rose model • DSIM/TSIM
JLAB81 (ITSS GSFC, MD) • 1 UPS • 1 SWTS	**JLAB41** (ISIM FSW Maintenance GSFC MD) • 1 UPS • 5 SWTS • FGSES • DSIM/TSIM	**JLAB85 & JFLT85** (NIRSpec Germany) • 3 UPS • 1 SWTS
RALF2 (IGSS GSFC, MD) • tbd	**JLAB89** (STScI Baltimore, MD) • **NO** UPS (remove any UPS before delivery) • 5 SWTS DSIM/TSIM	**JLAB86 & JFLT86** (FVTS Ottawa) • 3 UPS • 1 SWTS Rose model
JLAB30 (IGSS GFSC, MD) seed JLAB **see destination JLAB for component detail	**RALF** (STScI Baltimore, MD) • tbd	**JLAB87 & JFLT87** (NIRCam Arizona) • 2 UPS 1 SWTS
JLAB31 (IGSS GSFC, MD) seed JLAB **see destination JLAB for component detail	**JLAB96-EMTB** (Redondo, CA) • 2 UPS (IES racks only) • 5 SWTS • FGSES • DSIM/TSIM • IES	
JLAB37 (IGSS GSFC, MD) seed JLAB **see destination JLAB for component detail	**FOS-OTB** (STScI Baltimore, MD) • 4 UPS (IGSS racks only) • 5 SWTS • FGSES	

Table 1. FY'20 Tech-Refresh Perpetual JLAB/JFLT Racks and Components

(All JLABs (except RALF) listed will get Raytheon Domain Controller & Workstation(s))

JLAB Tech-Refresh Upgrade for IGSS and IES	JFLT Tech-Refresh Upgrade
The JLAB Tech-Refresh upgrade shall: 1. Exchange existing JLAB racks with new TR JLAB racks shown in Table 1 2. Resolve IP addressing such that the new TR JLAB will retain the same JLAB # and IP 3. Execute a complete data xfer at the Stakeholders site for data from the existing JLAB Eclipse directory and User data I: Drive to same on the new TR JLAB 4. Integrate **new KVMs with PIV** (assume all partners have a NASA PIV card) 5. Integrate **new routers & switches** replacing 2960G & 2960S switches and 2851 & 2951 routers 6. Integrate **new UPS** for IES & IGSS for US and European JLABs (Note: No UPS in the STScI JLAB89; and retain the BIG RED button for the NIRSpec Germany JLAB85) 7. Integrate new **Raytheon** H/W & S/W for their physical **domain controller** 8. Integrate new **Raytheon Workstations** (Win10) & **Servers** (VM; 2016 OS) + **Linux** (VM functions as APP60) 9. Integrate **new DSIM/TSIM** hardware/software (Win-10) 10. Integrate STS as appropriate 11. Integrate **IGSS-OBS R9.3.0** (CCTS B6.4). (Note: subsequent updates to IGSS-OBS R9.3 will be made available when available) **12.** Replace Firefox with **Chrome** 13. Resolve Win-10 **32-bit vs. 64-bit**	The JFLT Tech-Refresh upgrade shall: 1. Exchange existing components in JFLT racks with new components as shown in Table 1 2. Integrate new KVMs with PIV (assume all partners have a NASA PIV card) 3. Integrate new UPS for US and European JFLTs 4. Integrate new SWTS hardware/software upgrades 5. Integrate new ICDH software upgrades 6. Integrate new Bus Monitors (Win-10) 7. Integrate new ROSE software (Win-10) 8. Integrate new DSIM/TSIM hardware/software (Win-10)

Table 2. FY'20 Tech-Refresh JLAB/JFLT Initial Requirements

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
A JWST GS&O IGSS support facility at GSFC B13 provides an IGSS development lab; staff workspace; and space for storage and fabrication.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Eclipse™ (Raytheon)	
Windows-based ground development platform that includes the COTS *ScriptEase JavaScript* engine embedded in the original COTS *Integrated Software Development Kit (ISDK)*	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]
[redacted]
[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

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The list of task deliverables should include:

Integrated Ground Support System (IGSS)
Integration & Test Support • Deliver bug fixes & enhancements as required. (Up to 6 releases) • Maintain list of defects and enhancements. (Monthly) • Update Test Plans and Procedures. (Each release) • Conduct Test Readiness Reviews. (Major releases) • Provide Test Summary Reports. (Each release) • Provide Baseline/Functional/Physical Audits. (Major releases) • Training. (As necessary) • JWST-IGSS Lab area reconfigurations (For up to 2 configurations per Master Schedule)
IGSS & JLAB/JFLT documentation including: • IGSS JLAB/JFLT drawings (~43) • IGSS Hardware Engineering Support QA Plan (JWST-PLAN-017057) (as needed) • IGSS Sparing Plan (JWST-PLAN-025353) (as needed) • IGSS Architecture Document (JWST-ARCH-025345) (as needed) • IGSS External ICD (JWST-ICD-004747) (as needed) • IGSS Requirements Document (JWST-RQMT-004608) (as needed) • IGSS Tools (as needed) • Version Description Document (VDD) (Each release) • IGSS Requirements Traceability Matrix (RTM) (as needed) • IGSS Release Functional/Physical Audits (Major releases) • IGSS Release Test Readiness Review (Major releases) • IGSS Release Test Summary Report (Each release) • IGSS JLAB Tech Refresh Support System (TRSS) Specification (JWST-SPEC-tbd) (New) JLAB Database Tool (JDT): • Requirements document • Architecture document • Test Readiness Review (TRR) • Test Summary Report • JLAB Database Tool User's Guide • Overview presentation to JDT Stakeholders
IGSS & COTS S/W Support Renew and/or initially procure necessary software & licenses. (Specified in Vendor's material list) Documentation for COTS *ScriptEase JavaScript* engine enhancement: • Requirements document • User's Guide • Test Readiness Review (TRR) • Test Summary Report
IGSS Fabrication (JLAB & JFLT racks per Master Schedule) • Upgrade pertinent JLABs to RHEL (as required) • Perform FY'20 Tech-Refresh on JLABs/JLFLTs listed in Table 1
Software Telemetry Simulator (STS)
STS documentation including: • JWST-STS Delivery Letter (Each delivery) • JWST-STS Developer's Guide (Each delivery) • JWST-STS Installation Guide for Mac OS X (Each delivery) • JWST-STS Installation Guide for Windows 7 OS (Each delivery) • JWST-STS Maintenance Guide (Each delivery) • JWST-STS User's Guide (Each delivery)

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• JWST-STS Version Description Document (VDD) (Each delivery) • Updated Requirements Document (Each release if applicable) • Updated Requirement Traceability Matrix (RTM) (Each release if applicable) • Updated Test Plan. (Each release if applicable) • Test Summary Report. (Each release)
Deployment Electronics Unit (DEU)
None
IT Security Documentation assistance for JWST ISSO
• Support closing tbd outstanding POA&Ms • Document the Contingency Plan (CP) Test 2019 • Complete self-assessment in preparation for the next third-party assessment around 2019. • Provide updates to the following documents in the Risk Information Security Compliance System (RISCS) 2019: - System Security Plan (SSP) - Risk Assessment Report (RAR) - Contingency Plan (CP)

End of Task Order Statement of Work

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GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 37
Modification: 6
Task Name: SGSS Systems Engineering Support

GSMO-2 SOW Reference: 2.1, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	07/27/2018	Initial task order statement of work.
1	10/25/2017	07/27/2018	Re-plan to add resource to Subtask 2.
2	07/28/2018	08/24/2018	Admin Mod (No Cost Extension) by CO
3	08/25/2018	08/24/2019	Deleted Subtask 2 which will migrate to a new standalone task. Updated SOW to align with planned activities for project phase. Extended Period of Performance.
4	10/31/2018	08/24/2019	Re-plan
5	04/25/2019	08/24/2019	Re-plan
6	08/25/2019	08/29/2020	Extend Period of Performance. Updated SOW to align with planned activities for project phase.

II. Task Overview

The SGSS Systems Engineering Support task provides expertise to support the project office in maintaining adequate, effective, and efficient insight into and oversight of implementation contractor's design, development, integration, test, deployment, transition, and operations activities. The task also provides expertise to support project engineering activities that are independent of implementation contractor's effort.

III. Requirements

1	**SGSS Systems Engineering Support**
1.1	**General Systems Engineering Support**
1.1.1	The contractor shall support general engineering analyses and trade studies.
1.1.2	The contractor shall maintain insight into the Implementation Contractor's (IC's) plans and schedules, and assist the project in tracking progress against the plans.
1.1.3	The contractor shall support reviews of CDRL and non-CDRL documents as responsible document owners and/or subject matter experts.
1.1.4	The contractor shall participate in engineering peer reviews, system reviews, regularly scheduled and ad-hoc Technical Interchange Meetings.

1.1.5	The contractor shall evaluate the IC's plans and designs, ensuring the design meets requirements and specs.
1.1.6	The contractor shall provide subject matter experts to serve as functional area and element leads. The leads are expected to maintain diligent awareness of progress against the plans and provide weekly progress status reports.
1.1.7	The contractor personnel acting in lead role, shall take ownership of requirements associated to their domain and comprehensively review the test and verification artifacts.
1.1.8	The contractor shall support the test and verification efforts conducted by the IC, providing clarification on system requirements as needed. Ensure the derived requirements comply with the intent of the Level 3 requirements.
1.1.9	The contractor shall support the project and IC team in prioritization of the changes and defects.
1.1.10	The contractor shall support the project in assessing the completeness of verification of requirements. The contractor is also expected to support the project in maintaining a requirements traceability and verification matrix to depict situational awareness of requirements integration and verification.
1.1.11	The contractor shall develop and/or support development of validation checklists for interfaces, capabilities, etc. to help the project document compliance for associated requirements and functionalities.
1.1.12	The contractor shall develop and/or support the development of mission-specific interface control documents and other technical artifacts that enable the project to effectively communicate the technical information to stakeholders.
1.1.13	The contractor shall support the project in collaborating with the IC on technical planning; monitoring progress against the plan; devising technical solutions; defining criteria and methods for requirements verification; and any other technical areas of collaboration as needed.
1.1.14	The contractor shall support the project office in establishing and executing technical processes and updating the technical plans.
1.1.15	The contractor shall provide subject matter expertise in the area of IT Security and COMSEC. The subject matter expert(s) shall support the project in effectively executing through the Continuous Monitoring phases and Annual Assessments.
1.2	**System Integration and Test Support Services**
1.2.1	The contractor shall support the project in maintaining insight into and oversight of IC I&T detailed planning activities.
1.2.2	The contractor shall support the project in ensuring effective and efficient review of test plans, procedures, and any associated artifacts.
1.2.3	The contractor shall support reviews of CDRL and non-CDRL I&T documents as a subject matter expert.
1.2.4	The contractor shall monitor the IC's I&T plans, schedules, status and reports, and provide inputs to the SGSS Project.
1.2.5	The contractor shall participate in various I&T peer reviews, system reviews, and Technical Interchange Meetings.

1.2.6	The contractor shall support the project in developing a plan for subject matter experts' witness at IC and subcontractor's test and verification events. The events may occur in the labs or at site.
1.2.7	The contractor shall review discrepancy reports, and monitor progress of discrepancy resolutions.
1.3	**SGSS PMO Support**
1.3. .1	The contractor shall engage with existing SGSS project staff to gather relevant program status information and shall support NASA in developing program status presentations articulating program progress against milestone objectives, risks, anticipated costs, and so forth as per agency and center directives, guidelines, and procedures.
1.4	**Deployment, Transition, and Operations Support**
1.4.1	The contractor shall provide Subject Matter Expert to serve as Deputy Deployment, Transition, and Operations (DTO) Manager.
1.4.2	The contractor shall assist the DTO manager in monitoring the IC's DTO activities.
1.4.3	The contractor shall review IC's DTO plans and procedures.
1.4.4	The contractor shall assist DTO manager in planning and managing the DTO activities on the project including preparations of executive briefings, review of CDRL and non-CDRL documents, etc.
1.4.5	Building upon SOW Statement 1.1.12, the contractor shall develop and/or support development of comprehensive material related to customer mission specific transition testing. This would include coordination with IC for developing transition appendices and supporting material, facilitate and conduct coordination technical interchange meetings with the customer missions and related stakeholders, and supporting the DTO Manager in development of required configuration change details for the system.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

Reviews and Technical Interchange Meetings at IC facilities,
SN facilities.
I&T Surveillance at IC facilities.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Review of IC CDRL and non-CDRL items. (as required)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 38
Modification: 4
Task Name: SOHO Mission Operations

GSMO-2 SOW Reference: 3, 3.1-3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	01/26/2018	Initial task order statement of work.
1	01/27/2018	03/29/2019	One-year task extension.
2	01/23/2018		Administrative modification
3	02/20/2018	03/29/2019	Provide additional staffing for a backup software engineer.
4	03/30/2019	03/28/2020	One-year task extension.

II. Task Overview

The SOHO Mission Operations task provides operation support conducted from GSFC utilizing NASA institutional and project-unique support facilities. These facilities provide science planning and operations, control center operations, attitude and orbit computation, mission analysis, communications, simulations, and data capture and processing. Command uplink, telemetry acquisition, and metric tracking are through the DSN.

III. Requirements

1	**SOHO Mission Operations**
1.1	**Spacecraft Operations**
1.1.1	The contractor shall perform all real-time operations of the SOHO spacecraft including: • Telemetry, tracking and command activities, • Health and safety monitoring, • Orbital and/or attitude maintenance maneuvers, • System configuration, • Housekeeping telemetry processing, • Command load uplink and verification, • Onboard table and memory load/dump operations, • Management of the Solid State Recorder (SSR) and the Tape Recorder (TR) to capture and downlink all science and spacecraft engineering data.
1.1.2	The contractor shall perform all real time support operations including: • Planning and scheduling, •• Schedule DSN resources

	•• Schedule the European Space Agency tracking resources (New Norcia) to support holes in DSN coverage • Stored command load generation, • Maneuver planning, and • Spacecraft clock maintenance.
1.1.3	The contractor shall perform attitude operations for the SOHO mission including: • Attitude determination, • Attitude sensor calibration and trending, • Attitude product generation, • Attitude maneuver planning and execution, • Document all nominal and contingency attitude operations procedures, • Add workstation to host the SOHO attitude determination system in the MOC •• configure and test for operations.
1.1.4	The contractor shall monitor the spacecraft to prevent or detect spacecraft anomalies, and respond appropriately. Monitoring shall provide: • Sufficient warning to avoid anomalies caused by slow degradation, • Sufficient indicators to detect, as quickly as possible, anomalies that do occur.
1.1.5	The contractor shall respond to any single failure within 24 hours (assuming Hx momentum of at least –10 Nms).
1.1.6	The contractor shall respond to any failure triggered during thruster operations within 8 hours.
1.1.7	The contractor shall perform daily subsystem operations including: • Reaction wheel speed limit updates, • CRS drift term update, • Updating CELIAS and SWAN OBT, • Clock correlation checks, • SSR operations (dump/record), • RF trending data collection.
1.1.8	The contractor shall perform semi-routine (few times per week) subsystem operations including: • Dumping flight software maintenance parameters, • Updating ACU Hx limits, • Uploading new non-coherent (NONCOHO) commands.
1.1.9	The contractor shall perform special (> once per month) subsystem operations including: • Keyhole operations, • Reaction Wheel Momentum Management as required, • Station keeping Maneuvers as required, • Roll Profile, • Pitch or yaw off pointings for instrument calibration as required by the instrument teams, • Adjusting OBT clock frequency, • Dumping CDMU and ACU memory (RAM) every other month,

	• Tape Recorder Maintenance every other keyhole period, • Software patch uplink and testing, • Selecting new guide star, • Acquiring new tracking stars, • Switching from CAE A to B and B to A, • Uploading new Roll Steering Law table.
1.1.10	The contractor shall continue to develop and modify automated procedures and tools required to efficiently support the Bogart phase of the mission.
1.2	**Data Processing**
1.2.1	The contractor shall provide level zero processing of all observatory and science data.
1.2.2	The contractor shall ensure delivery goals are met.
1.2.3	The contractor shall perform data analysis for anomalous data.
1.2.4	The contractor shall interact with customers from EOF, EAF, CDHF and Stanford University.
1.3	**System Administration**
1.3.1	The contractor shall maintain network software configurations on hosts and Local Area Network (LAN) routers.
1.3.2	The contractor shall maintain compliance with NASA IT Security Policies and Guidance.
1.3.3	The contractor shall maintain complete documentation and strict configuration management of all operational system builds (from initial re-format to operational certification).
1.3.4	The contractor shall perform database administration to ensure the integrity and availability of database systems and their content.
1.4	**Sustaining Engineering**
1.4.1	The contractor shall provide all systems support, including updates, for the MOC and external interface changes and associated vendor licenses: • Software Sustaining Engineering/Enhancements: •• Arrange vendor maintenance agreements for Commercial Off-the-Shelf (COTS) products, •• Corrective maintenance of operational custom software systems, •• Modifications to existing operational custom software systems, •• Test and integration support of new or modified software, •• Documenting software problems and changes, •• Maintenance of operational parameter databases, •• Configuration control of software system configurations. • Hardware Maintenance and Sustaining Engineering/Enhancement: •• Respond to hardware malfunctions within 1 business day unless a subsequent failure would directly impact mission health and safety, •• Support around the clock maintenance for brief periods during critical mission activities, •• Provide stand by support as required during mission simulations, ground system tests, critical on-orbit activities, or in response to anomalies, • Recommend alternative solutions in anticipation of hardware and software obsolescence.

1.4.2	The contractor shall provide support for the Experimenters Operations Facility (EOF) Core System (ECS) software.
1.4.3	The contractor shall support and upgrade the SOHO simulator as required.
1.4.4	The contractor shall participate in any ground system re-engineering activities.
1.4.5	The contractor shall be exempt from CMMI.
1.4.6	The contractor shall provide PTI support.
1.4.7	The contractor shall provide SLE OS upgrade support.
1.4.8	The contractor shall support historical data transfer from RDA to RAID.
1.5	**Configuration Management**
1.5.1	The contractor shall administer existing Configuration Control Board (CCB) to review and approve changes to the configuration of deliverable items.
1.5.2	The contractor shall create and maintain documentation of the baseline of hardware, software, facilities, and support interfaces for operational systems that indicates models, versions, releases, and vendor support availability for each system and facility identified and consistent with IT Security guidance for certification and auditing.
1.5.3	The contractor shall create and maintain a full and complete written record of configuration changes to all deliverable items.
1.6	**Risk Management and Best Practices**
1.6.1	The contractor shall identify and evaluate risks to operational systems that support the missions, including risk of software and hardware obsolescence and IT Security vulnerabilities.
1.7	**End-of-Life Plan**
1.7.1	The contractor shall provide required updates and support to ESA SOHO End Of Mission Plan (EOMP) as needed.
1.8	**Flight Operations Mission Library**
1.8.1	The contractor shall maintain a library of operational documentation. The library includes but is not limited to: • Flight Operations Plan, • SOHO User's Manual, • Ground system user's guides, • Logbooks (since launch), • Operation Change Directives (OCDs) (since launch), • Spacecraft and ground anomaly reports (since launch).

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The Government will provide all SOHO mission operations facilities.
The Government will provide (make available for use) all tagged and installation-provided GFE currently located at GSFC.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) (NASA/GSFC Code 595)	GSC-15811-1
Command Management System (CMS)	
Transportable Payload Operations Control Center (TPOCC)	
SOHO Simulator	
FORMATS	
IRTS	
SOHOSLE	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Anomaly Reports including ground, spacecraft and database. (Within 1 business day of anomaly occurrence)
Monthly metrics reports covering the complete mission. (15th of the following month)
Ground system test reports for all new software releases for all ground systems. (After completion of acceptance testing)
Flight Operations Plan including mission requirements, implementation of requirements, description of operational processes, description of ground system, overview of spacecraft design, description of anomaly detection & response and a

mission management plan for SOHO operations. (Updated as required. Mission Management plan for task order delivered 25 days after contract award)
Nominal Operations Scripts for nominal, semi-routine or special operations including detailed stop-by-step instructions, constraints and abort/contingency criteria. (Updated as required)
Contingency Scripts with a description of each known contingency, detailed step-by-step instructions, constraints, and abort/contingency criteria. (Updated as required)
Training Plan with a description of training for SOHO operations and including recurring training for proficiency. (Updated as required)
Change Requests using the SOHO Programme Office form showing the end-to-end process for any changes to operational products or ground systems. (Generated for all changes to operational products and ground system configuration)
Risk Forms detailing risks to the mission. (Generated as risks are identified)
Semi-routine/special operations planning reports including a timeline for the activity, the DSN schedule, status of operational products and operational readiness. (Prior to activity at Special Operations Readiness Review)
End of Life Plan including the description of activities to close out the mission. (Updated as Required)
Anomaly closeout report including a summary of ground anomaly closures. (Weekly)
Operational Products including TSTOL procedures, TSTOL configuration monitor flies, TSTOL pages, C-shell and PERL scripts and other products. (Updated as required, all changes under configuration control)
Trending data as defined by ESA. (Monthly)
Special trending requests. (As requested)
Project Database containing limit information. (Updated as required)
Daily Reports including a summary of all activities for each mission day. (Within 7 business days)
Logbooks including the operations, OE, CMS offline string and simulator logbooks. (Updated as activities take place)
Data Processing products including: • VC01 routine products (24 hr. product). (2 wk. delivery goal) • VIRGO routine product (24 hr. product). (2 wk. delivery goal) • MDI-VC2 or 3 routine product (automatic per file). (4 day delivery goal) • MUX routine product (24 hr. product). (2 wk. delivery goal) • Trending routine product (24 hr. product). (2 wk. delivery goal)
Project Schedule including the status of work packages and their major sub-elements. (Presented as required)
Software & Documentation as dictated by individual work packages including executable and source code, media, documentation, etc. as negotiated within the individual work package. (As required, delivered to the MSL in bldg. 3)
CM Baseline including an accurate account of hardware, software, facilities and support interfaces for operational systems that indicate models, versions, releases and vendor support availability for each system and facility identified. (Maintained continually per CM process)
Final Mission Report. (End of Task Order POP)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 39
Modification: 5
Task Name: EOS Flight Operations

GSMO-2 SOW Reference: 3.3, 3.4, 3.6, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	08/23/2017		Admin Mod
2	06/30/2018	06/29/2019	CY2
3	09/13/2018		Admin Mod
4	10/01/2018	06/29/2019	Replan to reduce unused scope
5	06/30/2019	06/27/2020	CY3; Removed references to Science Interface Mngr; added statement regarding TS/SCI level coordination with CSpOC as needed

II. Task Overview

The EOS Flight Operations task provides flight operations of the EOS Terra, Aqua and Aura spacecraft consistent with established procedures. Flight operations includes all activities necessary to maintain spacecraft and instrument health and safety while working to achieve the objectives of the mission, provide daily operational continuity and perform on-going monitoring and analysis of onboard and ground systems.

III. Requirements

1	**EOS Flight Operations**
1.1	**Management Approach**
1.1.1	The contractor shall provide mission management support necessary to ensure staff availability, competence, reliability, performance, and reporting of the work force required to operate the EOS spacecraft and their associated ground system elements.
1.1.2	The contractor shall perform technical management of the EOS Operations Center (EOC) that's utilized to conduct EOS flight operations as specified in this subsection.
1.1.3	The contractor shall coordinate with Task Monitor for EOC operations scheduling, budgeting, and staffing.
1.1.4	The contractor shall plan, manage, and coordinate EOC operations and operations related functions specified within this task. This includes ensuring that spacecraft operations meet the requirements of this SOW,

	and includes performing appropriate staffing, scheduling, and budget planning activities.
1.1.5	The contractor shall coordinate configuration tracking for all mission operations changes with the ESMO Mission Director.
1.1.6	The contractor shall participate in engineering studies and recommend system and procedural (hardware/software upgrades, staffing adjustments, procedure modifications, facility enhancement, etc.) changes to meet future mission requirements and/or improve ongoing operations.
1.1.7	The contractor shall maintain awareness of EOS Data Operations System (EDOS) development and maintenance activities. The contractor shall coordinate with EDOS and the Science Interface Manager any flight operations activities, proposed concepts, and plans that impact EDOS data capture or processing and/or science team data products (for example, the SSR automation concept and plan).
1.1.8	The contractor shall participate in all ESMO Discrepancy Review (DR) Board and Project Configuration Management Board (PCMB) Meetings. Provide analysis and impacts on Discrepancy Reports (DRs) and Configuration Change Requests (CCRs) as requested by the ESMO Mission Director.
1.1.9	The contractor shall participate in Anomaly Review Boards and other regular activities related to spacecraft operations.
1.1.10	**Staff Allocation, Expertise, and Level of Effort**
1.1.10.1	The contractor shall, for EOS Flight Operations activities, provide the require expertise in on-console operations, spacecraft engineering data analysis, programming of operations scripts and reporting.
1.1.10.2	The contractor shall provide the proper staffing levels to safely and effectively operate the EOS missions.
1.1.11	**Management Reporting**
1.1.11.1	The contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance to adequately describe the EOS mission operations and mission support services activities that were provided to the ESMO Project.
1.1.11.2	The contractor shall provide monthly financial reporting by mission and by combined total task. Reporting will provide 533M level information by mission (Terra, Aqua and Aura) and contain sufficient detail to allow long-term budget planning.
1.1.11.3	The contractor shall provide an annual performance review of the EOS mission operations and mission support services based on current requirements and actual services used.
1.1.11.4	The contractor shall present to the Government an operations concept for the next year considering the EOS mission's current status, expected budget, and risk tolerance.
1.1.12	**Risk Management and Best Practices**
1.1.12.1	The contractor shall apply continuous Risk Management and Best Practices compliant with NPG 7120.5.

1.1.12.2	The contractor shall comply with all Agency, Center, and ESMO directives regarding Risk Management and Best Practices.
1.1.13	**Information Technology Security**
1.1.13.1	The contractor shall apply Information Technology (IT) security standards as defined by NPG 2810.1 for systems classified as Mission (MSN) for all ESMO IT systems.
1.1.13.2	The contractor shall comply with all Federal Rules and Regulations and Agency/ESMO directives. The EOS EOC is classified as an MSN system.
1.1.14	**Organizational Interfaces**
1.1.14.1	The contractor shall interface with all EOC service providers, and customers as specified in the Operations procedures, Interface Control Documents (ICDs) and Operations Agreements (OAs).
1.1.14.2	The contractor shall interface with GSFC Security Office as required.
1.2	**Technical Approach**
1.2.1	**Spacecraft Operations**
1.2.1.1	**Coordination with other Missions**
1.2.1.1.1	The contractor shall provide coordination with the Afternoon Constellation.
1.2.1.1.2	The contractor shall provide coordination with Terra and the Morning Constellation Satellites.
1.2.1.1.3	The contractor shall notify all member satellites of the Morning Constellation and the A-Train Afternoon Constellation of any and all instances of an EOS spacecraft transitioning into or out of Safe or Survival Mode. Notification shall be in accordance with the Constellation agreement documents between the member satellites of the Morning Constellation and/or A-Train Afternoon Constellation and the ESMO Project.
1.2.1.1.4	The contractor shall provide coordination with Non-nominal and/or Special Instrument Activities.
1.2.1.1.5	The contractor shall inform the ESMO Mission Director regarding any instrument team request to perform special or non-nominal activities.
1.2.1.1.6	The contractor shall support instrument teams in testing and checking of new or modified procedures. Simulations shall be performed to the extent possible prior to the uplink of any new commands/procedures. Any activity requiring the concurrence of the instrument teams and/or Project Scientists shall be coordinated with ESMO Mission Director.
1.2.1.1.7	The contractor shall provide coordination with External Users and/or Science Teams.
1.2.1.1.8	The contractor shall inform the ESMO Mission Director regarding any condition or activity that impact external users and/or the EOS Science Teams, for example, the Direct Broadcast users.
1.2.1.2	**Planning and Scheduling**
1.2.1.2.1	The contractor shall secure adequate communications services through the Ground Network (GN) and Space Network (SN), or other government provided communications networks for the delivery of spacecraft and

	instrument telemetry to the ground and the commanding and tracking of the Terra, Aqua and Aura spacecraft.
1.2.1.2.2	The contractor shall ensure a conflict-free schedule of activities for all spacecraft contacts, spacecraft activities, and instrument operations that is consistent with the overall Terra, Aqua and Aura mission operations requirements.
1.2.1.3	**Real-time and Support Operations**
1.2.1.3.1	The contractor shall support all real-time operations of the Terra, Aqua and Aura spacecraft from both ground and space networks, as necessary to meet mission objectives. Real-time operations consist of those activities that are necessary to support direct communication with the spacecraft and include: telemetry, tracking and command activities, health and safety monitoring, orbital maintenance maneuvers, system configuration, housekeeping telemetry processing, command load uplink and verification, onboard controller table and memory load/dump operations, and management of the Solid State Recorder (SSR) to capture and downlink all science and spacecraft engineering data. Support operations are those offline activities that are necessary to support the safe and nominal operation of the spacecraft and include: planning and scheduling, stored command load generation, ephemeris generation, maneuver planning support, spacecraft clock maintenance, and S-Band center frequency maintenance.
1.2.1.4	**Support of EOS Flight Dynamics System (FDS) Functions**
1.2.1.4.1	The contractor shall provide a Flight Operations Team (FOT) that works closely with the Flight Dynamics System Services (FDSS) contractor team to plan, coordinate and execute all EOS spacecraft orbit maintenance and attitude maneuvers. The FDSS contractor shall plan all maneuvers, and the FOT contractor shall coordinate and execute all maneuvers.
1.2.1.4.2	The contractor shall coordinate and communicate all Aqua and Aura orbit maintenance maneuvers with the other satellites of the "A-Train" Afternoon Constellation at least 1-week prior to any such maneuver. Notification shall also be provided within 1-hour after successful completion or postponement of all orbit maintenance maneuvers.
1.2.1.4.3	The contractor shall participate in all Constellation Working Group Meetings as requested by an ESMO Mission Director or the ESMO Constellation Team Manager. Participation may be via teleconference or may require travel to the Constellation Mission Operations Working Group (MOWG) Meeting at the request of an ESMO Mission Director or the ESMO Constellation Team Manager.
1.2.1.5	**Support of Operational Collision Avoidance Activities**
1.2.1.5.1	The contractor shall utilize contractor provided tools to develop a planned course of action for conjunctions where multiple predicted close approaches over a relatively short period of time need to be considered. For such events, the contractor shall recommend a course of action.

1.2.1.5.2	The contractor shall help the FOT and ESMO mission management personnel to establish and understand operational risk for a given conjunction event.
1.2.1.5.3	The contractor shall work with the FOT during the maneuver planning phase to help establish and mitigate collision risks.
1.2.1.5.4	The contractor shall work with the FOT to enable better understanding of the NASA Conjunction Assessment and Risk Analysis (CARA) or CRMS (Collision Risk Management System) conjunction assessment screening reports.
1.2.1.5.5	The contractor shall review the current ESMO collision avoidance risk evaluation procedures and provide recommended improvements where necessary.
1.2.1.5.6	The contractor shall review current ESMO maneuver planning and execution procedures.
1.2.1.5.7	The contractor shall present recent experience and lessons learned at Earth Science Constellation (ESC)/Afternoon Constellation (a.k.a. "A-Train) Mission Operations Working Group (MOWG) Meetings and other technical meetings dealing with collision avoidance risk management as requested by the ESMO Project.
1.2.1.5.8	The contractor shall provide, via a subscription service, persistent access to an online collaboration environment to analyze conjunction data. Access shall be for the following ESC missions: EOS Terra, Aqua, and Aura.
1.2.1.5.9	The contractor shall provide expertise in analyzing EOS Orbital Debris Messages (ODMs) and Conjunction Data Messages (CDMs) sent from the Consolidated Space Operations Center (CSpOC) and the Space-Track.org website to the Conjunction Risk Mitigation System (CRMS). The contractor shall possess the subject matter expertise and credentials needed to directly interact with Orbital Safety Analysts (OSAs) and/or the 18th Space Control Squadron (SPCS) at CSpOC at all security levels needed and provide advice to the Mission Director to safely mitigate conjunctions reported. EOS Mission Operations includes on-orbit debris avoidance to ensure the safety of the spacecraft. In this effort, the contractor shall participate in technical discussions with the CSpOC. Both programs have TS/SCI data that may be relevant to the safety of the EOS Mission's orbital environment. The CSpOC has TS/SCI data on classified orbital objects that may be relevant during collision avoidance events. The contractor shall be able to relay orbital and spacecraft technical information to the CSpOC OSAs, and shall participate in discussions utilizing TS/SCI data from classified objects to safely mitigate conjunctions that threaten the safety of the EOS spacecraft.
1.2.2	**Spacecraft Engineering**
1.2.2.1	The contractor shall provide a dedicated staff of experts to monitor and maintain the health of the Terra, Aqua and Aura spacecraft, collect

	telemetry data and process all health and status telemetry data to assess the performance of each spacecraft subsystem and instrument. The off-line engineering staff shall be the technical leadership of the Flight Operations Team and shall be responsible for ensuring all aspects of spacecraft performance.
1.2.2.2	**Anomaly Detection, Isolation, Analysis, Recovery and Reporting**
1.2.2.2.1	The contractor shall monitor and maintain the health of the Terra, Aqua and Aura spacecraft, collect telemetry data and process all health and status telemetry data to assess the performance of each spacecraft subsystem and instrument.
1.2.2.2.2	The contractor shall, in response to spacecraft anomalies, execute the pre-approved red-limit responses such as flight operations procedures and/or spacecraft commands. In response to spacecraft anomalies that do not have a pre-approved response and the spacecraft is not in imminent danger of loss of mission, the contractor shall defer sending corrective action spacecraft commands without the approval of the appropriate ESMO Mission Director. The ESMO Mission Director shall determine if the contractor to conduct anomaly investigations as needed to assess on-orbit problems and formulate a response using the appropriate expertise.
1.2.2.2.3	The contractor shall be responsible for support of anomaly resolution activities as defined in this section. An anomaly is defined as the occurrence of any event that causes the spacecraft, its instruments, or any of the ground-based support systems to perform in a non-standard manner during any normal or special operation. An anomaly may occur in either on-orbit or ground-based elements of the EOS mission operations system.
1.2.2.2.4	The contractor shall report all anomalies that occur to the spacecraft, the instruments, the mission operations facilities, or other areas that impact the operation or safety of personnel and equipment. The anomaly report shall be in accordance with NASA/GSFC's Code 400 Flight Programs and Projects Directorate Anomaly Notification Procedures and Guidelines and ESMO's Anomaly Management Procedures. This report shall be made to the ESMO Mission Director within one business day; unless the anomaly is mission threatening in which case the ESMO Mission Director shall be notified immediately. A summary of the anomaly shall be received via e-mail within one business day. The definition of an anomaly for the operational phase of the EOS mission is as follows: • Any spacecraft or ground system component not operating or functioning as expected, does not perform as expected, or exhibits behavior considered being different than normal. • Any flight operations procedure, or stored command activity, that produces unexpected results or fails to produce its desired results. • Any yellow or red limit violation on any telemetry parameter, or status flags in telemetry, which indicate an error has occurred, or abnormal trends in telemetry data.

	• Any configuration or state of the spacecraft that is unexpected or potentially harmful to the health and safety of the spacecraft or instruments. • Any other abnormal event or behavior that could potentially indicate a malfunction of the flight or ground system hardware or software. The ESMO Mission Director, or designee, is responsible for generation of all formal NASA Anomaly Reports, which were formally referred to as NASA Incident Reports.
1.2.2.2.5	The contractor shall, for each spacecraft anomaly, generate an Anomaly Report. This report shall describe how the anomaly was discovered, what were the results of the anomaly investigation, the impact of the anomaly, any interim work-around (if required), and the final resolution of the anomaly. The Anomaly Report shall be provided to the ESMO Mission Director within 10 business days of resolution of the anomaly
1.2.2.2.6	The contractor shall maintain a database of all spacecraft and ground-based flight operations anomalies. The contractor shall report on the status of all open anomaly investigations at all monthly status reviews or as requested by an ESMO Mission Director. As requested by an ESMO Mission Director, the contractor shall enter EOS spacecraft anomalies on a case-by-case basis into the GSFC Mission Assurance System (SOARS/META).
1.2.2.2.7	The contractor shall participate in the analysis of anomalies in support of the Anomaly Recovery Team (ART), when requested by and under the oversight of the ESMO Mission Director. The contractor shall also implement corrective actions as requested by an ESMO Mission Director. The Government is responsible for maintaining and managing the ART. In addition, the Government is responsible for any augmentation of technical staff to support anomaly analysis. The ART has lead responsibility for analysis of anomalies that are determined to be the result of the performance of an on-orbit system or subsystem, or a result of a procedural error. The ART is also responsible for development of a corrective action recommendation to be given to the ESMO Mission Director.
1.2.2.2.8	The contractor shall, under the oversight of the ESMO Mission Director, have responsibility for analysis and resolution of anomalies that are determined to be the result of performance or failure of a ground-based system or subsystem, or a result of procedural error.
1.2.2.3	**Performance Analysis and Trending**
1.2.2.3.1	The contractor shall collect and store the housekeeping and health and safety data from the Terra, Aqua and Aura spacecraft.
1.2.2.3.2	The contractor shall process, trend and analyze these data on a short-term, long-term and periodic basis depending on the specific parameters and objectives.
1.2.2.3.3	The contractor shall identify any parameters that might demonstrate unacceptable performance degradation with time and trends that could lead to future performance loss or degradation of flight hardware in the Monthly Spacecraft Performance Report.

1.2.2.3.4	The contractor shall generate ad hoc reports as needed to support anomaly investigations, maneuver planning, and any special reports requested by an ESMO Mission Director.
1.2.2.4	**Spacecraft & Instrument Off-Line Engineering Support**
1.2.2.4.1	The contractor shall provide off-line engineering support for the spacecraft and its instruments for all special engineering activities and contingency operations. Off-line, in-depth analysis shall be performed in order to validate spacecraft subsystem and instrument performance as well as to investigate any anomalies or trends that may occur. This includes support to investigation of any instrument anomalies.
1.2.2.4.2	The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.
1.2.2.4.3	The contractor shall maintain and update documentation, plans and procedures as required supporting mission operations and mission support activities.
1.2.2.4.4	The contractor shall maintain and update the spacecraft manufacturer provided documentation as needed.
1.2.2.4.5	The contractor shall maintain and update flight team training plans and provide the necessary training as classroom training, training exercises, and simulations.
1.2.2.4.6	The contractor shall develop and maintain spacecraft models and analysis tools as required for off-line engineering support of normal and special flight operations activities and contingency analysis activities.
1.2.2.4.7	The contractor shall support Ground System Upgrades and Technology Refresh Activities: -participate and provide support to all activities related to ground system changes or technology refresh activities. -assess the potential level of impacts and risk to normal mission operations activities for all ground system changes. -raise any issues of concerns and risk to the ESMO Mission Directors as results of changes to the ground system.
1.2.2.4.8	The contractor shall support Instrument and Science Activities: -support all instruments and sciences activities related to calibrations, anomaly resolution, reconfiguration and planning of instrument sciences activities. -provide direct support to the ESMO Science Interface Manager for all activities requiring flight operations intervention, consultation and technical expertise. -participate in all Science Team Mission Operations Working Group (MOWG) Meetings as requested by an ESMO Mission Director or the ESMO Constellation Team Manager. Participation may be via teleconference or may require travel to the Science Team Meeting at the request of an ESMO Mission Director or the ESMO Constellation Team Manager.

1.2.2.4.9	The contractor shall support the Configuration Management Process and follow established configuration management processes for all FOT products including documentation of new or updated products, peer review and internal sign off. The products will be presented to the Configuration Manager at the in-house Configuration Control Board meeting prior to being finalized.
1.2.2.4.10	The contractor shall support EOS automation development and implementation activities with EA now fully deployed as the framework.
1.2.2.5	**Spacecraft Subsystems and Associated Operations**
1.2.2.5.1	The contractor shall plan, rehearse, perform and assess real-time, special and contingency operations, which involve or impact any Terra, Aqua or Aura spacecraft subsystem.
1.2.2.5.2	The contractor shall support operational engineering and performance analysis of, at a minimum, the Electrical Power Subsystem (EPS), Thermal Control Subsystem (TCS), Flight Software (FSW), Command and Data Handling Subsystem (C&DH), Guidance, Navigation and Control Subsystem (GN&C), Radio Frequency Communications Subsystem (Comm.) and the Propulsion Subsystem (Prop).
1.2.2.5.3	The contractor shall, for the EOS Aqua and Aura spacecraft, take advantage of the economy-of-scale efficiencies of operating two nearly identical spacecraft busses to consolidate and combine off-line spacecraft subsystems engineering positions wherever feasible while maintaining adequate engineering staff to safely and effectively operate the missions.
1.2.2.6	**Flight Operations Mission Library**
1.2.2.6.1	The contractor shall maintain a library of current operating documents and reports for the Terra, Aqua, and Aura missions. This library shall serve as a repository for: • The mission history as captured in the weekly, monthly and anomaly reports • Flight operations training materials and certification records • On-console reference materials for flight operations activities
1.2.2.6.2	The contractor shall maintain an archive of all flight operations procedures, activity plans, timelines, and Command Authorization Meeting (CAM) presentations.
1.2.2.6.3	The contractor shall maintain all Instrument Operations Agreement documents and keep them current in consultation with the instrument operations teams and the ESMO Mission Director.
1.2.2.7	**Ground Systems Engineering Support**
1.2.2.7.1	The contractor shall work closely with the Ground Systems Maintenance and Operations Contractors, provided under separate contracts and/or GSMO Tasks, to ensure that planned IT Security-related ground system re-engineering activities and planned system upgrades do not interrupt on-going mission operations of the EOS Terra, Aqua and Aura spacecraft.
1.2.2.7.2	The contractor shall, with an FOT on duty 24 hours-per-day, report all ground system anomalies in accordance with the ESMO anomaly reporting procedures.

1.3	Performance Metrics
1.3.1	The contractor shall track metrics intended as example indicators of the EOS mission accomplishments and performance relative to mission requirements and objectives.
1.3.2	The contractor shall track metrics on spacecraft contacts successfully supported is a key element of measurement, reflecting the frequency and nature of EOS spacecraft contacts that are routinely and successfully supported on a daily basis
1.3.3	The contractor shall track metrics on successful verses unsuccessful preparation and execution of command and control sequences to reflect performance of the FOT with regard to accuracy and timeliness of the process to formulate and execute instructions to the on-orbit asset.
1.3.4	The contractor shall track metrics on science data scheduled and acquired to measure the effectiveness of the Solid State Recorder (SSR) management to meet the long-term acquisition plan, the translation of that plan to daily command sequences, and the effectiveness of delivering data acquired by the instrument to the designated ground receiving facilities.
1.3.5	The contractor shall track metrics on science data scheduled but not acquired to measure the problems encountered in attempting to fill out a data acquisition schedule, and of the operational practice of identifying and documenting failures in daily acquisition management.
1.3.6	The contractor shall track metrics on anomalies detected, analyzed, reported and resolved to measure the operational response to ad hoc situations and unexpected occurrences, and the performance of the contractor in responding to these demands.
1.3.7	The contractor shall track metrics on interface coordination activities to measure the effectiveness of coordinating and communicating with the various operational elements of the EOS mission operations support system required to carry out daily operational activities.
1.3.8	The contractor shall track metrics on state of documentation (procedures, operating instruction, etc.) detailing the state of the systems and operational procedures employed in flight operations.
1.3.9	The contractor shall track metrics on adherence to existing and developed configuration control mechanisms.
1.3.10	The contractor shall track metrics on the status of staffing levels, training and certification activities and identify any known areas of future attrition.
1.3.11	The contractor shall report metrics defined in this section through regular monthly meetings, reports, and briefings presented by the contractor and reviewed by the ESMO Mission Directors and ESMO Project Management Staff.

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The contractor shall establish the EOS mission operations workforce within the primary EOS Operations Center (EOC) currently located in Building 32 at the GSFC. The Contractor shall temporarily relocate the FOT, and any other required portions of the EOS mission operations workforce, to the Backup EOS Operations Center (BEOC) located at the GSFC, as needed, as required by the ESMO Mission Director. The contractor shall provide all office supplies and consumables used in the daily operation of these facilities.
The contractor shall perform flight operations in the Backup EOS Operations Center (BEOC) on an as needed basis, as required by the ESMO Mission Director. The contractor shall maintain the BEOC systems to provide a ready capability for relocation of operations and resumption of nominal flight operations within 2 hours of the loss of Building 32's EOC flight support functionality. The contractor shall exercise the BEOC on a regular basis to demonstrate support capability and readiness status.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
Integrated Trending and Plotting System (ITPS) (NASA/GSFC Code 583)	GSC-15532-1
EOS Real-time Processing System (ERPS) (NASA/GSFC Code 420)	
Space Network Access System (SNAS) (NASA/GSFC Code 581)	GSC-16844-1
Eclipse™ (Raytheon)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

(b) (4)

[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The Contractor shall move to ACES cell phones as soon as appropriate to reduce cost

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Mission Impact Reports: The contractor shall generate in real-time or near real-time Mission Impact Reports (MIRs) that document anomalous behavior exhibited by the EOS spacecraft or ground system. (as required)
Weekly Mission Top Ten FOT Priorities List: The contractor shall generate a Weekly list of FOT priorities and status of on-going tasks, anomalies, and investigations by mission. This list will be reviewed with the Mission Director at the start of the week to prioritize work assignments and coordinate activities. (5:30pm Monday, Weekly, unless otherwise deferred due to holiday or extenuating circumstances)
Monthly Spacecraft Performance Report: The contractor shall generate Monthly Spacecraft Performance Reports. The report shall include, as a minimum, a summary of the overall status and performance of the spacecraft and its instruments for the week, operational statistics, major upcoming activities, and status, performance, and plans for each spacecraft subsystem, flight software, and all spacecraft instruments. The report shall discuss the results of the trending analysis and highlight any areas of potential concern. Performance information and analysis results shall be transferred back to the spacecraft manufacturer so that any lessons learned may be applied to future missions. (Reports shall be provided to the ESMO Mission Director within two-weeks of completion of the reporting period)
Monthly Status Report: The contractor shall present a report on the activities of the preceding month. This report shall contain, but is not limited to, a summation of standard operational events, a listing of special activities, an accounting of instrument activities including non-nominal events, issues from the month, Non-nominal events due to FOT errors, science data collection statistics, anomaly metrics, staffing status, training/certification metrics, special initiatives, planned activities and cost/budget status. The ESMO Mission Director may require additional items to be addressed on a periodic basis. A softcopy of this report will be provided to the ESMO Mission Director and ESMO Management on the day of the present. (On a monthly basis)
Command Authorization Meetings: The contractor shall collect and present technical support data for the preparation and implementation of all special spacecraft engineering activities. All special spacecraft engineering activities will be preceded by a Command Authorization Meeting (CAM). Presentation materials and products relevant to the CAM will be distributed as early as practical prior to the CAM, so that CAM attendees can review them for accuracy and prepare questions and comments in advance of the CAM. (Prior to scheduled activity, normally the day preceding the activity)
Technical and Managerial Meeting Reports: The contractor shall generate minutes and capture actions items from any ad hoc technical and/or management meeting as requested by the ESMO Mission Director. The contractor shall track action items arising from the meetings for response and resolution and report status at follow-up meetings. (As required, within 24 hours of the meeting)
Anomaly Reports: For each anomaly, the contractor shall generate an Anomaly Report. This report shall describe how the anomaly was discovered, what were the results of the anomaly investigation, the impact of the anomaly, any interim work-around (if required), and the final resolution of the anomaly. (The Anomaly Report

shall be provided to the ESMO Mission Director within 10 business days of the resolution of the anomaly)
Annual Spacecraft Performance Report: The contractor shall generate an Annual Spacecraft Performance Report that contains the same content as the weekly report except that engineering evaluation of spacecraft performance shall be more detailed. Special emphasis in the annual report shall be placed on long-term spacecraft subsystems and instrument performance trends. Particular attention shall be paid to long-term performance trends that reflect the amount of remaining mission life or are of a consumable nature. Annual Spacecraft Performance Reports shall be delivered at the Annual Performance Review. (Scheduled in the first quarter of the year following)
Annual Performance Review: The contractor shall present to the ESMO Project an operations concept for the next year considering the mission's current status, expected budget, and risk tolerance. The contractor shall recommend changes to the systems that support the mission to achieve the mission's cost and performance goals. (Scheduled in the first quarter of the year following)
EOS Automation Operations Concept Document: The contractor shall maintain an EOS Automation Operations Concept that takes advantage of economy-of-scale efficiencies of operating the two nearly identical Aqua and Aura spacecraft busses, and automation initiatives that are being implemented for the EOS Terra, Aqua and Aura ground systems and/or flight systems to enable reductions in operations costs for all three EOS missions. This activity shall be coordinated with EDOS and other elements of the ground system to ensure an end-to-end concept and plan that is acceptable to the user community. (This document shall be maintained current with any changes that have been approved and updated annually concurrent with the annual performance review)
End-of-Mission Plans: Working with NASA personnel, the contractor shall prepare and update on an annual basis End-of-Mission Plans for each EOS spacecraft. The final version of each mission's plan shall be delivered to ESMO Management 6-months prior to the mission entering its Decommissioning Phase. (Annually, or as requested)
Training and Certification Plan: The contractor shall establish, maintain and execute a formal training and certification program. The objective of this program shall be to assure mission success by cultivating a diverse, competent staff of FOT professionals. This program shall include an active process of progressive skills enhancement, cross-training and contingency operations readiness. The program shall include a matrix of FOT positions and skills with defined certification levels and targeted staff certification goals. The program shall be documented in the Training and Certification Plan. The plan shall identify what positions within the Flight Operations Team (FOT) are considered certifiable and what frequency of re-certification is necessary to maintain competency. The plan shall specifically address formal (classroom) training, on-the-job training (OJT), simulations and rehearsal training and cross-training. The plan shall address assumed certifications, post-training certifications, cross-position certifications and the currency of all certifiable positions. The contractor shall report metrics on training and certification on a monthly basis. (As required and Monthly metrics reporting)
Anomaly Response Plan: The contractor shall establish, implement and maintain a mission-level Anomaly Response Plan that's consistent with NASA/GSFC's Code 400

Flight Programs and Projects Directorate Anomaly Notification Procedures and Guidelines and ESMO's Anomaly Management Procedures. (As needed, annual review minimum)
Mission Risk Management and Best Practices: The contractor shall establish, implement and maintain a mission-level Risk Management Plan that's compliant with NPG 7120.5. In addition, the contractor shall comply with all Agency, Center and ESMO directives regarding Risk Management and Best Practices. (As needed, annual review minimum)
Operations Procedures: The contractor shall update and revise the Operations Procedures as required to address changes in the procedures and/or operational concepts for the EOS flight and ground systems. (As required and Monthly metrics report)
Test Reports: The contractor shall provide findings from ground system-related testing activities performed by the Flight Operations Team (FOT). The Test Report shall include Discrepancy Reports (DRs) corrected and verified, new DRs opened, and the FOT recommendation to accept and/or reject the release being tested. (Test reports shall be delivered within 2-weeks of test completion)
Financial Reports: The contractor shall provide monthly financial reporting by mission and by combined total task. Reporting will provide 533M level information by mission (Terra, Aqua and Aura) and contain sufficient detail to allow long-term budget planning. (Monthly, not later than 10 working days following the close of the contractors' monthly accounting period)
Final Task Order Report: The contractor shall provide a comprehensive Task Order Self-Evaluation Performance Report by completion of the task order period of performance. The report should be in narrative form and include tables, graphs and diagrams to summarize task performance. The report shall include the final incurred task order cost along with recommendations and conclusions. (By completion of the task order period)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 40
Modification: 4
Task Name: SN Ground System Engineering and Integration Support

GSMO-2 SOW Reference: 2.1, 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/25/2018	Initial task order statement of work.
1	09/11/2017	05/25/2018	Addition of SAGE ITPS support as Subtask 2.
2	1/22/2018		Changed TM to Harry Shaw
3	05/26/2018	05/24/2019	Extension of Task
4	05/25/2019	05/23/2020	Extension of Task

II. Task Overview

The SN Ground System Engineering and Integration Support task provides ongoing operations and maintenance of the Tracking and Data Relay Satellite (TDRS)-based Space Network (SN) as well as the SN operated STPSat-6 Antennas And Ground Equipment (SAGE) system for STPSat-6.

Subtask 1: Covers all work associated with Integrated Trending & Plotting System (ITPS) for the TDRS constellation.

Subtask 2: Covers all work associated with ITPS for the SAGE ground system.

III. Requirements

1	**SN TDRS Integrated Trending & Plotting System (ITPS) Support**
1.1	The contractor shall provide development and sustaining engineering support, along with technical support pertaining to the ITPS systems (hardware and software) operated by the SN project in support of the TDRS constellation.
1.2	**ITPS Personnel Requirements**
1.2.1	The contractor shall provide personnel who have thorough knowledge of the TDRS ITPS Ground Software System, including the requirements, hardware and software design.
1.2.2	The contractor shall provide personnel who are proficient in the use of the C++ and JAVA (for web development) computer languages.
1.2.3	The contractor shall provide personnel who have thorough expertise with TDRS spacecraft telemetry processing.
1.3	**ITPS Support to TDRS Satellites**

1.3.1	The contractor shall update ITPS system documentation.
1.3.2	The contractor shall conduct ITPS feature training.
1.3.3	The contractor shall define mission-specific requirements associated with ITPS enhancements or ITPS discrepancy resolution.
1.3.4	The contractor shall define hardware specifications for any hardware required for the operation of ITPS.
1.3.5	The contractor shall provide support for ground system testing and verification of the ITPS.
1.3.6	The contractor shall formally deliver ITPS general and TDRS-specific ITPS software releases (hardware, software, including MATLAB, and associated documentation).
1.3.7	The contractor shall report and track ITPS software issues and enhancement lists.
1.3.8	The contractor shall provide ITPS user support for technical questions and system problems consultation.
1.4	**TDRS-K/L/M ITSP Support**
1.4.1	The contractor shall provide the TDRS K/L/M project with ITPS development and maintenance, responding to discrepancies and requests for new and enhanced capabilities.
1.4.2	The contractor shall provide ITPS technical consultation support for the operations and engineering teams at White Sands Complex (WSC) and Goddard Space Flight Center (GSFC).
1.4.3	The contractor shall ensure that the ITPS activities related to the operational TDRS satellites (3-10) do not interfere or affect the ITPS activities conducted for the TDRS-K/L/M satellites, and vice versa.
1.4.4	The contractor shall support the TDRS K/L/M project on any ITPS related technical issues during the integration and test of the ITPS into the TDRS K/L/M Transition Operations Control Center (TOCC) at WSC. *Note that a different contractor is doing the actual integration work of the systems in the TK TOCC.*
1.4.5	The contractor shall support TDRS K/L/M reviews associated with pre-launch testing and launch readiness as requested by the government.
1.5	**ITPS 64-Bit Development**
1.5.1	The contractor shall continue development work on the 64-bit version of ITPS with a targeted delivery date in 2018. This development is necessary in order to support more modern computing platforms and comply with IT security requirements.
2	**SAGE ITPS Support**
2.1	The contractor shall provide development and sustaining engineering support, along with technical support pertaining to the ITPS systems (hardware and software) operated by the SAGE system within the SN.
2.2	**ITPS Personnel Requirements**
2.2.1	The contractor shall provide personnel who have thorough knowledge of the SAGE ITPS Ground Software, including the requirements, hardware and software design.

2.2.2	The contractor shall provide personnel who are proficient in the use of the C++ and JAVA (for web development) computer languages.
2.2.3	The contractor shall provide personnel who have expertise with spacecraft telemetry processing.
2.3	**ITPS Support to the STPSat-6 Satellite**
2.3.1	The contractor shall update ITPS system documentation.
2.3.2	The contractor shall conduct ITPS feature training.
2.3.3	The contractor shall define mission-specific requirements associated with ITPS enhancements or ITPS discrepancy resolution.
2.3.4	The contractor shall define hardware specifications for any hardware required for the operation of ITPS.
2.3.5	The contractor shall provide support for ground system testing and verification of the ITPS.
2.3.6	The contractor shall formally deliver ITPS general and STPSat-6-specific ITPS software releases (software, including MATLAB, and associated documentation).
2.3.7	The contractor shall report and track ITPS software issues and enhancement lists.
2.3.8	The contractor shall provide ITPS user support for technical questions and system problems consultation.
2.3.9	The contractor shall provide the SAGE effort with ITPS development and maintenance, responding to discrepancies and requests for new and enhanced capabilities.
2.3.10	The contractor shall provide ITPS technical consultation support for the operations and engineering teams at WSC, GSFC, and support sites.
2.3.11	The contractor shall support the SAGE effort on any ITPS related technical issues during the integration and test of the STPSat-6 into SAGE systems at WSC, GSFC, and support sites.
2.3.12	The contractor shall support SAGE reviews associated with pre-launch testing and launch readiness as requested by the government.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order (b) (4) [redacted]

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The contractor shall deliver updates to the TDRS ITPS hardware and software systems and associated documentation as necessary for TDRS operations use.

The contractor shall deliver updates to the TDRS-K/L/M ITPS hardware and software systems and associated documentation as necessary for TDRS-K/L/M pre-launch and post-launch testing use.

The contractor shall deliver updates to the SAGE ITPS software systems and associated documentation as necessary for STPSat-6 pre-launch, Launch & Early Operations, and continued operations use.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 41
Modification: 3
Task Name: Mission Support Services

GSMO-2 SOW Reference: 2.3, 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	11/24/2017	Initial task order statement of work.
1	11/25/2017	11/23/2018	Extend task through Nov 2018.
2	11/24/2018	11/23/2019	Extend task through Nov 2019.
3	09/25/2019	03/28/2020	LRO MOC move B32 to B14, proposed as subtask 2. Also, Extend subtask 1 from 11/24/19 through Mar 2020.

II. Task Overview

The Mission Support Services task provides support services to GSFC's Space Science Mission Operations (SSMO) Project /Code 444.

Subtask 1: Covers all work associated with Mission Support Services.
Subtask 2: Covers all work associated with LRO MOC move B32 to B14.

III. Requirements

1	**Mission Support Services**
1.1	**Facilities Support**
1.1.1	The contractor facilitate maintenance, relocation/reconfiguration of Space Science Mission Operation facilities and support areas.
1.1.2	The contractor shall provide system administration of support facilities (including conference room computer/television and SSMO printers.
1.2	**Library Services**
1.2.1	The contractor shall maintain a library of software systems and system and mission related documentation.
1.2.2	The contractor shall provide long term recommendations for library support and staffing.
1.2.3	The contractor shall propose a process for accepting electronic delivery of software delivery letters.
1.3	**Electrical Systems Support**
1.3.1	The contractor shall support management and maintenance of Power Distribution Units (PDUs) serving MOCs.

2	LRO MOC Move
2.1	The contractor shall support the facility footprint reduction in the B32 LRO MOC and the permanent move of the LRO MOC to B14.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Semi-Annual Performance Review: The Contractor shall generate a Semi-Annual Performance Report during award fee period that summarizes the weekly reports. It shall cover the six month performance period and be reviewed with the TM for format and content. (Semi-Annually during award fee period)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 43
Modification: 4
Task Name: WFIRST Test Conductor Support

GSMO-2 SOW Reference: 2.4.11

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	04/28/2017	11/23/2018	Task order continuation
2	07/28/2018	11/23/2018	Task modification for additional support
3	11/24/2018	09/28/2019	Task modification for additional support
4	09/29/2019	09/26/2020	Task order continuation

II. Task Overview

The WFIRST Test Conductor Support task provides testing support and ground test system engineering for the development of the spacecraft bus avionics subsystems.

Subtask 1: Covers all work associated with WFIRST Test Conductor Support
Subtask 2: Covers all work associated with WFIRST WFI Test Engineering Support

III. Requirements

1	WFIRST Test Condnctor Support
1.1	The contractor shall work with the WFIRST C&DH and WFI teams to develop ASIST products, such as procs, pages or related items, used in the development of the WFIRST C&DH subsystem and WFI.
1.2	The contractor shall provide test conductor personnel with the following experience. i. Experience writing ASIST test scripts, developing an ASIST database, and developing ASIST pages. ii. Experience working in a flight hardware development lab. iii. Experience testing flight hardware. iv. Experience in the integration and test environment from development through delivery.
1.3	The contractor shall provide engineering support for ground system design of the WFIRST I&T ground systems.
1.4	The contractor shall provide engineering personnel with the following experience. i. Experience developing ground test systems for flight avionics. ii. Experience with integration and test of flight avionics. iii. Experience working in an avionics development environment.

2	WFIRST WFI Test Engineering Support
2.1	The contractor shall work with the WFIRST IC&DH team and other members of the WFI team to support the development of EGSE
2.2	The contractor shall provide test engineer personnel with the following experience: i. Experience developing ground test systems for flight avionics ii. Experience working in a flight hardware development lab. iii. Experience with integration and test of flight avionics and flight hardware. iv. Experience in the integration and test environment from development through delivery.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 44
Modification: 4
Task Name: MUSTANG, PACE and OCI I&T and Test Conductor Support

Deleted: 3

GSMO-2 SOW Reference: 2.4.11

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	05/25/2018	Initial task order statement of work.
1	04/23/2018	05/25/2019	Extension of work effort – adding support for PACE Spacecraft – 1FTE
2	07/28/2018	05/24/2019	Software development & maintenance support work for PACE and OCI. Adding travel in support of all the various efforts. Up to 0.5FTE.
3	11/26/2018	05/24/2019	Adding additional test conductor support for PACE Spacecraft I&T.
4	05/25/2019	05/23/2020	Extending PoP for one year. Moving LOE from one Subtask to another Adding OCI I&T Subtask 6

II. Task Overview

The MUSTANG Test Conductor Support task provides test conductor support to the PACE Spacecraft and OCI Instrument to develop ITOS products used in the development of the PACE Spacecraft, OCI and MUSTANG hardware.

III. Requirements

Subtask Descriptions

Subtask 1 – Deleted

Subtask 2 – OCI Subsystem Level I&T and Test Conductor Support

The contractor shall work with the OCI and MUSTANG team to develop ITOS products, such as procs, pages or related items, used in the development of the OCI Instrument and MUSTANG hardware.

The contractor shall provide test conductor personnel with the following experience.
-Experience writing ITOS test scripts, developing an ITOS database, and developing ITOS pages.
-Experience working in a flight hardware development lab.

-Experience testing flight hardware.
-Experience in the integration and test environment from development through delivery.

Travel as necessary to support testing at various locations on average 2 trips a year.
Training as required (training includes but not limited to ESD training, Mate/Demate Training)

The contractor shall work with the team to manage existing software applications, develop new scripts and applications to facilitate testing of MUSTANG hardware with existing GSE, as well as the test software system ITOS and FEDS.

The contractor shall provide test conductor personnel with the following experience.
-Experience developing new and managing existing unique one of a kind self-contained software solutions in several different test environments, on a multitude of hardware devices.
-Experience deploying, configuring & managing test software systems (ITOS, FEDS, SWTS, NTGSE etc.)
-Experience administering different operating systems across a wide set of hardware and environments.
-Experience working in a flight hardware development lab.
-Experience in the integration and test environment from development through delivery.

Subtask 3 – PACE Avionics Subsystem Level I&T and Test Conductor Support

The contractor shall work with the PACE Avionics and MUSTANG team to develop ITOS products, such as procs, pages or related items, used in the development of the PACE Spacecraft MUSTANG hardware.

The contractor shall provide test conductor personnel with the following experience.
-Experience writing ITOS test scripts, developing an ITOS database, and developing ITOS pages.
-Experience working in a flight hardware development lab.
-Experience testing flight hardware.
-Experience in the integration and test environment from development through delivery.
Travel as necessary to support testing at various locations on average 2 trips a year.
Training as required (training includes but not limited to ESD training, Mate/Demate Training)

The contractor shall work with the team to manage existing software applications, develop new scripts and applications to facilitate testing of MUSTANG hardware with existing GSE, as well as the test software system ITOS and FEDS.

The contractor shall provide test conductor personnel with the following experience.
-Experience developing new and managing existing unique one of a kind self-contained software solutions in several different test environments, on a multitude of hardware devices.
-Experience deploying, configuring & managing test software systems (ITOS, FEDS, SWTS, NTGSE etc.)
-Experience administering different operating systems across a wide set of hardware and environments.
-Experience working in a flight hardware development lab.
-Experience in the integration and test environment from development through delivery.

Subtask 4 – MAIA I&T and Test Conductor Support

An additional 0.3 WYE for this effort.

The contractor shall work with the MAIA and MUSTANG team to develop ITOS products, such as procs, pages or related items, used in the development of the PACE Spacecraft MUSTANG hardware

The contractor shall provide test conductor personnel with the following experience.
-Experience writing ITOS test scripts, developing an ITOS database, and developing ITOS pages.
-Experience working in a flight hardware development lab.
-Experience testing flight hardware.
-Experience in the integration and test environment from development through delivery.

Travel as necessary to support testing at various locations on average 2 trips a year.
Training as required (training includes but not limited to ESD training, Mate/Demate Training)

Subtask 5 – PACE I&T and Test Conductor Support

The contractor shall work with the PACE I&T and MUSTANG team to develop ITOS products, such as procs, pages or related items, used in the development of the PACE Spacecraft MUSTANG hardware

The contractor shall provide test conductor personnel with the following experience.
-Experience writing ITOS test scripts, developing an ITOS database, and developing ITOS pages.
-Experience working in a flight hardware development lab.
-Experience testing flight hardware.
-Experience in the integration and test environment from development through delivery.

Travel as necessary to support testing at various locations on average 2 trips a year.
Training as required (training includes but not limited to ESD training, Mate/Demate Training)

Subtask 6 – OCI I&T and Test Conductor Support

The contractor shall work with the OCI I&T team to develop ITOS products, such as procs, pages or related items, used in the development of the PACE Spacecraft MUSTANG hardware

The contractor shall provide test conductor personnel with the following experience.
-Experience writing ITOS test scripts, developing an ITOS database, and developing ITOS pages.
-Experience working in a flight hardware development lab.
-Experience testing flight hardware.
-Experience in the integration and test environment from development through delivery.

Travel as necessary to support testing at various locations on average 2 trips a year.
Training as required (training includes but not limited to ESD training, Mate/Demate Training)

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The contractor shall work in the MUSTANG development lab on site at GSFC. Software and hardware required for this task will be made available to the contractor in the development lab.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. Some travel is required for support of offsite testing.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 46
Modification: 4
Task Name: JPSS Ground Project JCDS Support

GSMO-2 SOW Reference: 2.1, 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	04/27/2018	Initial task order statement of work.
1	10/12/2017		Admin mod: RA reassignment
2	04/28/2018	04/26/2019	One year extension
3	2/11/2019		Admin mod:RA reassignment
4	4/27/2019	4/25/2020	One year extension

II. Task Overview

The JPSS Ground Project JPSS Comprehensive Discrepancy System (JCDS) Support task provides support for the JCDS environment with associated administrative support for use by the JPSS Ground Project discrepancy review boards.

III. Requirements

1	CDS Sustainment Support
1.1	The contractor shall provide sustainment of the JCDS operationally deployed in 2013.
1.2	The contractor shall perform various functions including database administration, account management, remedy administration, operating system administration, IT security management, hardware maintenance, and user support.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities associated with this Task Order.

There is Government furnished equipment associated with this task for which the contractor shall be accountable.

The contractor shall provide laptop and server computer equipment needed to perform the task in an effective manner, unless provided by the JPSS Ground Project at the customer's discretion. This shall include the standard software application suite used at GSFC. Any special software applications needed to perform the task (e.g. Microsoft Project) will be provided as GFE. Additionally, the laptop and server computer

equipment shall be upgraded as needed for performance and compliant to NASA Security requirements and subject to NASA security configuration and audits as necessary.

Government Furnished Equipment Description
JPSS Comprehensive Discrepancy System (JCDS) hardware

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
JPSS Comprehensive Discrepancy System (JCDS) applications	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide a weekly technical status report, monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 48
Modification: 3
Task Name: ESMO Mission Engineering Support Group

Deleted: 1

GSMO-2 SOW Reference: 3.7.2, 3.7.3, 3.7.4, 3.7.5

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	06/29/2018	Initial task order statement of work.
1	6/30/2018	6/29/2019	Extend Period to another 12 months, no other technical changes.
2	9/13/2018		Admin Change
3	6/30/2019	6/27/2020	Extend Period to another 12 months, no other technical changes.

Deleted: 29

II. Task Overview

The ESMO Mission Engineering Support Group task provides technical engineers to staff the Building 32 Utilities Working Group (UWG). These engineers are expected to have skills required to implement; UWG processes, procedures, mission operations support of building infrastructure.

Subtask 1: Covers all work associated with ESMO.
Subtask 2: Covers all work associated with ESDIS/MODAPS.
Subtask 3: Covers all work associated with GCDC.

III. Requirements

The requirements table below is subdivided into six principal areas of support (x.1 through x.5). The contractor shall apply these requirements to each subtask (1 to 3), as noted:

1 ESMO Mission Engineering Support (subtask: 1)
2 Infrastructure Support (subtask: 1, 2, 3)
3 Analysis and Consulting to Code 610 (subtask: 3)

1	ESMO Mission Engineering Support
1.1	The contractor shall perform technical planning and execute plans of the UWG.
1.2	The contractor shall support to satisfy the requirements in this section. Priorities of work items under each requirement, and schedule conflicts of work items across requirements shall be coordinated with the Task Monitor.

1.3	The contractor shall staff certain specified positions on this Task Order which may require the ability to obtain Secret Clearance or above, as determined by the Task Monitor, for continued support on this Task Order.
2	**ESMO and ESDIS Support**
2.1	The contractor shall Provide infrastructure planning and technical services to Bldg. 32 UWG Chair, FOM and FMD support teams (Power, HVAC, structure, etc.).
2.2	The contractor shall prepare and implement work orders, work requests, and outage requests as requested by the Bldg. 32 UWG Chair, FOM and building tenants.
2.3	The contractor shall review and process all work request and outage request packages. Providing a single point of contact, tracking and control of all infrastructure work.
2.4	The contractor shall provide infrastructure configuration management and documentation. Develop additional infrastructure drawings and documentation as required. (Red line reviews/updates, power panel chart updates, etc.).
2.5	The contractor shall coordinate infrastructure activities with tenants and support teams (outages, construction, Power PMs, etc.).
2.6	The contractor shall participate in the development and implementation of UWG Bldg. 32 procedures/policies (Bldg. 32 Standard Operating Procedure maintenance/updates).
2.7	The contractor shall provide point of contact for emergency communication/coordination for all infrastructure activities that will/could impact critical mission operations with Bldg. 32.
2.8	The contractor shall monitor and help coordinate the utilization of critical Bldg. resources (UPS power, power audits, HVAC, space, etc.).
2.9	The contractor shall provide technical briefings and presentations as required.
2.10	The contractor shall chair the Electrical Configuration Panel and HVAC Configuration Panel. Lead the UWG status meetings.
2.11	The contractor shall participate in Bldg. 32 facility safety reviews (includes: GSFC Safety team review support, work with tenants to have sighted safety issues addressed, support internal inspections).
2.12	The contractor shall provide Alternate FOM support activities.
2.13	The contractor shall support Bldg. 32 physical security requests and requirements changes and implementation.
2.14	The contractor shall provide coordination with vendors to support facility changes in operational areas.
2.15	The contractor shall manage all building infrastructure activity schedules. Set and Communicate schedules. Generate and manage Freeze Exemption Requests for Code 700.
2.16	The contractor shall provide minor infrastructure change support (power, structural) needed to insure mission requirements and success.
2.17	The contractor shall provide the Moderate Resolution Imaging Spectroradiometer (MODIS) project with the following engineering services as required: - Product analysis

	- Equipment Integration/Installation - Remedial Maintenance support - Infrastructure design, development - System Administration support - Logistic services: Configuration Management (System diagrams/documentation); Property Management; Procurement support activities - Power Configuration/Install for new systems
3	**Analysis and Consultation to Code 610**
3.1	The contractor shall provide infrastructure/engineering support to the B32/C101 tenant that includes: - Facility Zone Map development and maintenance - Infrastructure resource engineering, planning and management (power, HVAC, structural) - System configuration support and documentation as needed - Infrastructure configuration support - Power reconfiguration/management/installation support - System Administrative support as needed - Hardware engineering support as needed

IV. Government Furnished Facilities, Equipment, and Software

There is no Government furnished equipment or software associated with this Task Order.

There are Government furnished facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Facilities Description
ETS/MPS. (B32, Room C210H)
ETSF. (B32, Room C210 & B14, Room W224)
Terra Sim1 and Sim3. (B32, Room C210)
Terra Sim 2 & Flight Software Labs. (B1, Rooms 12, 17, 19, 23, 25, 25B & 29)
GPM MOC. (B32, Room N217)
GPM FlatSat. (B32, Room W030)
GPM EMOC, Dev/Test. (B3, Room S025E)
ERPS. (B32, Svalbard, Norway; Gilmore Creek, Alaska, Wallops Island, Virginia, and White Sands, New Mexico)
ESMO Infrastructure servers. (B32)
EOC – Mission Operations System (EMOS). Includes Online Subsystem - Raytheon Eclipse Product with modifications, Mission Management Subsystem (MMS), Analysis and its replacement system ITPS. (B32)
EOC- Backup Mission Operations Center (BEOC). (B13)
ESDIS (various network infrastructure). (B32)
Code 420 Division Office. (B16 and 16W)

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The proposed material list should include:

The Contractor shall procure materials specific for maintaining the facilities infrastructure and are limited to be based on a Calendar year of utilization.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Hardware and other procurements for system maintenance/upgrades and vendor maintenance agreements. (as required)
Facility and power diagram updates. (as required)
Status Reports. (weekly)
Performance Reports. (monthly)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 49
Modification: 3
Task Name: WFIRST GS/MOC and Flight Ops Development Support

GSMO-2 SOW Reference: 2.4

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	03/30/2018	Initial task order statement of work.
1	03/31/2018	03/29/2019	Task modification #1
2	11/1/2018	03/29/2019	Task modification #2
3	03/30/2019	03/28/2020	Task modification #3- This is to ensure that task 49 is broken out by 49.01 (GS MOC Development) and 49.02 (GS System Engineering Support)

II. Task Overview

The WFIRST Mission Support task provides support for the WFIRST Ground System (GS) Systems Engineering and the WFIRST GS/MOC System Engineering effort including Ops Concept and requirements development, IT Security requirement analysis, MOC System design and documentation development, Observatory and TT&C networks planning and scheduling, MOC Preliminary Design Review preparation, and Flight Operations planning during this Phase B of the mission. The

III. Requirements

1	**WFIRST Mission Support**
1.1	**Management Approach**
1.1.1	The contractor shall create and maintain a Task Plan that describes the manner in which the Contractor will manage the work for each of the elements identified in this SOW. The task plan will identify major milestones, and resource allocations.
1.1.2	The contractor shall ensure the availability and competence of the work force necessary to execute the management and technical activities of this Task Order.
1.1.3	The contractor shall manage staff allocation to the required tasks specified.
1.1.4	The contractor shall perform the work specified in this SOW at GSFC. Travel to support Technical Interface Meetings and Working Groups may be required.
1.1.5	The contractor shall support Information Technology Security by performing the work specified in this SOW in compliance with the security procedures established by the WFIRST Project Office and Center Policy.

1.2	**Technical**
1.2.1	The contractor shall provide technical support to the Ground System Project Manager (GSPM) and MOC Manager for the program. These tasks include the following functions:
1.2.2	**GS Systems Engineering**
1.2.2.1	The contractor shall maintain the GSRD Level-3 requirements document.
1.2.2.2	The contractor shall support preparation for the Mission Preliminary Design Review scheduled for October 2019.
1.2.2.4	The contractor shall provide support for Mission concepts development.
1.2.2.5	The contractor shall support GS preliminary design effort.
1.2.2.6	The contractor shall support GS system trade study effort as needed.
1.2.2.7	The contractor shall lead Mission Operations Working Group activities
1.2.2.8	The contractor shall develop schedule of activities to ensure GS readiness to support a GSFC Systems Review Team status update in July 2019 prior to the Mission Preliminary Design Review expected in October 2019.
1.2.3	**MOC SE and Development**
1.2.3.1	The contractor shall revise MOC level-3 requirements as needed.
1.2.3.2	The contractor shall maintain and update MOC level-4 requirements to ensure consistency with design.
1.2.3.3	The contractor shall support Working Group meetings as needed to fully define MOC internal and external interfaces and data flows.
1.2.3.4	The contractor shall support developing MOC/Flight Operations concepts.
1.2.3.5	The contractor shall support MOC system preliminary design effort.
1.2.3.6	The contractor shall draft MOC to other GS elements Interface Control Documents (ICDs).
1.2.3.7	The contractor shall support MOC system trade studies as needed.
1.2.3.8	The contractor shall develop MOC documentation to a level of maturity as specified in SOW section VII.
1.2.4	**Security Planning, Implementation, and Administration**
1.2.4.1	The contractor shall maintain the MOC IT Security documentation per NASA Information Technology Security requirements.
1.2.4.2	The contractor shall coordinate with GSFC Code 400/700 to perform IT security risk assessments and perform risk reporting.
1.2.4.3	The contractor shall identify and support the implementation of security controls as per NASA IT Security requirements.
1.2.4.4	The contractor shall maintain the WFIRST Project IT Security Plan.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

Provide 533 reports for 49.01 (GS MOC Development) and 49.02 (GS System Engineering Support).

The list of task deliverables for this period of performance includes:

Project /GS IT Security Assessment Report. (as needed)
Preliminary MOC Product Specification (September 2019)
Internal Review Version MOC-SOC ICD (September 2019)
Internal Review Version MOC-SSC ICD (September 2019)
Internal Review Version MOC-CIEC ICD (September 2019)
Internal Review Version MOC-WIEC ICD (September 2019)
Draft MOC Software Development Plan (October 2019)
Internal Review Version MOC Configuration Management Plan (April 2019)
Preliminary MOC Configuration Management Plan (May 2019)
Draft MOC Design Specification (February 2020)
Draft MOC Internal ICD (February 2020)
Draft MOC Acceptance Test Plan (October 2019)
Preliminary Road to Ground System PDR (July 2019)
Draft Ground System Readiness Test Plan (February 2020)
Draft MOC Project Reference Database (PRD) DFCD (Feb 2020)
Weekly Progress Report (emailed to MOC PDL). (Every Week)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 50
Modification: 3
Task Name: GOES-R Software Quality Assurance

GSMO-2 SOW Reference: 2.1, 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/01/2017	01/26/2018	Initial task order statement of work.
1	01/27/2018	01/25/2019	1-year task extension.
2	06/11/2018	01/25/2019	Augment software assurance support
3	01/26/2019	01/25/2020	1-year task extension.

II. Task Overview

The GOES-R Software Quality Assurance task provides overall Software Assurance support for the GOES R Project. This task provides support to GOES R in the development and implementation of quality assurance requirements over the entire program life cycle through independent surveillance, audit, review, and assessment of the full spectrum of project development activities.

III. Requirements

1	**GOES-R Mission Support**
1.1	**Ground System and Antenna Sustainment Quality Engineer**
1.1.1	The contractor shall provide GOES R ground system software assurance support.
1.1.2	The contractor shall support the review GOES R project documentation and review against NASA quality assurance and software safety standards.
1.1.3	The contractor shall submit written findings and recommendations after reviewing GOES R documentation and procedures consistent with NASA GPRs and NASA quality assurance standards.
1.1.4	The contractor shall report and track process and product nonconformities per GPR 5340.2, Control of Non-conformances, and copy task monitor and/or CSO on all written correspondences/email.
1.1.5	The contractor shall evaluate prime contractor and subcontractor plans, performance, and deliverables for adequacy. Perform post award audits per GPR 5100.4, Supplier Quality Audits, of contractor and subcontractor activities and provide comments and recommendations to the S&MA.
1.1.6	The contractor shall review quality assurance information submitted by contractor/subcontractors/vendors and prepares reports that identify

	differences between prime contractor and project documentation and NASA requirements and recommended changes.
1.2	**Pre-Launch and Launch Quality Engineering Support**
1.2.1	The contractor shall review and track RFAs/findings from software deliveries. (i.e. review Delivery Letter and VDDs).
1.2.2	The contractor shall support System Test Readiness Review System Test Plan Review Software-based System Test Procedures Support Command and Telemetry Definition Peer Reviews Support STOL.
1.2.3	The contractor shall participate in peer, design, readiness and other formal reviews.
1.2.4	The contractor shall provide GOES operations assurance during all phases (Integration, test Check-out(ITCO))
1.2.5	The contractor shall review and track RFAs/findings from SW review I&T Work Orders.
1.2.6	The contractor shall witness testing that includes I&T Work Orders Support Pre-Ship Review and evaluate on entrance/success criteria.
1.2.7	The contractor shall review, witness, and evaluate the Work Request Review Board (WRB) process.
1.2.8	The contractor shall review and track RFAs/findings including reviews of SW review Delivery Letter and VDD Support System Test Readiness Review System Test Plan Review Software-based System Test Procedures Support Command and Telemetry Definition Peer Reviews Support STOL.
1.2.9	The contractor shall participate in formal review of the data package Review and track RFAs/findings.
1.2.9.1	The contractor shall review plans (e.g., Ops Concept, Risk Management Plan, Verification and Validation (V&V)/I&T Plans, Mission Operations Plan (MOP), Standard Operating Procedures (SOPs). Perform other activities as defined in the GOES MOAP.
1.2.9.2	The contractor shall witness End to End Testing and Mission Sims.
1.2.9.3	The contractor shall participate in project meetings such as I&T meeting, S/C checkout meetings (i.e. PTL meetings), GOES MOST staff meetings, instrument mission assurance meetings, SPLITS (Additional Spacecraft/Instrument) meetings.
1.3	**Antenna Operations Quality Engineering Support**
1.3.1	The contractor shall witness antenna testing reporting on status and success criteria.
1.3.2	The contractor shall review test procedures, test results, and review documentation.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

The contractor shall travel as necessary to perform the work associated with this Task Order. The work required under this task will primarily be performed at the NOAA Satellite Operations Facility (NSOF) in Suitland, Maryland. Periodic local travel is required to NASA GSFC. 50% travel to travel is required to WCDAS (Wallops VA) and CBU in Fairmont WV with an occasional trip to Harris in Melbourne, Florida.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Status reporting: Weekly, Monthly, Dailey updates for special task as assigned.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 51
Modification: 7
Task Name: Space Geodesy Satellite Laser Ranging Design and Development

GSMO-2 SOW Reference: 2.2, 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	08/01/2017	07/27/2018	Initial task order statement of work.
1	09/13/2017	07/27/2018	Add subtask 4
2	01/22/2018	07/27/2018	Remove subtask 3 starting 1/22/2018
3	2/5/2018	7/27/2018	Replan by KBRwyle only (no cost)
4	3/5/2018	7/27/2018	Add subtask 5 (which will continue into next task year)
5	5/17/2018	7/27/2018	Add procurements for subtask 1
6	7/28/2018	7/26/2019	Task order for Contract Year 2
7	5/6/2019	7/26/2019	Mod for subtask 1, subtask 2, and subtask 5.

II. Task Overview

The Space Geodesy Satellite Laser Ranging (SGSLR) Design and Development task provides for the design of the NASA Space Geodesy Project's Next Generation Satellite Laser Ranging System and the build, testing and deployment of the operational McDonald SGSLR system. In addition it includes the development of the testing facilities here at the Goddard Geophysical and Astronomical Observatory (GGAO), the preliminary implementation of the Vector Tie System (VTS). (b) (4) [redacted]

Subtask 1: Covers all work associated with (1) the baseline design of the SGSLR system (2) the configuration of the SGSLR testing facilities at GGAO, (3) the delivery of three successfully tested Gimbal and Telescope Assemblies (GTAs), and (4) the development, testing, and deployment of the operational SGSLR system for McDonald Geophysical Observatory (MGO) in Texas.

Subtask 2: Covers all work associated with Space Geodesy Project (SGP) Vector Tie System (VTS) and surveying. This task was not active but is currently being turned back on at a limited level.

Subtasks 3 & 5: These subtasks are now closed.

(b) (4) [redacted]

The changes from mod 6 to mod 7 are in red. Unless specifically stated that a requirement has been removed, all requirements given below remain in effect in mod 7.

III. Requirements

The Contractor shall be governed, for this task order, by GSMO-2 Contract Clause H.9, 52.227-17, Rights in Data-Special Works (Dec 2007) as modified by NASA FAR Supplement 1852.227-17 and GSFC 52.227-93, which will be the applicable Data Rights Clause. The exclusion to this clause will be the (b) (4) [redacted]

This task is not required to follow NPR 7150.2A.

1	**SGSLR Design and Development (Subtask 1)**
1.1	**Support the Government led SGSLR design effort**
1.1.1	The contractor shall support the completion of the SGSLR hardware design and support any remaining Engineering Peer Reviews.
1.1.2	The contractor shall support the completion of the SGSLR software design and support the Software Engineering Peer Review.
1.1.3	The contractor shall develop documentation required for the Critical Design Review.
1.1.4	The contractor shall support the preparation and presentation of information at the SGSLR Critical Design Review.
1.1.5	The contractor shall support the close out of RFAs from the Critical Design Review and the finalization of associated documentation.
1.2	**Support the build of the SGSLR facility at GGAO**
1.2.1	The contractor shall support code 220's build of the SGSLR shelter at GGAO by answering questions, monitoring the progress and effectiveness of the work being done, and ensuring that the dome arrives at the right time.
1.2.2	The contractor shall populate the SGSLR facility with the required SGSLR instrumentation (both interior and exterior to the shelter) needed to adequately test the GTAs.
1.2.3	Perform installation and connection of the external instrumentation.
1.2.4	Support the manufacturer's installation of the dome to the GGAO shelter.
1.3	**Procure, test and deliver Gimbal and Telescope Assembly (GTA) units**
1.3.1	The contractor shall deliver three fully tested and accepted GTA units to the Government that meet the SGSLR requirements. The units shall pass Acceptance testing at the factory and at the relevant site (units 1 and 2 at GGAO and unit 3 at MGO). Test Plans shall be provided to the Government prior to any acceptance testing.
1.3.2	The contractor shall install each GTA unit on the pier and ensure the system is working prior to any site testing.
1.3.3	The contractor shall develop testing capabilities to be used at the GTA Factory.

1.3.4	The contractor shall develop capabilities to test units 1 and 2 at GGAO and unit 3 at MGO for Site Acceptance Testing (SAT).
1.3.5	The contractor shall crate unit #1 after testing is completed in preparation for shipping to deployment site.
1.3.6	The contractor shall provide documentation on the GTA design, analysis, modeling and verification test results and clearly show that each GTA met each SGSLR requirement.
1.3.7	Contract with (b) (4) [redacted] to have gimbal #1 crated and shipped from their Lansdale facility to GGAO and installed in the SGSLR facility. Also ship gimbal #1 back to (b) (4) [redacted] is ready to install the SGSLR telescope in the gimbal.
1.4	**Build and test SGSLR system for Texas**
1.4.1	The contractor shall procure and install the SGSLR shelter on the pad built for SGSLR at MGO by the University of Texas. (b) (4) [redacted] Include support for evaluating and responding to shelter subcontractor's questions and RFIs.
1.4.2	The contractor shall procure and/or build all operational subsystems required at this time for the Texas SGSLR following the in-house developed design and the Level 4 and 5 SGSLR Requirements.
1.4.3	The contractor shall adequately test all procured and built components and subsystems and document the successful Verification of Requirements.
1.4.4	The contractor shall provide all documentation on each subsystem, including build information and/or vendor documentation, and test results.
1.5	**Build up the SGSLR Software and Hardware Labs and maintain them**
1.5.1	The contractor shall complete the build of the required subsystems and capabilities needed for software development in the SGSLR SW Lab at the 1.2 meter telescope facility.
1.5.2	The contractor shall support the build of the required subsystems and capabilities needed for detector and laser testing in the SGSLR HW Lab at the 1.2 meter telescope facility.
1.5.3	The contractor shall support the population of the lab in 28/W120G with the required tools, test equipment, and other instrumentation needed to perform the testing of the lasers and the builds of the optical bench subsystems.
1.5.4	The contractor shall support the maintenance of all three labs.
1.5.5	The contractor shall provide System Administration support for the SGSLR computer systems and related development systems at GGAO and those at (b) (4) [redacted] and MGO for testing.
1.6	(b) (4) [redacted]
1.6.1	This section has been descoped and removed from this task.

1.7	**Support SGSLR safety and laser safety in an automated laser ranging system and maintain all SGSLR required laser safety documentation**
1.7.1	The contractor shall participate in the SAE G10T working group and support Goddard's lead role in the update of FAA regulations for automated laser operations.
1.7.2	The contractor shall maintain all SGSLR related laser safety documentation and keep it up to date.
1.7.3	The contractor shall support Government led development of the SGSLR automation plan.
1.7.4	The contractor shall work with NASA to develop methods of aircraft avoidance other than a co-located radar. In particular the contractor shall work with NASA in its interactions with the FAA to obtain an FAA radar feed for the GGAO and Haleakala sites.
1.8	**Participate in the ILRS and keep the SGSLR design up to date on current activities and procedures**
1.8.1	The contractor shall attend ILRS CB meetings and keep the SGSLR team apprised of all new developments in the ILRS.
1.8.2	The contractor shall participate in ILRS Workshops presenting the current activities of SGSLR to the global community.

2	**Space Geodesy Surveying (Subtask 2): Turned back on at limited level.**
2.1	**Space Geodesy Vector Tie System and Surveying**
2.1.1	The contractor shall provide vector tie system (VTS) support for GGAO, McDonald Observatory, and other SGP locations.
2.1.2	The contractor shall provide site development planning / implementation at GGAO, McDonald Observatory, and other SGP locations.
2.1.3	The contractor shall maintain the VTS equipment.

Subtasks 3 and 4 have been closed and removed from this task.

(b)(4)	[redacted]
	[redacted]
	[redacted]
	[redacted]

	(b) (4) [redacted]

IV. Government Furnished Property/Facilities and Software

The government will furnish laboratory space at GGAO (area 200), access and use of NGSLR and the 1.2 meter telescope for testing of SGSLR subsystems, access and use of 28/W120G, and use of code 61A test equipment at GGAO, building 28 and Goddard Corporate Part (GCP). In addition after the SGSLR facility is built that facility will be used as part of this task for SGSLR development and testing.

All Government Property and Facilities will remain on the property lists and under the accounting of Government personnel and their Property Custodians. There is no Government furnished Property/Facilities associated with this task for which the contractor will be accountable.

This is a Government-led effort, however, the contractor makes use of parts of the following software that must be handled in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
SGSLR (Space Geodesy Satellite Laser Ranging) Software Suite (NASA/GSFC Code 61A)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The proposed travel should include, but not be limited to, the following given in the following table:

	(b) (4) [redacted]
	[redacted]
	[redacted]
	[redacted]

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall procure the equipment given in the table below, and also propose any other material that they identify as necessary to perform the work associated with this Task Order.

A proposed material list is given below. It includes items ordered under previous task years. These are included to account for deliverables. Please do not double order these.

(b) (4) [redacted]

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order. The deliverables shall include:

(b) (4) [redacted]

(b) (4) [redacted]
[redacted]
[redacted]

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 51
Modification: 9
Task Name: Space Geodesy Satellite Laser Ranging Design and Development

GSMO-2 SOW Reference: 2.2, 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	08/01/2017	07/27/2018	Initial task order statement of work.
1	09/13/2017	07/27/2018	Add subtask 4
2	01/22/2018	07/27/2018	Remove subtask 3 starting 1/22/2018
3	2/05/2018	7/27/2018	Replan by KBRwyle only (no cost)
4	3/05/2018	7/27/2018	Add subtask 5 (will continue into next task year)
5	5/17/2018	7/27/2018	Add procurements for subtask 1
6	7/28/2018	7/27/2019	Task order for start in Contract Year 2
7	5/06/2019	7/27/2019	Mod for subtask 1, subtask 2, and subtask 5
8	7/25/2019	8/24/2019	Task no cost extension
9	8/25/2019	2/22/2020	Task order for start in Contract Year 3 (SOW v10)

II. Task Overview

The Space Geodesy Satellite Laser Ranging (SGSLR) Design and Development task provides for the design of the NASA Space Geodesy Project's Next Generation Satellite Laser Ranging System and the build, testing and deployment of the operational McDonald SGSLR system. In addition it includes the development of the testing facilities here at the Goddard Geophysical and Astronomical Observatory (GGAO), the preliminary implementation of the Vector Tie System (VTS), and the (b) (4) [redacted]

Subtask 1: Covers all work associated with (1) the baseline design of the SGSLR system (2) the configuration of the SGSLR testing facilities at GGAO, (3) the delivery of three successfully tested Gimbal and Telescope Assemblies (GTAs), and (4) the development, testing, and deployment of the operational SGSLR system for McDonald Geophysical Observatory (MGO) in Texas.

Subtask 2: Covers all work associated with Space Geodesy Project (SGP) Vector Tie System (VTS) and surveying.

Subtasks 3 & 5: These subtasks are now closed.

(b) (4) [redacted]

III. Requirements

The Contractor shall be governed, for this task order, by GSMO-2 Contract Clause H.9, 52.227-17, Rights in Data-Special Works (Dec 2007) as modified by NASA FAR Supplement 1852.227-17 and GSFC 52.227-93, which will be the applicable Data Rights Clause. The exclusion to this clause will be the (b) (4) [redacted]

This task is not required to follow NPR 7150.2A.

Activities below that have been removed from the previous year's Task 51 SOW have been lined out for clarification on what was removed and what remains.

Changes/additions from mod 7 are in red. Strikethroughs represent items removed from mod 7 or from earlier versions of mod 9 (included for informational purposes only).

1	**SGSLR Design and Development (Subtask 1)**
1.1	**Support the Government led SGSLR design effort**
1.1.1	The contractor shall support the analysis of the SGSLR hardware performance, including SSRx, RCE, and gimbal. ~~The contractor shall support the completion of the SGSLR hardware design and support any remaining Engineering Peer Reviews.~~
1.1.2	The contractor shall support the Government led completion of the SGSLR software design, software development, and support the internal Software Review.
~~1.1.3~~	~~The contractor shall develop documentation required for the Critical Design Review.~~
~~1.1.4~~	~~The contractor shall support the preparation and presentation of information at the SGSLR Critical Design Review.~~
1.1.5	The contractor shall support the Government led close out of several of the RFAs from the Critical Design ~~and the finalization of associated documentation~~.
1.1.6	The contractor shall provide System Administration support for the SGSLR computer systems and related development systems at GGAO and those at (b) (4) [redacted] and MGO for testing. This includes SysAdmin support for the computers at building 208.
1.1.7	The contractor shall procure computers for software development and testing as needed.
1.1.8	The contractor shall complete the design of the operational SGSLR optical bench subsystem.
1.2	**Support the build of the SGSLR facility at GGAO**
1.2.1	The contractor shall support code 220's build of the SGSLR shelter at GGAO by answering questions, monitoring the progress and effectiveness of the work being done, ~~and ensuring that the dome arrives at the right time.~~

~~1.2.2~~	~~The contractor shall populate the SGSLR facility with the required SGSLR instrumentation (both interior and exterior to the shelter) needed to adequately test the GTAs. This includes racks, timing and computers.~~
~~1.2.3~~	~~Perform installation and connection of the external instrumentation.~~
~~1.2.4~~	~~Support the manufacturer's installation of the dome to the GGAO shelter.~~
1.2.5	(b) (4) [redacted]
1.3	**Procure, test and deliver Gimbal and Telescope Assembly (GTA) units**
1.3.1	The contractor shall deliver three fully tested and accepted GTA units to the Government that meet the SGSLR requirements. The units shall pass Acceptance testing at the factory and at the relevant site ~~(units 1 and 2 at GGAO and unit 3 at MGO)~~. Test Plans and documentation on the GTA design shall be provided to the Government prior to any acceptance testing. Test Results, analysis, and modelling shall be provided to the Government after acceptance testing that clearly show that each GTA met each SGSLR requirement.
~~1.3.2~~	~~The contractor shall install each GTA unit on the pier and ensure the system is working prior to any site testing and Test Results shall be provided to the Government after acceptance testing.~~
~~1.3.3~~	~~The contractor shall develop testing capabilities to be used at the GTA Factory.~~
~~1.3.4~~	~~The contractor shall develop capabilities to test two GTA units 1 and 2 at GGAO and the third unit 3 at MGO for Site Acceptance Testing (SAT).~~
1.3.5	The contractor shall crate unit #2 after testing is completed in preparation for shipping to deployment site. The contractor shall crate unit #3 after testing is completed in preparation for storage. Move to Government specified location.
~~1.3.6~~	~~The contractor shall provide documentation on the GTA design, analysis, modeling and verification test results and clearly show that each GTA met each SGSLR requirement.~~
1.3.7	The contractor shall contract with (b) (4) [redacted] to have gimbal #1 with the mass simulator crated and shipped from their (b) (4) [redacted] facility to GGAO and installed in the SGSLR facility. The contractor shall also provide for removing and shipping gimbal #1 back to (b) (4) [redacted] when (b) (4) [redacted] is ready to install the SGSLR telescope in the gimbal.
1.3.8	The contractor shall design and build the risers for the GTAs at GGAO.
1.4	**Build and test SGSLR shelter and related items at MGO (Texas)**
1.4.1	The contractor shall procure and install the SGSLR shelter on the pad built for SGSLR at MGO by the University of Texas. The contractor shall monitor and evaluate the shelter subcontractor, and respond to shelter subcontractor's questions and RFIs. As built shelter documentation with pictures shall be delivered to the Government upon shelter completion.
~~1.4.2~~	~~The contractor shall procure and/or build all operational subsystems required at this time for the Texas SGSLR following the in-house developed design and the Level 4 and 5 SGSLR Requirements.~~

~~1.4.3~~	~~The contractor shall adequately test all procured and built components and subsystems and document the successful Verification of Requirements.~~
~~1.4.4~~	~~The contractor shall provide all documentation on each subsystem, including build information and/or vendor documentation, and test results.~~
1.4.5	The contractor shall complete the procurement of the MGO dome and perform Acceptance Testing at the vendor factory (FAT). FAT results documentation shall be delivered to the Government. The contractor shall ensure that Site Acceptance Testing (SAT) is successfully performed, and shall provide the SAT results documentation to the Government.
1.5	**~~Build up the SGSLR Software and Hardware Labs and maintain them~~**
	This item has been moved to 1.15

1.6	**~~Support technical interactions with the Norwegians.~~**
	This item has been removed from TO#51.

1.7	**~~Support SGSLR safety and laser safety in an automated laser ranging system and maintain all SGSLR required laser safety documentation~~**
	This item has been moved to 1.16.
1.8	**~~Participate in the ILRS and keep the SGSLR design up to date on current activities and procedures~~**
	This item has been removed into 1.16.

The following are requirements added in mod 9.

1.9	**Procure MET and Time & Frequency Subsystems for GGAO & MGO**
1.9.1	The contractor shall procure the remaining MET subsystem equipment for GGAO and MGO.
1.9.2	The contractor shall procure the remaining Time & Frequency subsystem equipment for GGAO and MGO.

1.10	**Maintain the SGSLR shelter**
1.10.1	Once the SGSLR facility is ready for GTA testing, the contractor shall support maintenance of the dome, HVAC, UPS, PDUs and any other technical equipment in this facility that they deem necessary (contractor to specify).
1.10.2	The contractor shall populate the SGSLR facility with the required SGSLR instrumentation (both interior and exterior to the shelter) needed to adequately test the GTAs. This includes racks, timing and computers.
1.10.3	The contractor shall integrate SGSLR equipment coming into the shelter as needed.
1.10.4	The contractor shall perform installation and connection of the external instrumentation (excluding the LHRS).

1.10.5	The contractor shall install the GGAO riser on the pier.
1.10.6	~~The contractor shall procure tools and test equipment for use in this facility.~~

1.11	**Develop the Optical Bench Subsystem required for GTA testing**
1.11.1	The contractor shall design the SGSLR GTA OB and optical bench support structure for GGAO and MGO.
1.11.2	The contractor shall procure any needed materials for building the support structure, the optical breadboard and any materials, optics and instrumentation required for use on the GTA optical bench for GGAO.
1.11.3	The contractor shall procure any cameras and associated equipment required on the gimbal for GTA testing.
1.11.4	The contractor shall build / assemble and test the GTA optical bench (OB) subsystem.
1.11.5	The contractor shall test the cameras and other equipment related to the OB for GTA testing.

1.12	**Support the GTA Build and Test**
1.12.1	The contractor shall support the completion of the gimbal and telescope design.
1.12.2	The contractor shall support the build and test of GTA unit #1 through FAT and SAT.
1.12.3	The contractor shall install the GTA units on the GGAO riser/pier and ensure the system is working prior to any site testing at GGAO.
1.12.4	The contractor shall develop testing capabilities to be used at the GTA Factory.
1.12.5	The contractor shall develop capabilities to test the three GTA units for Site Acceptance Testing (SAT).
1.12.6	The contractor shall support all GTA testing at the GGAO SGSLR facility.

1.13	**Build and test the SGSLR operational Timing and MET Subsystems**
1.13.1	The contractor shall build and test the Time & Frequency subsystem for GGAO and provide as built documentation and test results verifying requirements.
1.13.2	The contractor shall build and test the Meteorological subsystem for GGAO and provide as built documentation and test results verifying requirements.

1.14	**Build and test the RCE and LSS/LI prototypes and operational units**
1.14.1	The contractor shall build Ranging Control Electronics (RCE) prototype and support testing of it in the SGSLR SW Lab.
1.14.2	The contractor shall build the prototype Laser Safety Subsystem Laser Interlock(LI) and support testing of it in the SGSLR SW Lab.
1.14.3	The contractor shall procure parts for, build and test the operational RCE for GGAO and provide as built documentation and test results verifying requirements.

1.14.4	The contractor shall procure parts for, build and test the operational Laser Safety Subsystem for GGAO and provide as built documentation and test results verifying requirements.

1.15	**Maintain the SGSLR Software and Hardware Labs**
1.15.1	The contractor shall support the technical capabilities of all three SGSLR labs: 28/W120G, the HW Lab in building 208, and the SW Lab in building 208.
1.15.2	The contractor shall support the testing of the detectors and lasers in the SGSLR HW Lab, 1.2 meter telescope facility, and the SGSLR facilities.

1.16	**Tasks common to all of SGSLR**
1.16.1	The contractor shall keep active with International Laser Ranging Service (ILRS) to ensure SGSLR stays current with ILRS procedures and practices. The contractor shall attend meetings and Workshops.
1.16.2	The contractor shall participate in Goddard's Government led SAE G10T Working Group and support Goddard's attempt to change FAA regulations to clarify automated laser operations. Attend meetings and prepare documentation and presentations as needed in between meetings.
1.16.3	The contractor shall support Government-led Hazard analysis & Hazard remediation for SGSLR.
1.16.4	The contractor shall support the Laser Safety Subsystem design and provide the design documentation to the Government and present to the SGSLR team in an internal review.
1.16.5	The contractor shall develop and maintain laser safety documentation for the SGSLR facility at GGAO and keep it up to date.
1.16.6	The contractor shall procure, setup and configure computers needed for testing at the SGSLR facility, GSFC labs, and remote testing locations.
1.16.7	The contractor shall support the [redacted] (b) (4) testing at the GGAO labs and at the GGAO SGSLR facility, and support the [redacted] (b) (4) Review. The contractor shall perform the combined receiver ([redacted] (b) (4) and RCE) testing.
1.16.8	~~The contractor shall work with NASA in its interactions with the FAA to obtain an FAA radar feed for the GGAO and Haleakala sites.~~

1.17	**Documentation**
1.17.1	Test Plans for gimbal & mass simulator testing at GGAO. Documentation of results from this period of testing.
1.17.2	Documentation for LSS/LI, RCE, T&F, and MET.
1.17.3	SAE G10T meeting presentations, documents and notes.
1.17.4	ILRS presentations and papers given at Workshops or other meetings.
1.17.5	Laser Safety Documentation for SGSLR.
1.17.6	Trip reports for any travel other than local travel.
1.17.7	As built documentation and test report for T&F subsystem build and testing.
1.17.8	As built documentation and test reports for MET subsystem build and testing.
1.17.9	As built documentation for the RCE along with the testing report.
1.17.10	As built documentation for the LSS/LI along with the testing report.

1.17.11	As built documentation for the radar along with the testing report.

2	**Space Geodesy Surveying (Subtask 2):**
2.1	**Space Geodesy Vector Tie System and Surveying**
2.1.1	The Contractor shall provide periodic support to maintain and test for functionality and operational status of the NASA geodetic survey equipment stored in the survey equipment trailer at GGAO. The period for this support shall not exceed every 3 months. ~~The contractor shall provide vector tie system (VTS) support for GGAO, McDonald Observatory, and other SGP locations.~~
2.1.2	~~The contractor shall provide site development planning / implementation at GGAO, McDonald Observatory, and other SGP locations.~~
2.1.3	~~The contractor shall maintain the VTS equipment.~~

Subtasks 3 and 4 have been closed and removed from Task Order 51.

(b)(4)	[redacted]
[redacted]	[redacted]

IV. Government Furnished Property/Facilities and Software

The government will furnish laboratory space at GGAO (area 200), access and use of NGSLR and the 1.2 meter telescope for testing of SGSLR subsystems, access and use of 28/W120G, and use of code 61A test equipment at GGAO, building 28 and Goddard Corporate Part (GCP). In addition after the SGSLR facility is built that facility will be used as part of this task for SGSLR development and testing.

All Government Property and Facilities will remain on the property lists and under the accounting of Government personnel and their Property Custodians. There is no Government furnished Property/Facilities associated with this task for which the contractor will be accountable.

This is a Government-led effort, however, the contractor makes use of parts of the following software that must be handled in accordance with clause I.20 -

GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

GFCS Description	GSC ID
SGSLR (Space Geodesy Satellite Laser Ranging) Software Suite (NASA/GSFC Code 61A)	

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The proposed travel should include, but not necessarily limited to, the following given in the following table:

(b) (4) [redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]

VI. Material Procurement

The Contractor shall procure the equipment given in the table below, and also propose any other material that they identify as necessary to perform the work associated with this Task Order.

A proposed material list is given below. It includes some items ordered under previous task years. Contractor to propose materials needed for this POP.

(b) (4) [redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]
[redacted]

(b) (4)

[redacted]

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order. Delivery dates listed here beyond the end of the POP are for information purposes only. The deliverables shall include:

(b) (4)

[redacted]

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 52
Modification: 09
Task Name: Integration, Test, Science and Mission Operations Centers

GSMO-2 SOW Reference: **2.0 Mission Ground System Development**
2.4 Mission Ground System Development
2.4.1 Telemetry, Command, and Control
2.4.4 Trending
2.4.6 Level Zero Processing
2.4.8 Automation
2.4.9 Information Technology Support
2.4.11 Ground Support Equipment (GSE)
2.5 Operations Products
3.0 Mission Operations
3.3 Flight Operations
3.6 Mission Data Collection and Distribution
3.7 Sustaining Engineering
3.7.2 Ground System Software
3.7.3 Ground System Hardware
3.7.4 System Administration and IT Security
3.7.5 Database Administration

I. Task Order History

Mod #	Start	End	Brief Description
00	09/01/2017	04/27/2018	Initial task order statement of work
01	10/09/2017	04/27/2018	Equipment procurement and supporting labor
02	12/18/2017	04/27/2018	Addition of Subtask 7 for LEMNOS support
03	02/05/2018	04/27/2018	Purchase of disk drives to support NICER data storage
04	04/28/2018	04/26/2019	Renewal mod to continue work on all 7 subtasks
05	09/24/2018	04/26/2019	New work on Subtask 7 and addition of Subtask 8 (WIEC)
06	10/22/2018	04/26/2019	Addition of Subtask 9 for Resolve I&T Support
07	12/03/2018	04/26/2019	Subtask 3 purchases and increased scope on Subtask 2
08	02/15/2019	04/26/2019	Increased scope on Subtask 7 and addition of Subtask 10
09	04/27/2019	04/25/2020	Renewal of task and continuation of work on all 10 subtasks

II. Task Overview

The “Integration, Test, Science and Mission Operations Centers” task provides ground system development, Systems Administration, IT Security, and Operations support for multiple missions hosted in or associated with the Science & Planetary Operations Control Center (SPOCC) in Bldg. 32, Room C101C at the Goddard Space Flight Center (GSFC). In support of these missions, work is also performed in project offices, development labs and Integration and Test (I&T) facilities that are physically outside of the SPOCC.

This mod (Mod 09) renews GSMO-2 Task 52 for a full year and continues work shown on all 10 subtasks at the same levels as of the most recent previous mod (Mod 08).

Subtask 1: Covers all work associated with the Neutron Star Interior Composition Explorer (NICER) ISS payload Science and Mission Operations Center (SMOC).

Subtask 2: Covers all work associated with the Instrument Team Facility (ITF) for the Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument on-board the MAVEN Mars orbiter.

Subtask 3: Covers generic mission support work as part of the SPOCC infrastructure.

Subtask 4: Covers all work associated with the Space Geodesy Project (SGP) Space Geodesy Network Operations Center (SGNOC).

Subtask 5: Covers all work associated with the ICESat-2 Advanced Laser Altimeter System (ATLAS) Instrument Support Facility (ISF).

Subtask 6: Covers all work associated with the DSCOVR Science Operations Center (DSOC).

Subtask 7: Covers Ground System and Mission Operations Systems Engineering work in support of Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS).

Subtask 8: Covers systems analysis, system definition, and facility interface definition in support of deployment of the Wide Field Infrared Instrument Engineering Center (WIEC) in the SPOCC.

Subtask 9: Covers Systems Administration, Network Administration, and IT Security support to the Integration and Test (I&T) Lab for the GSFC-developed X-ray Imaging and Spectroscopy Mission (XRISM) Resolve instrument in the Cryogenic Integration Facility (CRIF) located in GSFC Bldg. 7.

Subtask 10: Covers definition of network topology for support of network connectivity testing for the Cubesat for the Study of Solar Particles (CuSP) mission.

III. Requirements

1	NICER
1.1	**Ground System Development**
1.1.1	The contractor shall maintain configurations and software for Telemetry, Command, and Control systems, Trending, Level 0 Processing, and Automation in the NICER SMOC
1.1.2	The contractor shall develop and maintain on-line Operations Products.
1.1.3	The contractor shall support the configuration of NICER Ground Support Equipment (GSE) in Bldg. 23 that interfaces remotely with the SMOC
1.1.4	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NICER SMOC
1.2	**Mission Operations**
1.2.1	The contractor shall perform NICER Flight Operations.
1.2.2	The contractor shall perform NICER Mission Data Collection and Distribution
1.3	**Sustaining Engineering**
1.3.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NICER SMOC
1.3.2	The contractor shall maintain the NICER Operations Data Base
1.3.3	The contractor shall be responsible for Systems Administration and IT Security in the NICER SMOC

2	NGIMS
2.1	**Mission Operations**
2.1.1	The contractor shall support NGIMS Instrument Flight Operations
2.1.2	The contractor shall perform NGIMS Mission Data Collection, Processing and Distribution in the NGIMS ITF

2.1.3	The contractor shall provide support for generation of the data products sent to the Planetary Data System (PDS) and to perform backup operational activities for NGIMS on an as-needed basis. Backup operational support is comprised of completing activities such as Level 0 data processing and Virtual Machine Language (VML) uplink file review, and attending MAVEN Project and MAVEN Science weekly meetings. Backup operational support will be required whenever other instrument operations members are unavailable to support completion of these activities. In order to satisfy PDS delivery requirements, the Contractor will draw upon direct experience working in the software development and science operations areas in support of the NGIMS experiment. The following tasks will need to be performed in preparation for data deliveries to the PDS every three months: • Modification of existing Python scripts as the processing of on-orbit experiment data evolves; • Maintenance of existing Python scripts required to expedite the PDS delivery process; • Generation of the required PDS-compliant orbit experiment files as well as their corresponding metadata represented using Extensible Markup Language (XML); • Delivery of the required NGIMS bundle to MAVEN's Science Data Center at the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado in Boulder for archival and submission to PDS; and • Review of the Science Data Center submission to PDS
2.2	**Sustaining Engineering**
2.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NGIMS ITF
2.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NGIMS ITF
2.2.3	The contractor shall perform Systems Administration and IT Security for the NGIMS ITF

3	**SPOCC**
3.1	**Sustaining Engineering**
3.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of missions leveraging the SPOCC infrastructure
3.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
3.1.3	The contractor shall provide Systems Administration and IT Security support

3.1.4	The contractor shall purchase specific computer equipment and software licenses (and provide labor for procurement, logistical support, and set-up) for the NASA MatISSE (Maturation of Instruments for Solar System Exploration) program, in support of future payload ops from the SPOCC
	Subtask 3 will be funded via multiple WBS elements (at least one from each of the SPOCC tenant missions) in order to pay for miscellaneous labor, upgrades and procurements that are generic, i.e., benefiting multiple (or potentially all) missions hosted in the SPOCC

4	**SGNOC**
4.1	**Ground System Development**
4.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software licenses and hardware for the SGNOC
4.1.2	The contractor shall provide Systems Administration and IT Security support for the SGNOC

5	**ATLAS**
5.1	**Ground System Sustaining Engineering**
5.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of the ATLAS ISF
5.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
5.1.3	The contractor shall perform System Administration and IT Security for the ATLAS ISF

6	**DSCOVR**
6.1	**Mission Operations**
6.1.1	The contractor shall perform DSCOVR Mission Data Collection, Processing and Distribution in the DSOC
6.2	**Sustaining Engineering**
6.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the DSOC
6.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the DSOC
6.2.3	The contractor shall perform System Administration and IT Security for the DSOC

7	**LEMNOS**
7.1	**Mission Ground System Development**
7.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support.
7.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations. Mod 08 increased the scope this subtask to encompass the preliminary design of a laser pointing planning system for the Integrated Laser Communication Relay Demonstration (LCRD) Low-Earth Orbit (LEO) User Modem and Amplifier - Terminal (ILLUMA-T) International Space Station (ISS) payload, to be deployed in the Lasercom Terminal Support Console (LTSC) in the SPOCC at GSFC. This system will be based upon the existing Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System managed by the GSFC Attitude Control Systems Engineering Branch (Code 591).
7.2	**Mission Operations**
7.2.1	System Engineering: The Contractor shall provide the overarching engineering to ensure the complement of elements, systems, and subsystems interact effectively to achieve mission objectives. The Contractor shall coordinate interfaces, internal and external, to ensure compatibility and interoperability.

8	**WIEC**
8.1	**Mission Ground System Development**
8.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support.
8.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations.

9	**XRISM/Resolve**
9.1	**I&T Ground System Deployment and Sustaining Engineering**
9.1.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the XRISM/Resolve I&T facility.
9.1.2	The contractor shall perform System Administration, Network Administration, and IT Security support for the XRISM/Resolve I&T facility.

10	CuSP Network Topology
10.1	**Mission Ground System Development (Support Network Topology Definition)**
10.1.1	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order. The Contractor will be responsible for IT assets located in the SPOCC (Bldg. 32, Room C101C) and in development labs supporting SPOCC tenant missions (including in the CRIF in GSFC Bldg.7), but will not have any responsibilities pertaining to facility property or building structure.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

The list of catalogued Government-Furnished Computer Software (GFCS) is as follows:

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test Software (ASIST), Front-End Data Systems/Digital History Data Store Software (FEDS/DHDS)	GSC-15832-1
Integrated Test and Operations System (ITOS)	GSC-16025-1
Consultative Committee for Space Data Systems (CCSDS) File Delivery Protocol (CFDP) Software Library, Version 3.1	GSC-14993-1
Integrated Trending and Plotting System (ITPS)	GSC-15532-1
Goddard Mission Services Evolution Center (GMSEC) Criteria Action Table (CAT)	GSC-17185-1
Goddard Mission Services Evolution Center (GMSEC) Alert Notification System Router (ANSR)	GSC-17233-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System	GSC-15811-1
Goddard Dynamic Simulator (GDS)	GSC-15340-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The Government currently envisions the travel described in the table during the period encompassed by this task mod (Mod 09).

Travel Description	# Travelers	Duration	Time Frame
MIT (Lexington, MA) for ILLUMA-T Ops Meetings	1	3	September 2019
JSC (Houston, TX) for Orion Ops Working Group	1	4	March 2020

VI. Material Procurement

Only miscellaneous small hardware purchases (of items such as such as replacement disk drives, flash drives, fiber optic cabling, etc.) are anticipated during the period of performance of this task mod (Mod 09).

VII. Deliverables

The Contractor shall provide brief monthly status reports on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 52
Modification: 11
Task Name: Integration, Test, Science and Mission Operations Centers

GSMO-2 SOW Reference: **2.0 Mission Ground System Development**
2.4 Mission Ground System Development
2.4.1 Telemetry, Command, and Control
2.4.4 Trending
2.4.6 Level Zero Processing
2.4.8 Automation
2.4.9 Information Technology Support
2.4.11 Ground Support Equipment (GSE)
2.5 Operations Products
3.0 Mission Operations
3.3 Flight Operations
3.6 Mission Data Collection and Distribution
3.7 Sustaining Engineering
3.7.2 Ground System Software
3.7.3 Ground System Hardware
3.7.4 System Administration and IT Security
3.7.5 Database Administration

I. Task Order History

Mod #	Start	End	Brief Description
00	09/01/2017	04/27/2018	Initial task order statement of work
01	10/09/2017	04/27/2018	Equipment procurement and supporting labor
02	12/18/2017	04/27/2018	Addition of Subtask 7 for LEMNOS support
03	02/05/2018	04/27/2018	Purchase of disk drives to support NICER data storage
04	04/28/2018	04/26/2019	Renewal mod to continue work on all 7 subtasks
05	09/24/2018	04/26/2019	New work on Subtask 7 and addition of Subtask 8 (WIEC)
06	10/22/2018	04/26/2019	Addition of Subtask 9 for Resolve I&T Support
07	12/03/2018	04/26/2019	Subtask 3 purchases and increased scope on Subtask 2
08	02/15/2019	04/26/2019	Increased scope on Subtask 7 and addition of Subtask 10
09	04/27/2019	04/25/2020	Renewal of task and continuation of work on all 10 subtasks
10			Administrative mod
11	06/10/2019	04/25/2020	New work on Subtasks 7&10; addition of Subtasks 11, 12, & 13

II. Task Overview

The "Integration, Test, Science and Mission Operations Centers" task provides ground system development, Systems Administration, IT Security, and Operations support for multiple missions hosted in or associated with the Science & Planetary Operations Control Center (SPOCC) in Bldg. 32, Room C101C at the Goddard Space Flight Center (GSFC). In support of these missions, work is also performed in project offices, development labs and Integration and Test (I&T) facilities that are physically outside of the SPOCC.

This mod (Mod 11) continues work on all 10 pre-existing subtasks, increases support on Subtasks 7 and 10, and adds 3 new subtasks (Subtasks 11, 12, and 13).

Subtask 1: Covers all work associated with the Neutron Star Interior Composition Explorer (NICER) ISS payload Science and Mission Operations Center (SMOC).

Subtask 2: Covers all work associated with the Instrument Team Facility (ITF) for the Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument on-board the MAVEN Mars orbiter.

Subtask 3: Covers generic mission support work as part of the SPOCC infrastructure.

Subtask 4: Covers all work associated with the Space Geodesy Project (SGP) Space Geodesy Network Operations Center (SGNOC).

Subtask 5: Covers all work associated with the ICESat-2 Advanced Laser Altimeter System (ATLAS) Instrument Support Facility (ISF).

Subtask 6: Covers all work associated with the DSCOVR Science Operations Center (DSOC).

Subtask 7: Covers Ground System and Mission Operations Systems Engineering work in support of Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS).

Subtask 8: Covers systems analysis, system definition, and facility interface definition in support of deployment of the Wide Field Infrared Instrument Engineering Center (WIEC) in the SPOCC.

Subtask 9: Covers Systems Administration, Network Administration, and IT Security support to the Integration and Test (I&T) Lab for the GSFC-developed X-ray Imaging and Spectroscopy Mission (XRISM) Resolve instrument in the Cryogenic Integration Facility (CRIF) located in GSFC Bldg. 7.

Subtask 10: Covers definition of network topology for support of network connectivity testing for the Cubesat for the Study of Solar Particles (CuSP) mission.

Subtask 11: Provides Internet Technology (IT) Security support for the Integration and Test (I&T) facility for the L'Ralph instrument on the ***Lucy*** asteroid mission.

Subtask 12: Supports software upgrades for systems supporting the Deep Space Climate Observer (DSCOVR) mission in the control center operated by the National Oceanic and Atmospheric Administration (NOAA).

Subtask 13: Supports the Surface and Exosphere Alterations by Landers (SEAL) investigation by providing engineering support during the refurbishment of the mass spectrometer on the Japanese Nozomi spacecraft.

III. Requirements

1	**NICER**
1.1	**Ground System Development**
1.1.1	The contractor shall maintain configurations and software for Telemetry, Command, and Control systems, Trending, Level 0 Processing, and Automation in the NICER SMOC
1.1.2	The contractor shall develop and maintain on-line Operations Products.
1.1.3	The contractor shall support the configuration of NICER Ground Support Equipment (GSE) in Bldg. 23 that interfaces remotely with the SMOC
1.1.4	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NICER SMOC
1.2	**Mission Operations**
1.2.1	The contractor shall perform NICER Flight Operations.
1.2.2	The contractor shall perform NICER Mission Data Collection and Distribution
1.3	**Sustaining Engineering**
1.3.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NICER SMOC
1.3.2	The contractor shall maintain the NICER Operations Data Base
1.3.3	The contractor shall be responsible for Systems Administration and IT Security in the NICER SMOC

2	**NGIMS**
2.1	**Mission Operations**
2.1.1	The contractor shall support NGIMS Instrument Flight Operations
2.1.2	The contractor shall perform NGIMS Mission Data Collection, Processing and Distribution in the NGIMS ITF

2.1.3	The contractor shall provide support for generation of the data products sent to the Planetary Data System (PDS) and to perform backup operational activities for NGIMS on an as-needed basis. Backup operational support is comprised of completing activities such as Level 0 data processing and Virtual Machine Language (VML) uplink file review, and attending MAVEN Project and MAVEN Science weekly meetings. Backup operational support will be required whenever other instrument operations members are unavailable to support completion of these activities. In order to satisfy PDS delivery requirements, the Contractor will draw upon direct experience working in the software development and science operations areas in support of the NGIMS experiment. The following tasks will need to be performed in preparation for data deliveries to the PDS every three months: • Modification of existing Python scripts as the processing of on-orbit experiment data evolves; • Maintenance of existing Python scripts required to expedite the PDS delivery process; • Generation of the required PDS-compliant orbit experiment files as well as their corresponding metadata represented using Extensible Markup Language (XML); • Delivery of the required NGIMS bundle to MAVEN's Science Data Center at the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado in Boulder for archival and submission to PDS; and • Review of the Science Data Center submission to PDS
2.2	**Sustaining Engineering**
2.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NGIMS ITF
2.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NGIMS ITF
2.2.3	The contractor shall perform Systems Administration and IT Security for the NGIMS ITF

3	**SPOCC**
3.1	**Sustaining Engineering**
3.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of missions leveraging the SPOCC infrastructure
3.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
3.1.3	The contractor shall provide Systems Administration and IT Security support

3.1.4	The contractor shall purchase specific computer equipment and software licenses (and provide labor for procurement, logistical support, and set-up) for the NASA MatISSE (Maturation of Instruments for Solar System Exploration) program, in support of future payload ops from the SPOCC
	Subtask 3 will be funded via multiple WBS elements (at least one from each of the SPOCC tenant missions) in order to pay for miscellaneous labor, upgrades and procurements that are generic, i.e., benefiting multiple (or potentially all) missions hosted in the SPOCC

4	**SGNOC**
4.1	**Ground System Development**
4.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software licenses and hardware for the SGNOC
4.1.2	The contractor shall provide Systems Administration and IT Security support for the SGNOC

5	**ATLAS**
5.1	**Ground System Sustaining Engineering**
5.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of the ATLAS ISF
5.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
5.1.3	The contractor shall perform System Administration and IT Security for the ATLAS ISF

6	**DSCOVR**
6.1	**Mission Operations**
6.1.1	The contractor shall perform DSCOVR Mission Data Collection, Processing and Distribution in the DSOC
6.2	**Sustaining Engineering**
6.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the DSOC
6.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the DSOC
6.2.3	The contractor shall perform System Administration and IT Security for the DSOC

7	**LEMNOS**
7.1	**Mission Ground System Development**
7.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support. This mod (Mod 11) increases information technology and systems engineering support for the hosting of specific LEMNOS software components on virtual machines developed in the "corporate cloud" or in the Amazon Web Services (AWS) GovCloud under the auspices of the Goddard Space Flight Center (GSFC) Enterprise Managed Cloud Computing (EMCC) office.
7.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations. Mod 08 increased the scope of this subtask to encompass the preliminary design of a laser pointing planning system for the Integrated Laser Communication Relay Demonstration (LCRD) Low-Earth Orbit (LEO) User Modem and Amplifier - Terminal (ILLUMA-T) International Space Station (ISS) payload, to be deployed in the Lasercom Terminal Support Console (LTSC) in the SPOCC at GSFC. This system will be based upon the existing Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System managed by the GSFC Attitude Control Systems Engineering Branch (Code 591).
7.2	**Mission Operations**
7.2.1	System Engineering: The Contractor shall provide the overarching engineering to ensure the complement of elements, systems, and subsystems interact effectively to achieve mission objectives. The Contractor shall coordinate interfaces, internal and external, to ensure compatibility and interoperability.

8	**WIEC**
8.1	**Mission Ground System Development**
8.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support.
8.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations.

9	**XRISM/Resolve**
9.1	**I&T Ground System Deployment and Sustaining Engineering**

9.1.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the XRISM/Resolve I&T facility.
9.1.2	The contractor shall perform System Administration, Network Administration, and IT Security support for the XRISM/Resolve I&T facility.

10	**CuSP Network Topology**
10.1	**Mission Ground System Development (Support Network Topology Definition)**
10.1.1	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations. This mod (Mod 11) increases scope to include: 1) Radio Frequency (RF) engineering analysis to support the DSN interface and the frequency allocation/approval process with the National Telecommunications Information Agency (NTIA) for the **Iris** deep space transponder system on-board the CuSP CubeSat.

11	**L'Ralph**
11.1	**I&T Ground System IT Security**
11.1.1	The Contractor shall provide IT Security support to L'Ralph I&T facility, providing an ISSO (Information Systems Security Officer) and network administration support.
11.1.2	The Contractor shall modify the Distributed Virtual Environment for Secure Test & Operations (DVESTO) IT SSP (System Security Plan) as necessary to incorporate changes applicable to L'Ralph.
11.1.3	The Contractor shall work with GSFC Code 700 personnel and L'Ralph Systems Administrators on the annual SA&A (System Assessment & Authorization) process encompassing L'Ralph I&T systems.
11.1.4	The Contractor shall track Plans of Actions & Milestones based on scan and annual SA&A results.

12	**NOAA**
12.1	**Mission Ground System Development**
12.1.1	The Contractor shall upgrade the Integrated Trending and Plotting System (ITPS) software for the Deep Space Climate Observer (DSCOVR) control center operated by NOAA.
12.1.2	The Contractor shall upgrade the Mission Training Simulator (MTS) software for the Deep Space Climate Observer (DSCOVR) control center operated by NOAA.

13	**SEAL**
13.1	**Sustaining Engineering**

13.1.1	The contractor shall support the Surface and Exosphere Alterations by Landers (SEAL) investigation by providing engineering support to generate, align and communicate technical requirements during the refurbishment of the mass spectrometer on the Japanese Nozomi spacecraft.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order. The Contractor will be responsible for IT assets located in the SPOCC (Bldg. 32, Room C101C) and in development labs supporting SPOCC tenant missions (including in the CRIF in GSFC Bldg.7), but will not have any responsibilities pertaining to facility property or building structure.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

The list of catalogued Government-Furnished Computer Software (GFCS) is as follows:

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test Software (ASIST), Front-End Data Systems/Digital History Data Store Software (FEDS/DHDS)	GSC-15832-1
Integrated Test and Operations System (ITOS)	GSC-16025-1
Consultative Committee for Space Data Systems (CCSDS) File Delivery Protocol (CFDP) Software Library, Version 3.1	GSC-14993-1
Integrated Trending and Plotting System (ITPS)	GSC-15532-1
Goddard Mission Services Evolution Center (GMSEC) Criteria Action Table (CAT)	GSC-17185-1
Goddard Mission Services Evolution Center (GMSEC) Alert Notification System Router (ANSR)	GSC-17233-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System	GSC-15811-1
Goddard Dynamic Simulator (GDS)	GSC-15340-1

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The Government currently envisions no additional travel as part of this task mod (Mod 11).

VI. Material Procurement

The Contractor shall propose procurements they identify as necessary to perform the work associated with this Task Order and to continue support of the operational missions. Procurements to update software licenses, increase data storage capacity and enhance virtualization are anticipated by the Government during the period of this Task Order mod (Mod 11). The Government requests that the Contractor:

1) Complete an assessment of needs for the supported missions;
2) Produce a Basis of Materials (BOM) for the required purchases; and
3) Submit information and costs in the response to this task mod request.

VII. Deliverables

The Contractor shall provide brief monthly status reports on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 52
Modification: 12
Task Name: Integration, Test, Science and Mission Operations Centers

GSMO-2 SOW Reference: **2.0 Mission Ground System Development**
2.4 Mission Ground System Development
2.4.1 Telemetry, Command, and Control
2.4.4 Trending
2.4.6 Level Zero Processing
2.4.8 Automation
2.4.9 Information Technology Support
2.4.11 Ground Support Equipment (GSE)
2.5 Operations Products
3.0 Mission Operations
3.3 Flight Operations
3.6 Mission Data Collection and Distribution
3.7 Sustaining Engineering
3.7.2 Ground System Software
3.7.3 Ground System Hardware
3.7.4 System Administration and IT Security
3.7.5 Database Administration

I. Task Order History

Mod #	Start	End	Brief Description
00	09/01/2017	04/27/2018	Initial task order statement of work
01	10/09/2017	04/27/2018	Equipment procurement and supporting labor
02	12/18/2017	04/27/2018	Addition of Subtask 7 for LEMNOS support
03	02/05/2018	04/27/2018	Purchase of disk drives to support NICER data storage
04	04/28/2018	04/26/2019	Renewal mod to continue work on all 7 subtasks
05	09/24/2018	04/26/2019	New work on Subtask 7 and addition of Subtask 8 (WIEC)
06	10/22/2018	04/26/2019	Addition of Subtask 9 for Resolve I&T Support
07	12/03/2018	04/26/2019	Subtask 3 purchases and increased scope on Subtask 2
08	02/15/2019	04/26/2019	Increased scope on Subtask 7 and addition of Subtask 10
09	04/27/2019	04/25/2020	Renewal of task and continuation of work on all 10 subtasks
10			Administrative mod
11	06/10/2019	04/25/2020	New work on Subtasks 7&10; addition of Subtasks 11, 12, & 13
12	10/27/2019	04/25/2020	Addition of Subtask 14

II. Task Overview

The "Integration, Test, Science and Mission Operations Centers" task provides ground system development, Systems Administration, IT Security, and Operations support for multiple missions hosted in or associated with the Science & Planetary Operations Control Center (SPOCC) in Bldg. 32, Room C101C at the Goddard Space Flight Center (GSFC). In support of these missions, work is also performed in project offices, development labs and Integration and Test (I&T) facilities that are physically outside of the SPOCC.

This mod (Mod 12) descopes Subtask 9 as the work on Task 52 in support of this instrument test lab has been completed. This mod continues work on the remaining 12 pre-existing subtasks and adds 1 new subtask (Subtask 14).

Subtask 1: Covers all work associated with the Neutron Star Interior Composition Explorer (NICER) International Space Station (ISS) payload Science and Mission Operations Center (SMOC).

Subtask 2: Covers all work associated with the Instrument Team Facility (ITF) for the Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument on-board the MAVEN Mars orbiter.

Subtask 3: Covers generic mission support work as part of the SPOCC infrastructure.

Subtask 4: Covers all work associated with the Space Geodesy Project (SGP) Space Geodesy Network Operations Center (SGNOC).

Subtask 5: Covers all work associated with the ICESat-2 Advanced Laser Altimeter System (ATLAS) Instrument Support Facility (ISF).

Subtask 6: Covers all work associated with the DSCOVR Science Operations Center (DSOC).

Subtask 7: Covers Ground System and Mission Operations Systems Engineering work in support of Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS).

Subtask 8: Covers systems analysis, system definition, and facility interface definition in support of deployment of the Wide Field Infrared Instrument Engineering Center (WIEC) in the SPOCC.

~~Subtask 9: Covers Systems Administration, Network Administration, and IT Security support to the Integration and Test (I&T) Lab for the GSFC-developed X-ray Imaging and Spectroscopy Mission (XRISM) Resolve instrument in the Cryogenic Integration Facility (CRIF) located in GSFC Bldg. 7.~~

Subtask 10: Covers definition of network topology for support of network connectivity testing for the Cubesat for the Study of Solar Particles (CuSP) mission.

Subtask 11: Provides Internet Technology (IT) Security support for the Integration and Test (I&T) facility for the L'Ralph instrument on the ***Lucy*** asteroid mission.

Subtask 12: Supports software upgrades for systems supporting the Deep Space Climate Observer (DSCOVR) mission in the control center operated by the National Oceanic and Atmospheric Administration (NOAA).

Subtask 13: Supports the Surface and Exosphere Alterations by Landers (SEAL) investigation by providing engineering support during the refurbishment of the mass spectrometer on the Japanese Nozomi spacecraft.

Subtask 14: Provides Systems Engineering and Test support for the Integrated Laser Communication Relay Demonstration (LCRD) Low-Earth Orbit (LEO) User Modem and Amplifier - Terminal (ILLUMA-T) International Space Station (ISS) payload.

III. Requirements

1	**NICER**
1.1	**Ground System Development**
1.1.1	The contractor shall maintain configurations and software for Telemetry, Command, and Control systems, Trending, Level 0 Processing, and Automation in the NICER SMOC
1.1.2	The contractor shall develop and maintain on-line Operations Products.
1.1.3	The contractor shall support the configuration of NICER Ground Support Equipment (GSE) in Bldg. 23 that interfaces remotely with the SMOC
1.1.4	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NICER SMOC
1.2	**Mission Operations**
1.2.1	The contractor shall perform NICER Flight Operations.
1.2.2	The contractor shall perform NICER Mission Data Collection and Distribution
1.3	**Sustaining Engineering**
1.3.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NICER SMOC
1.3.2	The contractor shall maintain the NICER Operations Data Base
1.3.3	The contractor shall be responsible for Systems Administration and IT Security in the NICER SMOC

2	**NGIMS**
2.1	**Mission Operations**

2.1.1	The contractor shall support NGIMS Instrument Flight Operations
2.1.2	The contractor shall perform NGIMS Mission Data Collection, Processing and Distribution in the NGIMS ITF
2.1.3	The contractor shall provide support for generation of the data products sent to the Planetary Data System (PDS) and to perform backup operational activities for NGIMS on an as-needed basis. Backup operational support is comprised of completing activities such as Level 0 data processing and Virtual Machine Language (VML) uplink file review, and attending MAVEN Project and MAVEN Science weekly meetings. Backup operational support will be required whenever other instrument operations members are unavailable to support completion of these activities. In order to satisfy PDS delivery requirements, the Contractor will draw upon direct experience working in the software development and science operations areas in support of the NGIMS experiment. The following tasks will need to be performed in preparation for data deliveries to the PDS every three months: • Modification of existing Python scripts as the processing of on-orbit experiment data evolves; • Maintenance of existing Python scripts required to expedite the PDS delivery process; • Generation of the required PDS-compliant orbit experiment files as well as their corresponding metadata represented using Extensible Markup Language (XML); • Delivery of the required NGIMS bundle to MAVEN's Science Data Center at the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado in Boulder for archival and submission to PDS; and • Review of the Science Data Center submission to PDS
2.2	**Sustaining Engineering**
2.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the NGIMS ITF
2.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the NGIMS ITF
2.2.3	The contractor shall perform Systems Administration and IT Security for the NGIMS ITF

3	**SPOCC**
3.1	**Sustaining Engineering**
3.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of missions leveraging the SPOCC infrastructure
3.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
3.1.3	The contractor shall provide Systems Administration and IT Security support

3.1.4	The contractor shall purchase specific computer equipment and software licenses (and provide labor for procurement, logistical support, and set-up) for the NASA MatISSE (Maturation of Instruments for Solar System Exploration) program, in support of future payload ops from the SPOCC
	Subtask 3 will be funded via multiple WBS elements (at least one from each of the SPOCC tenant missions) in order to pay for miscellaneous labor, upgrades and procurements that are generic, i.e., benefiting multiple (or potentially all) missions hosted in the SPOCC

4	**SGNOC**
4.1	**Ground System Development**
4.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software licenses and hardware for the SGNOC
4.1.2	The contractor shall provide Systems Administration and IT Security support for the SGNOC

5	**ATLAS**
5.1	**Ground System Sustaining Engineering**
5.1.1	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades in support of the ATLAS ISF
5.1.2	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the SPOCC
5.1.3	The contractor shall perform System Administration and IT Security for the ATLAS ISF

6	**DSCOVR**
6.1	**Mission Operations**
6.1.1	The contractor shall perform DSCOVR Mission Data Collection, Processing and Distribution in the DSOC
6.2	**Sustaining Engineering**
6.2.1	The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups in the DSOC
6.2.2	The contractor shall maintain Ground System Hardware and Software, including the purchase of software license updates and new hardware for upgrades to the DSOC
6.2.3	The contractor shall perform System Administration and IT Security for the DSOC

7	**LEMNOS**
7.1	**Mission Ground System Development**
7.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support. Mod 11 increases information technology and systems engineering support for the hosting of specific ground system software components on virtual machines developed in the "corporate cloud" or in the Amazon Web Services (AWS) GovCloud under the auspices of the Goddard Space Flight Center (GSFC) Enterprise Managed Cloud Computing (EMCC) office.
7.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations. Mod 08 increased the scope of this subtask to encompass the preliminary design of a laser pointing planning system for the Integrated Laser Communication Relay Demonstration (LCRD) Low-Earth Orbit (LEO) User Modem and Amplifier - Terminal (ILLUMA-T) International Space Station (ISS) payload, to be deployed in the Lasercom Terminal Support Console (LTSC) in the SPOCC at GSFC. This system will be based upon the existing Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System managed by the GSFC Attitude Control Systems Engineering Branch (Code 591).
7.2	**Mission Operations**
7.2.1	System Engineering: The Contractor shall provide the overarching engineering to ensure the complement of elements, systems, and subsystems interact effectively to achieve mission objectives. The Contractor shall coordinate interfaces, internal and external, to ensure compatibility and interoperability.

8	**WIEC**
8.1	**Mission Ground System Development**
8.1.1	Systems Engineering: The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support.
8.1.2	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations.

9	**XRISM/Resolve – *Subtask 9 will be descoped effective with Mod 12***
~~**9.1**~~	~~**I&T Ground System Deployment and Sustaining Engineering**~~
~~9.1.1~~	~~The Contractor shall provide information technology support including system and/or software installation; IP management; account management; and system backups for the XRISM/Resolve I&T facility.~~
~~9.1.2~~	~~The contractor shall perform System Administration, Network Administration, and IT Security support for the XRISM/Resolve I&T facility.~~

10	**CuSP Network Topology**
10.1	**Mission Ground System Development (Support Network Topology Definition)**
10.1.1	Engineering Studies: The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of mission operations. This mod (Mod 12) increases scope to include: 1) Radio Frequency (RF) engineering analysis to support the DSN interface and the frequency allocation/approval process with the National Telecommunications Information Agency (NTIA) for the **Iris** deep space transponder system on-board the CuSP CubeSat.

11	**L'Ralph**
11.1	**I&T Ground System IT Security**
11.1.1	The Contractor shall provide IT Security support to L'Ralph I&T facility, providing an ISSO (Information Systems Security Officer) and network administration support.
11.1.2	The Contractor shall modify the Distributed Virtual Environment for Secure Test & Operations (DVESTO) IT SSP (System Security Plan) as necessary to incorporate changes applicable to L'Ralph.
11.1.3	The Contractor shall work with GSFC Code 700 personnel and L'Ralph Systems Administrators on the annual SA&A (System Assessment & Authorization) process encompassing L'Ralph I&T systems.
11.1.4	The Contractor shall track Plans of Actions & Milestones based on scan and annual SA&A results.

12	**NOAA**
12.1	**Mission Ground System Development**
12.1.1	The Contractor shall upgrade the Integrated Trending and Plotting System (ITPS) software for the Deep Space Climate Observer (DSCOVR) control center operated by NOAA.
12.1.2	The Contractor shall upgrade the Mission Training Simulator (MTS) software for the Deep Space Climate Observer (DSCOVR) control center operated by NOAA.

13	SEAL
13.1	**Sustaining Engineering**
13.1.1	The contractor shall support the Surface and Exosphere Alterations by Landers (SEAL) investigation by providing engineering support to generate, align and communicate technical requirements during the refurbishment of the mass spectrometer on the Japanese Nozomi spacecraft.

14	ILLUMA-T
14.1	**Systems Engineering and Test**
14.1.1	Support personnel at the Massachusetts Institute of Technology Lincoln Laboratory (MIT-LL) to ensure the compliance of software interfaces with the written ISS requirements
14.1.2	Help to plan and coordinate interface testing with ISS hardware for the ILLUMA-T 1553, Ethernet, and optical interfaces
14.1.3	Help to plan and coordinate RAPTR (Remote Advanced Payload Test Rig) testing of the ILLUMA-T controller electronics with personnel at MIT-LL and NASA's Marshall Space Flight Center (MSFC)
14.1.4	Support the set-up and population of MSFC tools such as the PDL (Payload Data Library), EPC (Enhanced HOSC System Personal Computer) and GSE (Ground Support Equipment) Packets, and ensure that the ILLUMA-T inputs are compliant with MSFC / ISS requirements
14.1.5	Report regularly on status / issues to the ILLUMA-T team

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order. The Contractor will not have any responsibilities pertaining to facility property or building structure.

There is Government-Furnished Computer Software (GFCS) associated with this task which the contractor must handle in accordance with clause I.20 - GOVERNMENT-FURNISHED COMPUTER SOFTWARE AND RELATED TECHNICAL DATA.

The list of catalogued Government-Furnished Computer Software (GFCS) is as follows:

GFCS Description	GSC ID
Advanced Spacecraft Integration and System Test Software (ASIST), Front-End Data Systems/Digital History Data Store Software (FEDS/DHDS)	GSC-15832-1
Integrated Test and Operations System (ITOS)	GSC-16025-1
Consultative Committee for Space Data Systems (CCSDS) File Delivery Protocol (CFDP) Software Library, Version 3.1	GSC-14993-1
Integrated Trending and Plotting System (ITPS)	GSC-15532-1

Goddard Mission Services Evolution Center (GMSEC) Criteria Action Table (CAT)	GSC-17185-1
Goddard Mission Services Evolution Center (GMSEC) Alert Notification System Router (ANSR)	GSC-17233-1
Multi-Mission Three-Axis Stabilized Spacecraft (MTASS) Attitude Determination and Sensor Calibration System	GSC-15811-1
Goddard Dynamic Simulator (GDS)	GSC-15340-1

V. Travel

The Government currently envisions a total of 4 trips as part of this task mod (Mod 12):

(b) (4) [redacted]

VI. Material Procurement

There are no planned procurements associated with this task mod.

VII. Deliverables

The Contractor shall provide brief monthly status reports on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 54
Modification: 7
Task Name: Landsat 9 Mission Ops Facility Engineering and Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	07/17/2017	07/27/2018	Initial task order statement of work.
1	01/15/2018	07/27/2018	Addition of relocation of displaced systems
2	04/12/2018		Admin change
3	05/15/2018	07/27/2018	Addition of material procurement for the LMOC
4	07/29/2018	07/26/2019	2nd year for the Task includes material procurements for the LMOC and LSR/CSA
5	07/26/2019	07/27/2019	Admin change
6	07/27/2019	07/27/2019	Admin change
7	07/28/2019	07/25/2020	3rd year for the Task includes material procurements for the LSR/CSA

II. Task Overview

The Landsat 9 Mission Ops Facility Engineering and Support task provides technical engineering support for the build-out of a new Landsat Multi-satellite Operations Center (LMOC), associated Landsat Mission Equipment Rooms (LMER) in Buildings 32 and 14, a backup Landsat Multi-satellite Operations Center (bLMOC) in Building 14, a Launch Support Room (LSR), a space-segment Contractor Support Area (CSA), plus office space and additional support areas.

The Landsat 9 Mission is a joint undertaking by the National Aeronautics and Space Administration (NASA) and the Department of the Interior, United States Geological Survey (USGS). The L9 Observatory will provide the USGS with continuation of four decades of global terrestrial imaging by extending the measurement series previously carried out by the Landsat series of satellites. NASA will provide the space segment (spacecraft and instruments) and launch segment. The USGS will provide the ground segment, including the Landsat Mission Operations Center (LMOC), Landsat Ground Network (LGN), and science data processing, archival, and distribution. The USGS will also perform mission operations.

The location selected for the LMOC is the space currently occupied by the Landsat 7 Mission Operations Center (MOC) and the Landsat 8 Backup MOC (bMOC). The L7 MOC will permanently relocate into a space in Building 25. During the LMOC construction, the computer racks from the L8 bMOC will be re-located to Room C101 in

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Building 32 and the consoles will be temporarily relocated to EOS Training Area also in Building 32.

Landsat 9 was fast-tracked for a December 2020 launch.

III. Requirements

1	Landsat 9 Mission Ops Facility Engineering and Support
1.1	The contractor shall provide support for the preparation, design, and integration of facilities in support of mission operations activity for Landsat 9. The support includes identification of communications, power, and heating ventilation and air conditioning requirements. The support also includes the physical configuration and layout of the room(s), consoles, computer equipment and peripherals, clocks, visual displays, and other systems required for effective and efficient mission operations.
~~1.1a~~	~~The contractor shall provide support for the relocation of the L7 MOC. The support includes identification of: communications, power, heating ventilation and air conditioning requirements. This support also includes the physical configuration and layout of the: room(s), consoles, computer equipment and peripherals, clocks, visual displays, and other systems required for effective and efficient mission operations.~~
~~1.1b~~	~~The contractor shall provide support for the relocation of the L8 bMOC.~~
~~1.1c~~	~~The contractor shall support the closeout of the reconfiguration of the L7 MOC space in Bldg. 32 into the LMOC.~~
~~1.1d~~	~~The contractor shall provide support to complete the~~ conversion of Bldg. 32 ~~Rm. N202B into Office space.~~
~~1.1e~~	~~The contractor shall provide support start the build out of the LMER in Bldg. 14.~~
1.2	The contractor shall support the NASA/USGS team during the facility identification process and conceptual facility layout.
1.3	The contractor shall provide infrastructure build-out planning, as noted in this subsection, for areas identified for conceptual facility layout.
1.3.1	The contractor shall provide for collaboration/iteration of Operations Requirements and Facilities: - Review of identified facility area infrastructure and support resources - Review of conceptual facility layout - Identify and document infrastructure requirements to meet conceptual facility layout and generic control room and system needs
1.3.2	The contractor shall provide coordination with GSFC's Facilities Management Division: - Engage support teams (NASA Facilities Management Division, FMD) as needed for major facility change concepts to obtain insight and cost estimates - Develop Plan, ROM costs, and schedule for build-out activities - Deliver/present plan to NASA/USGS Team for inputs, changes and final approval

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1.4	The contractor shall implement the facility build-out plans, as noted in this subsection, for areas approved for build out.
1.4.1	The contractor shall organize and lead task kick-off meeting - Task Work Breakdown - Master schedule
1.4.2	The contractor shall coordinate funding WBS for support team's (FMD) identified activities.
1.4.3	The contractor shall generate work requests for support team (FMD) as needed.
1.4.4	The contractor shall schedule, coordinate, and manage implementation efforts: (includes tech meetings as needed) - Facility access - Support Team - Contractor Team - Building Management
1.4.5	The contractor shall perform implementation activities, such as installation of clocks, projectors, wall-mounted monitors and/or video screen displays, and other Government-furnished peripherals.
1.4.6	The contractor shall participate in related Working Group Meetings (as requested).
1.4.7	The contractor shall support final facility acceptance/transition to owner.
1.4.8	The contractor shall provide network distribution using CAT 6A shielded, via patch panels from each operational console and workstation area to the network switch rack. The patch panels to be used at each CDP location will be 12 ports CAT 6A shielded compliant.
1.4.9	The contractor shall provide redundant power to the LSR equipment as required.
1.5	The contractor shall provide facility monitoring and maintenance support activities as needed through pre-launch activities.
1.6	The contractor shall provide coordination with GSFC's Mission and Corporate Network Groups: - to ensure NASA/USGS/Contractor requirements are met - developing and submitting all NASA service requests (NISN CRQ's/Corporate ESD's) to appropriate Customer Service Rep (CSR) - to provide ROM costing to NASA/USGS team for inputs, changes, final approvals in order to manage the complete life cycle of service requests

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IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The Government will provide office area or support room will be provided for support personnel during the build-out.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

Local travel to procure materials for installations and maintenance activities, as needed.

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VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

The Contractor shall provide, as a minimum, the following materials items to support this task effort, as amended via Mod. 1:

(b) (4) [redacted]

The Contractor shall additionally provide the following materials items to support this task effort, as amended via Mod. 2:

(b) (4) [redacted]

The Contractor shall additionally provide the following materials items to support this task effort, as amended via Mod. 4 (per requirements 1.4.8 and 1.4.9).

(b) (4) [redacted]

The Contractor shall provide, as a minimum, the following materials items to support this task effort, as amended via Mod. 5:

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(b) (4) [redacted]

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The contractor shall consult the task monitor for details on the above required material items.

Note: All major procurements for HVAC, power, MOC furniture, etc. will be procured by the Government through the FMD/MOSI process, unless otherwise specifically stated.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The list of task deliverables should include:

ID	Deliverable Description	Due Date
1	Technical briefings and presentations	As requested
2	Status Reports	Weekly
3	Provide infrastructure configuration management and documentation in the form of "As Built" drawings (if applicable).	End of Task

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 55
Modification: 3
Task Name: Landsat 9 CTP & LSIMSS Support

GSMO-2 SOW Reference: 2.4.1 Telemetry, Command, and Control

I. Task Order History

Mod #	Start	End	Brief Description
0	08/14/2017	08/24/2018	Initial task order statement of work.
1	08/25/2018	02/22/2019	No Cost Extension by vendor
2	02/23/2019	07/27/2019	No Cost Extension by vendor
3	07/28/2019	07/25/2020	1 year task extension

II. Task Overview

1 Background

The goal of Landsat 9 (L9) is to continue the collection, archival, and distribution of multispectral imagery affording global, synoptic, and repetitive coverage of the Earth's land surfaces at a scale where natural and human-induced changes can be detected, differentiated, characterized, and monitored over time. The L9 goal is in keeping with the Landsat programmatic goals stated in the United States Code, Title 15 Chapter 82 "Land Remote Sensing Policy" (derived from the Land Remote Sensing Policy Act of 1992). This policy requires that the Landsat Program provide data into the future that are sufficiently consistent with previous Landsat data to allow the detection and quantitative characterization of changes in or on the land surface of the globe. L9 was conceived as a follow-on mission to the highly successful Landsat series of missions that have provided satellite coverage of the Earth's continental surfaces since 1972. The data from these missions constitute the longest continuous record of Earth's surface as seen from space.

L9 is intended to ensure that Landsat-like data be provided to the USGS National Satellite Land Remote Sensing Data Archive (NSLRSDA) for at least 5 years. The intent with the implementation of L9 is to leverage, to the extent practical, the designs and systems used for Landsat 8 (L8) for both the Space Segment and the Ground Segment.

2 Scope

The L9 Ground System is made up of the Ground Network Element (GNE), the Mission Operations Center (MOC), and the Data Processing and Archive System (DPAS). The GNE includes the Landsat Ground Network (LGN) ground stations that provide S-Band (command and telemetry) and X-Band (mission data) Radio Frequency (RF) communications with the observatory, Command & Telemetry Processor (CTP),

command and telemetry pass-through software, and Landsat Scalable Integrated Multi-Mission Simulation (LSIMSS), a ground support software. L9 GNE will leverage the heritage CTP (90% reuse expected) and LSIMSS (70% reuse expected) that have been used in L8 GS with necessary updates to meet L9 requirements. Even though CTP and LSIMSS are two applications that serve different purposes, they were both built using MISTE, a modular application development framework, for L8; therefore, they will continue to be treated as one development effort for L9.

The Landsat 9 CTP & LSIMSS Support task provides documentation and software development and/or software updates for L9 CTP & LSIMMSS software based on the heritage CTP & LSIMSS software from L8

III. Requirements

1	**CTP & LSIMSS Support Technical Requirements**
1.1	**Documentation and Review**
1.1.1	The contractor shall update and deliver applicable documentations (in section VII of this SOW) for each software release and/or as coordinated with TM
1.2	**Development, Integration and Test**
1.2.1	The contractor shall develop, test, integrate, and deliver software releases/patches according to the deliverable section of this SOW and/or as coordinated with TM.
1.2.2	The contractor shall perform configuration management and discrepancy tracking of CTP & LSIMSS software
1.2.3	The contractor shall participate in technical meetings, reviews, and technical working groups as coordinated with TM to communicate/coordinate/resolve technical issues with stakeholders.
1.2.4	The contractor shall use the Government Furnished Equipment (GFE), as defined in section IV of this SOW, for development, integration and test.
1.3	**User and Operation Support**
1.3.1	The contractor shall provide training for users in installing, configuring, running, and maintaining CTP&LSIMSS software.
1.3.2	The contractor shall support installation and integration of CTP & LSIMSS into user/operation infrastructure, especially with respect to network and information technology (IT) security.
1.3.3	The contractor shall support CTP & LSIMSS operation by providing oversight of execution and troubleshooting as needed.
2.1	**Project Management, Status, and Reporting**
2.1.1	The contractor shall develop and maintain an LSIMSS/CTP development/support schedule
2.1.2	The contractor shall develop resource usage estimates and profiles
2.1.3	The contractor shall manage work to schedules and resource usage profiles.

2.1.4	The contractor shall support execution of L9 project configuration management processes, including participation in change control and discrepancy boards as needed
2.1.5	The contractor shall provide a monthly status report of progress/work accomplished, schedule status/performance, and resource utilization.
2.1.6	The contractor shall participate in status meetings as coordinated with TM.

IV. Government Furnished Property/Facilities and Software

Government Furnished Property/Facilities Description
The Government will provide Mini-MOC virtual machine instance and necessary updates to test interface with MOC
The Government will provide translated L9 TLM/CMD database and necessary updates in the format specified in the LMOC to GNE ICD to test interface with MOC

V. Travel

It is anticipated that travel will be necessary to (b) (4) [redacted]

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

1 Documentation

All documents will adhere to NASA L9 project standards. The specific documentation delivery and date will be coordinated with TM

1.1 Software Development Management Plan (SDMP)

The SDMP specific policies, standards, and procedures for software development and management activities.

1.2 Software Integration and Test Plan (SITP)

The I&T plan describes the test procedures, data, and schedule that will be used to carry out subsystem I&T for releases and provides specific detail of the subsystem I&T processes

1.3 Software Requirements Specification (SRS)

The SRS provides the level 5 (L5) requirements for CTP&LSIMSS.

1.4 Software Design Document (SDD)

The SDD presents the subsystem design, includes descriptions of functions associated with the subsystem and describes the software design of the subsystem.

1.5 Status and Control Interface Control Document (ICD)

The ICD defines the interface between the CTP and the LGN station controller/automation system for status and control. The ICD also defines the serial data/clock interfaces between the CTP and the station S-Band equipment (exciter, telemetry receiver, etc.).

1.6 User's Guide (UG)

The UG provides a design and theory of operation summary, instructions on configuring and operating the LSIMSS/CTP, and information to maintain the LSIMSS/CTP for routine operations.

1.7 Test Cases

This document comprises the completed test procedures and data for the successful as-run test for each release. It incorporates any updates to the procedure that were made during testing, as well as the analysis and disposition of any test discrepancies

1.8 Version Description Document (VDD)

The VDD describes the modifications and changes incorporated in the described subsystem release, including the change requests and/or problem description that is being addressed.

1.9 Build Guide (BG)

The build guide defines the resources and procedure to build the subsystem starting with a basic host server. Both software and hardware system requirements are covered. Any customization of the basic operating system install is defined, including specific versions and packages to be installed.

2 Releases and Patches

The specific release/patch delivery and date will be coordinated with TM.
Release/patches will include

- Release software (executables, source code, configuration files, build files)

- Release documentation (As-run Test Cases and Test Report, VDD, Build guide, Users Guide)

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 57
Modification: 5
Task Name: Lucy Ground Systems and Operations Engineering Support

GSMO-2 SOW Reference: 2.4, 2.6, 3, 3.7.4

I. Task Order History

Mod #	Start	End	Brief Description
0	08/01/2017	07/27/2018	Initial task order statement of work.
1	03/01/2018	07/27/2018	Update to address additional scope.
2	05/01/2018	07/27/2018	Update to address additional scope.
3	7/28/2018	12/28/2018	Update to address additional scope.
4	12/29/2018	12/28/2019	Update to address additional scope.
5	12/29/2019	12/26/2020	Update to address needed scope.

II. Task Overview

This Ground Systems Engineering Support task provides mission lifecycle leadership and support for the Lucy mission, which is a space probe that will tour five Jupiter Trojans, asteroids which share Jupiter's orbit around the Sun, orbiting either ahead of or behind the planet.

III. Requirements

1	**Lucy Ground Systems Engineering Support**
1.1	**Ground Systems Management**
1.1.1	The contractor shall lead the Ground System (GS) Management effort including activities described in this subsection.
1.1.2	The contractor shall provide Project Management support such as updating Ground Element CDRL's, Service Agreements, and assisting with Ground Element Task Plans.
1.1.3	The contractor shall provide Interface Management by managing the ground to ground and ground to flight interface development. Assure all stakeholders have buy-in of interfaces. This effort includes overseeing the development and maintenance of: - MOC to NOC, MOC to SOC Interface Control Documents – interface documentation between the Level 4 subsystems that together comprise the Ground System. These ICDs describe in detail all aspects of the interfaces (products, files, software and data). - Flight to Ground ICD – interface documentation between the Lucy Spacecraft and the Ground Systems, including the DSN. It

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	describes the allocation of functions and communications formats and protocols. - DSN Operations ICD – interface documentation between the Lucy Project and the DSN. The final version of the DSN OICD is to be released prior to the Mission Operations Review. - Operations Interface Agreements/Software Interface Specifications (OIAs/SISs) – details the cadence and formats of agreed to product deliveries.
1.1.4	The contractor shall provide Schedule Management by working with Project scheduler and Element schedulers to maintain a properly detailed and manageable GDS schedule. Work with schedulers to avoid schedule conflicts, identify and address schedule issues and to maintain schedule
1.1.5	The contractor shall provide Risk Management by identifying risks, participate in and provide inputs to Project Level Risk Board.
1.1.6	The contractor shall provide SEWG and Mission Systems Support by providing status on Mission Systems and attending weekly SEWG meetings.
1.1.7	The contractor shall participate in mission reviews including executing the Ground Systems Critical Design Review (CDR) as well as planning for and executing the Mission Operations Review (MOR).
1.1.8	The contractor shall oversee the preparations of the Ground Elements in support of the Mission Operations Review.
1.1.9	The contractor shall lead the team through all pertinent reviews and help to organize and resolve action items.
1.1.10	The contractor shall participate in EPRs and TIMS as needed.
1.1.11	The contractor shall update the Project Protection Plan as required for Mission Milestones.
1.1.12	The contractor shall work with NASA's Communication Program (CP) in procuring NASCOM services needed for launch site ATLO support. NASCOM services to be documented in a CP Project Level Service Agreement.
1.1.13	The contractor shall be the Project point of contact for the maintenance of Service Agreements. This includes: - Deep Space Network (DSN) Service Agreement – the documentation that identifies the scope of the DSN's support to the Lucy Project, including services to be provided. Maintenance of the DSA may be required. - MultiMission Ground Systems and Services (MGSS) Service Level Agreement – the documentation that identifies the scope of MGSS's support to the Lucy Project. Maintenance of the SLA may be required. - NASA Communications Program Project Service Level Agreement – the documentation that identifies the scope of NASCOM's support to the Lucy Project.
1.1.14	In addition to the Interface Management task identified in Section 1.1.3, the contractor shall maintain:

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	- Lucy to MGSS ICD – this document defines the interfaces and products necessary to conduct science and mission operations for the Lucy mission between the Lucy Flight Team (FT) and the Navigation and Ancillary Information Facility (NAIF) and Multimission Resource Scheduling Services (MRSS) organizations located at the Jet Propulsion Laboratory. - SOC to NOC ICD – interface documentation between the SOC to Navigation Operations Center (NOC). This ICD describes in detail all aspects of the interfaces (products, files, software and data). - Lucy to SSMO ICD - this document defines the mission interfaces the Lucy Ground Development team will establish to enable SSMO to perform its post-launch mission operations management functions
1.1.15	The contractor shall participate in the PI Monthly Reviews. This includes providing status on ConOps development as well as Ground Systems & Operations.
1.1.6	The contractor shall maintain a Ground System End to End drawing, capturing each Ground element and their components. The drawing is to document the interfaces between the elements as well as within each element.
1.1.17	The contractor shall maintain a Rec/Del list based on the Ground Elements' ICD products and integrated schedule.
1.1.18	The Contractor shall prepare for and participate in the launch site Ground Operations Working Groups.
1.2	**Ground System Requirements, V&V and Test Program**
1.2.1	The contractor shall lead the Lucy GDS V&V and Test Program including activities described in this subsection.
1.2.2	Lead the level 3 V&V efforts, support the level 2 V&V effort, and oversee the level 4 V&V effort. The contractor shall maintain the Ground System V&V Plan.
1.2.3	The contractor shall provide Requirement Management by working with Mission Systems in properly allocating level 2 requirements to the GS. Maintain level 3 requirements for the entire ground system. Requirement development to include verification methods and verification descriptions. Work with Elements in flowing level 3 requirements down to them.
1.2.4	The contractor shall implement the Ground Readiness Test (GRT) campaign. This includes preparations and executions of the GRTs scheduled for the current Period of Performance.
1.3	**Mission Operations**
1.3.1	The contractor shall provide Mission Operations support including activities described in this subsection.
1.3.2	The contractor shall conduct Ground/Operations Working Groups. This includes developing agenda and providing meeting minutes.
1.3.3	The contractor shall maintain the Ops Readiness Plan. The Final version is to be completed in support of MOR.
1.3.4	The contractor shall maintain the Mission Operations Concept Document. The MOCD describes the operations processes, roles and responsibilities

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	and operations timeline during each phase of the mission. The document is to be updated in preparations for MOR.
1.3.5	The contractor shall maintain the Lucy Mission Plan. This includes updating the document to reflect the latest agreed to concepts of operations.
1.3.6	The contractor shall oversee the updating of the Lockheed Martin Design Reference Mission (DRM). This includes working closely with LM on identifying the proper level of detail and content of the document.
	The contractor shall oversee the update of the Southwest Research Institute's Payload Operations Plan. This includes working closely with SwRI on identifying the proper level of detail and content of the document.
1.3.7	The contractor shall conduct ConOps Working Groups as needed. This includes developing agenda and providing meeting minutes.
1.3.8	The contractor shall provide the Cruise Phase Lead. The Lead is responsible for documenting all SC and instrument configurations and mission activities for Cruise Phase, including Earth Gravity Assist (EGA) operations. The Lead will direct and work with Subject Matter Experts in developing the Cruise Phase details.
1.3.9	The contractor shall prepare for and conduct ConOps TIMs that will focus on Launch, Cruise and Encounter phases. These TIMs are to be conducted in support of System Verification Tests (SVTs) development as needed.
1.4	**Instrument and Science Operations**
1.4.1	The contractor shall provide Instrument and Science Operations support including activities described in this subsection.
1.4.2	The contractor shall, from a level 3 perspective, manage interfaces between SwRI and the MOC and SwRI and the NOC.
1.5	**Lucy IT Security**
1.5.1	The contractor shall lead the Lucy IT Security activities described in this subsection.
1.5.2	The contractor shall provide support as the Lucy Information System Security Officer.
1.5.3	The contractor shall determine how Lucy will address current and new security controls and directives.
1.5.4	The contractor shall document security weaknesses and present recommendations to Project.
1.5.5	The contractor shall assist the Ground elements (NOC, MOC, SOC) in updating their System Security Plans as necessary.
1.5.6	The contractor shall assist the Ground elements (NOC, MOC, SOC) in developing the baselined versions of their Risk Assessment Reports (RARs).
1.5.7	The contractor shall be the point of contact for the NASA IT Security data repository (the Risk Information Security Compliance System).
1.5.8	The contractor shall perform internal assessments of all the NOC, MOC, SOC.
1.5.9	The contractor shall assist each Ground element (NOC, MOC, SOC) in activities required to obtain an Authorization to Process (ATP) NASA data. ATP's are anticipated in the period following this Period of Performance.

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1.5.10	The contractor shall be the liaison between mission elements and the Code 700 outreach initiative.
1.6	**Systems Level Testing**
1.6.1	The contractor shall participate in RF Compatibility Test planning meetings as well as supporting the DSN Compatibility Test Trailer (CTT) test at Lockheed Martin.
1.6.2	The contractor shall support the planning of and the execution of System Verification Tests (SVTs). This includes actively participating in the SVT Working Groups, verifying test products are flight-like and that the tests are designed to validate the mission's ConOps. The contractor shall also witness the execution of the tests.

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IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel for Mod 1 should include:

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VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 60
Modification: 10
Task Name: JPSS Ground Project – B2.0 Deployed Systems Team (DST)

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod#	Start	End	Brief Description
0	9/1/2017	4/27/2018	Initial task order statement of work.
1	1/27/2018	4/27/2018	Addition of [redacted] for MDL work.
2	2/24/2018	4/26/2019	Addition of [redacted] ([redacted] Mission Ops Engineers) and 1 year POP extension
3	4/2/2018	4/26/2019	Addition of T&C position, create Subtask 2 (C3S)
4	10/1/2018	4/26/2019	Addition of Subtask 3, OSPO Operability Study
5	2/27/2019		Administrative Mod
6	4/27/2019	5/10/2019	Administrative Mod to add two weeks to task at no cost (NCE: No Cost Extension)
7	5/11/2019	4/25/2020	1 year POP extension including OSPO Operability Support
8	6/4/2019		Administrative Mod
9	7/18/2019		Administrative Mod
10	11/8/2019	4/25/2020	Add [redacted] for an Integration Lead

II. Task Overview

Deployed Systems Team (DST) – As a Lesson Learned from the Block 2 tech refresh effort, identifying the differences between design and usability early on reduces the risk/impact to cost and schedule associated with not meeting operational needs. The Deployed Systems Team, working with Raytheon and OSPO, provides support to reduce the operational gap between engineering development and operational use. The DST will provide technical oversight of all operational systems, perform assessments of operational functionality for future releases, and provide operational assistance throughout the engineering lifecycle. This team will support design and development reviews regarding future block releases and capability also ensuring the operability of the system prior to transitioning to OSPO. The DST will complete all remaining B1.2 data migration and ops product maturation readiness activities to sustain operational readiness. This team will also ensure updates to operational products continue to support operations in lieu of new software releases. Subtask 2 will be added to this effort in order to provide operational feedback to NASA C3S on required updates for future software releases that improve operations. Subtask 3 will be added to this effort in order to provide an OSPO operability study. This extension through April 2020 includes all ongoing efforts, addition of a short-term (3 month) C3S Deconfliction Tool effort, and implementation of the results and detailed planning from the OSPO operability study.

III. Requirements

Requirements are embedded in the Subtask and descriptions below.

Subtask 1:

[1.1] Deputy Deployed Systems Manager (DDSM) – ***The contractor shall*** *support the Deployed Systems Manager as well as ensure the day to day activities within the deployed systems team are properly managed. Support WRRP's, DRB's and ICB's when needed to provides appropriate feedback to NASA C3 and IDP dealing with future builds*

- DST coordination
- Supports / attends the C3S, IDPS, and Flight Product (OSPO) WRRPs when needed
- Supports / attends the MRDRBs and C3S and IDPS ICBs
- Backfills for the DSM
- Oversee the remaining B2.0 TTO activities (data migration and product maturation); this is a short-term task

[1.2] Ground Configuration Engineer – ***The contractor shall*** *work with the Ground Project IPT's ensuring ground system architecture and configuration changes do not adversely affect nominal operations. This role includes awareness of build and hardware deployments to assure they do not affect nominal operations.*

- Interfaces with Ground IPT leads for planned upgrades, changes with respect to Ops
- Participate in Daily MODEM
- Participate in weekly C3 and IDP WRRP's to understand work to be performed
- Maintains cognizance of the planned maintenance and development release contents and schedules as well as security patching / implications
- Provide feedback / consultation to the IPTs for the entire Ground System (includes GRAVITE, Simulators, and FTS)
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.3] B2.0 Deployed System Team Schedule and Technical Support – ***The contractor shall*** *oversee the overall engineering administrative tasks for the Deployed Systems Team. Aware of schedules for new builds and deployments, ensuring team members are aware of team and ground project information, ensuring OSPO is aware of any schedule changes or conflicts, and possibly supporting any WRRP's or DRB's providing the appropriate operational engineering guidance.*

- Maintains a DSM schedule of events
- Provide technical advice to DSM and DDSM dealing with Deployed System Team activities and B2.0 builds and enhancements
- Generates/maintains the calendar (tool) of all events and activities in support of the RMM
- Track the burndown of B2.0 workarounds to ensure future builds are addressing OSPO concerns to eliminate the need for the assisted GSE position

- Coordinate / completes the remaining B2.0 TTO activities (data migration and product maturation); this is a short-term task
- Maintain the B2.0 Deployed System Teams Risks and Issues
- Maintain the B2.0 Deployed System Teams weekly and monthly

[1.4] Mission Ops Engineer (x5) – ***The contractor shall*** *support engineering and/or flight operations for JPSS supported and managed missions on B2.0 and beyond. Provide operational feedback to sustainment on required updates for future software releases that improve operations. Works with Raytheon C3/IDP and NASA C3/IDP on testing new builds to ensure they are satisfactory for mission operations and engineering. Attend appropriate WRRP's and DRB's to stay. Works with NOAA mission planning to assist in issues regarding production of weekly schedule products, development and updates to MM tasks, development and updates for job enhancement tools. Attend appropriate WRRP's*

- Understand the Flight Ops concept by the OSPO MOT dealing with S/C Activities
    - SOTC, CLG(DAS's), STA, OO
- Understand the Flight Ops concept by the OSPO MOT dealing with Instrument Activities
    - SOTC, CLG(DAS's), STA
- Understand the Mission Planning concept by the OSPO MP dealing with building DAS's and scheduling of Ground Stations
    - MM & Basic OO
- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Understand WR's written by OSPO to provide appropriate details to DDSM for feedback to ICB's
- Participates in the B2.x and B3.x development efforts
- Support SEIT and NASA C3 teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove MOT Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.5] Ground System Engineer (x2) – ***The contractor shall*** *oversee functionality of ground system interfaces and networks. Work with Raytheon C3 and NASA C3 to verify fixes in new builds are acceptable for OSPO Operations. Ensure system updates (WRs), and build deploys are done with the least impact to ongoing operations. Attend appropriate WRRP's and DRB's to stay aware of issues and problems to provide proper feedback to Deputy Deployed Systems Manager. In addition, the GSEs will support the development efforts of B2.x and B3.x to ensure operational need is at the forefront of development activities. The GSEs will support via PDR, CDR, MPDR, etc. and targeted test activities.*

- Understand the concept by the OSPO Operators dealing with Operation activities
    - SOTC, GO, SGE, JSH, EM, CCM, Situational Awareness, Multi Mission activities

- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Work with the Ground Configuration Engineer to ensure continuation of Ops during building deploys, WR work offs, and patching activities
- Participates in the B2.x and B3.x development efforts (Provide operational perspective / feedback through the design and development)
- Understand WR's written by OSPO or MST C3 GSE to provide appropriate details to DDSM for feedback to ICB's
- Support SEIT and NASA C3 teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove Operations Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Work with MST to address issues and concerns that Operations may encounter
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.6] Data Processing Engineer (x2) – ***The contractor shall*** *work with NASA and RTN IDPS teams to ensure any system updates (WRs), reconfigurations and build deploys are done in a manner to least impact ongoing data capture, processing and delivery. Also, these engineers will ensure the fixes and updates are acceptable for OSPO Operations. Attend appropriate WRRP's and DRB's to stay aware of issues and problems to provide proper feedback to Deputy Deployed Systems Manager.*

- Understand the concept by the OSPO Operators dealing with Data Processing activities
    - IDPS, CPERT, Mission Partners
- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Work with the Ground Configuration Engineer to ensure continuation of Ops during building deploys, WR work offs, and patching activities
- Participates in the B2.x and B3.x development efforts (Provide operational perspective / feedback through the design and development)
- Understand WR's written by OSPO or MST IDP GSE to provide appropriate details to DDSM for feedback to ICB's
- Support SEIT and NASA IDP teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove Operations Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Work with MST to address issues and concerns that Operations may encounter
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.7] Mission Data Leads (MDLs) (x5) – **The contractor shall** *monitor all mission data capture, processing and delivery. These engineers will troubleshoot and assist in the resolution of mission data related issues and support the closure of associated WRs and DRs. MDLs will cross-train in and support other DST functions as determined by the Deployed Systems Manager.*

- Monitor CPERT Report production and analyze for inconsistencies in data receipt, production and deliveries
- Track and resolve issues between IDPS & JSH and support anomaly resolution relevant to mission data processing and receipt
- Primary point of contact for Mission Partners regarding mission data receipt, planned maintenance, and other potential data interruptions
- Notify JPSS Project and OSPO of planned Mission Partner maintenance activities
- Review and validate relevant SOPs for operability
- Report daily mission ingest, processing and delivery status to the MODEM
- On call 24/7 for mission partner data related issues
- Cross-train in other DST functions

[1.8] **Flight Engineer – *The contractor shall*** *support Flight-related scope and activities including all mission operations teams and simulator activities across DST functions as determined by the Deployed Systems Manager***:**

- Utilize Operational Managed Mission simulators for DST validation activities associated with changes to new C3S Builds
- Understand and update Simulator scripts and SOPs as needed
- Document results associated with simulator-driven validation activities
- Understand the Flight Ops concept by the OSPO MOT dealing with simulation Activities
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (up to 2 trips/year to Aurora, CO, Local Travel: 3 trips/week to NSOF

[1.9] **DST Integration Lead – *The contractor shall*** *facilitate communications between ground projects IPTs ensuring any updates or changes to the deployed system properly considers operations and future missions:*

- Collaborate with JPSS ground system users to improve, develop and streamline processes to support and execute sustainment activities
- Identify and perform trade analysis to support an evolving concept of operations for current and future JPSS managed missions
- Review current and future requirement and interface updates to ensure operational needs are properly assessed and leads to timely sell off of requirements
- Improve the communication and operability between sustainment organizations within NASA and NOAA
- Develop a process for enhancing Integration and test activities in support of build deployments

Subtask 2:
C3S Subtask

[2.1] Telemetry and Command Subject Matter Expert – ***The contractor shall*** *support engineering and/or flight operations for JPSS supported and managed missions on B2.0 and beyond. Provide operational feedback to NASA C3S on required updates for future software releases that improve operations. Works with Raytheon C3S on designing, implementing, and testing new builds to ensure they are satisfactory for mission operations and engineering. Provides domain-specific subject matter expertise to NASA C3S to ensure that developed and deployed systems meet mission operational needs.*

- Understand the Flight Ops concept by the OSPO MOT dealing with S/C Activities related to T&C (SOTC, CLG(DAS's), STA)
- Review and provide input on DRs to ensure that problem reports are fairly represented and successfully adjudicated
- Participate in the NASA lifecycle review process
- Witness formal verification test events when applicable
- Participate in trade studies related to T&C
- Participate in the development of future builds
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[2.2] C3S Operations Engineer– ***The contractor shall*** *provide systems engineering support for Ground Segment for operations testing oversight. Specifically:*

- Provide engineering support for interface support with spacecraft, instruments, space segment, and ground segment.
- Support the system operations testing activities.
- Support document reviews, preparation for proper implementation and verification of systems.
- Identify risks/issues and assist in the effort to mitigate concerns, especially for operations.
- Develop, maintain the tools necessary to assist in anomaly evaluation and resolution.

[2.3] Operations Programmer- ***The contractor shall p***rovide short-term (3 month) dedicated support to accomplish the following:

- Augment the existing "DST deconfliction tool" to include the following capabilities:
    - De-conflict NOAA-20 and DMSP in-views by offloading NOAA-20 contracts to Troll where feasible.
    - Produce downtime information for Mission Management to allow deconflicted schedule information from DMSP's scheduling system to be utilized.
    - Correctly utilize Ka-Band in-views

- Augment Mission Management tasks to utilize the downtime information in 1b
- Coordinate and conduct test activity to ensure that new operational products are mature

Subtask 3:
OSPO Operability Subtask

The contractor shall *complete final study observations and develop detailed recommendations and plans to improve DST, OSPO, and CGS Contractor communications, documentation, technical processes, associated business processes and training. The contractor shall propose an implementation plan and timetable including a set of products and other deliverables such as dashboards. Work performance for this subtask will be integrated into existing and evolving teams and may encompass any of the following areas as determined by Ground Segment Project Management and the Deployed Systems Team:*

- *Communication and Information Management*
- *Configuration Management and Business Process Documentation*
- *Mission Planning and Scheduling*
- *Ground and Flight Monitoring, Anomaly Reporting, and Trend Analysis.*

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

[redacted]

Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VI. Deliverables

Deliverables:

- Resource Management Tool
- Operational Build Checkout Plan
- Deploy Readiness Report
- Monthly DR work off report
- Monthly status report
- Weekly status report

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 60
Modification: 10
Task Name: JPSS Ground Project – B2.0 Deployed Systems Team (DST)

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod#	Start	End	Brief Description
0	9/1/2017	4/27/2018	Initial task order statement of work.
1	1/27/2018	4/27/2018	Addition of [redacted] for MDL work.
2	2/24/2018	4/26/2019	Addition of [redacted] ([redacted] Mission Ops Engineers) and 1 year POP extension
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9	7/18/2019		Administrative Mod
10	11/8/2019	4/25/2020	Add [redacted] for an Integration Lead

II. Task Overview

Deployed Systems Team (DST) – As a Lesson Learned from the Block 2 tech refresh effort, identifying the differences between design and usability early on reduces the risk/impact to cost and schedule associated with not meeting operational needs. The Deployed Systems Team, working with Raytheon and OSPO, provides support to reduce the operational gap between engineering development and operational use. The DST will provide technical oversight of all operational systems, perform assessments of operational functionality for future releases, and provide operational assistance throughout the engineering lifecycle. This team will support design and development reviews regarding future block releases and capability also ensuring the operability of the system prior to transitioning to OSPO. The DST will complete all remaining B1.2 data migration and ops product maturation readiness activities to sustain operational readiness. This team will also ensure updates to operational products continue to support operations in lieu of new software releases. Subtask 2 will be added to this effort in order to provide operational feedback to NASA C3S on required updates for future software releases that improve operations. Subtask 3 will be added to this effort in order to provide an OSPO operability study. This extension through April 2020 includes all ongoing efforts, addition of a short-term (3 month) C3S Deconfliction Tool effort, and implementation of the results and detailed planning from the OSPO operability study.

III. Requirements

Requirements are embedded in the Subtask and descriptions below.

Subtask 1:

[1.1] Deputy Deployed Systems Manager (DDSM) – ***The contractor shall*** *support the Deployed Systems Manager as well as ensure the day to day activities within the deployed systems team are properly managed. Support WRRP's, DRB's and ICB's when needed to provides appropriate feedback to NASA C3 and IDP dealing with future builds*

- DST coordination
- Supports / attends the C3S, IDPS, and Flight Product (OSPO) WRRPs when needed
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- Oversee the remaining B2.0 TTO activities (data migration and product maturation); this is a short-term task

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- Interfaces with Ground IPT leads for planned upgrades, changes with respect to Ops
- Participate in Daily MODEM
- Participate in weekly C3 and IDP WRRP's to understand work to be performed
- Maintains cognizance of the planned maintenance and development release contents and schedules as well as security patching / implications
- Provide feedback / consultation to the IPTs for the entire Ground System (includes GRAVITE, Simulators, and FTS)
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.3] B2.0 Deployed System Team Schedule and Technical Support – ***The contractor shall*** *oversee the overall engineering administrative tasks for the Deployed Systems Team. Aware of schedules for new builds and deployments, ensuring team members are aware of team and ground project information, ensuring OSPO is aware of any schedule changes or conflicts, and possibly supporting any WRRP's or DRB's providing the appropriate operational engineering guidance.*

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- Generates/maintains the calendar (tool) of all events and activities in support of the RMM
- Track the burndown of B2.0 workarounds to ensure future builds are addressing OSPO concerns to eliminate the need for the assisted GSE position

- Coordinate / completes the remaining B2.0 TTO activities (data migration and product maturation); this is a short-term task
- Maintain the B2.0 Deployed System Teams Risks and Issues
- Maintain the B2.0 Deployed System Teams weekly and monthly

[1.4] Mission Ops Engineer (x5) – ***The contractor shall*** *support engineering and/or flight operations for JPSS supported and managed missions on B2.0 and beyond. Provide operational feedback to sustainment on required updates for future software releases that improve operations. Works with Raytheon C3/IDP and NASA C3/IDP on testing new builds to ensure they are satisfactory for mission operations and engineering. Attend appropriate WRRP's and DRB's to stay. Works with NOAA mission planning to assist in issues regarding production of weekly schedule products, development and updates to MM tasks, development and updates for job enhancement tools. Attend appropriate WRRP's*

- Understand the Flight Ops concept by the OSPO MOT dealing with S/C Activities
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- Understand the Flight Ops concept by the OSPO MOT dealing with Instrument Activities
    - SOTC, CLG(DAS's), STA
- Understand the Mission Planning concept by the OSPO MP dealing with building DAS's and scheduling of Ground Stations
    - MM & Basic OO
- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Understand WR's written by OSPO to provide appropriate details to DDSM for feedback to ICB's
- Participates in the B2.x and B3.x development efforts
- Support SEIT and NASA C3 teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove MOT Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

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- Understand the concept by the OSPO Operators dealing with Operation activities
    - SOTC, GO, SGE, JSH, EM, CCM, Situational Awareness, Multi Mission activities

- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Work with the Ground Configuration Engineer to ensure continuation of Ops during building deploys, WR work offs, and patching activities
- Participates in the B2.x and B3.x development efforts (Provide operational perspective / feedback through the design and development)
- Understand WR's written by OSPO or MST C3 GSE to provide appropriate details to DDSM for feedback to ICB's
- Support SEIT and NASA C3 teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove Operations Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Work with MST to address issues and concerns that Operations may encounter
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.6] Data Processing Engineer (x2) – ***The contractor shall*** *work with NASA and RTN IDPS teams to ensure any system updates (WRs), reconfigurations and build deploys are done in a manner to least impact ongoing data capture, processing and delivery. Also, these engineers will ensure the fixes and updates are acceptable for OSPO Operations. Attend appropriate WRRP's and DRB's to stay aware of issues and problems to provide proper feedback to Deputy Deployed Systems Manager.*

- Understand the concept by the OSPO Operators dealing with Data Processing activities
    - IDPS, CPERT, Mission Partners
- Review the existing Open Urgent and Routine MRDR's to determine if any can be closed or transitioned to Ground DR's
- Work with the Ground Configuration Engineer to ensure continuation of Ops during building deploys, WR work offs, and patching activities
- Participates in the B2.x and B3.x development efforts (Provide operational perspective / feedback through the design and development)
- Understand WR's written by OSPO or MST IDP GSE to provide appropriate details to DDSM for feedback to ICB's
- Support SEIT and NASA IDP teams with their activities to provide an Ops viewpoint
- Ensure when new builds are ready to be deployed that the appropriate steps were taken to either add, update or remove Operations Ops products, workarounds and tools.
- Create appropriate DR's when needed to address WR's written by OSPO
- Work with MST to address issues and concerns that Operations may encounter
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[1.7] Mission Data Leads (MDLs) (x5) – **The contractor shall** *monitor all mission data capture, processing and delivery. These engineers will troubleshoot and assist in the resolution of mission data related issues and support the closure of associated WRs and DRs. MDLs will cross-train in and support other DST functions as determined by the Deployed Systems Manager.*

- Monitor CPERT Report production and analyze for inconsistencies in data receipt, production and deliveries
- Track and resolve issues between IDPS & JSH and support anomaly resolution relevant to mission data processing and receipt
- Primary point of contact for Mission Partners regarding mission data receipt, planned maintenance, and other potential data interruptions
- Notify JPSS Project and OSPO of planned Mission Partner maintenance activities
- Review and validate relevant SOPs for operability
- Report daily mission ingest, processing and delivery status to the MODEM
- On call 24/7 for mission partner data related issues
- Cross-train in other DST functions

[1.8] **Flight Engineer – *The contractor shall*** *support Flight-related scope and activities including all mission operations teams and simulator activities across DST functions as determined by the Deployed Systems Manager***:**

- Utilize Operational Managed Mission simulators for DST validation activities associated with changes to new C3S Builds
- Understand and update Simulator scripts and SOPs as needed
- Document results associated with simulator-driven validation activities
- Understand the Flight Ops concept by the OSPO MOT dealing with simulation Activities
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (up to 2 trips/year to Aurora, CO, Local Travel: 3 trips/week to NSOF

[1.9] **DST Integration Lead – *The contractor shall*** *facilitate communications between ground projects IPTs ensuring any updates or changes to the deployed system properly considers operations and future missions:*

- Collaborate with JPSS ground system users to improve, develop and streamline processes to support and execute sustainment activities
- Identify and perform trade analysis to support an evolving concept of operations for current and future JPSS managed missions
- Review current and future requirement and interface updates to ensure operational needs are properly assessed and leads to timely sell off of requirements
- Improve the communication and operability between sustainment organizations within NASA and NOAA
- Develop a process for enhancing Integration and test activities in support of build deployments

Subtask 2:
C3S Subtask

[2.1] Telemetry and Command Subject Matter Expert – ***The contractor shall*** *support engineering and/or flight operations for JPSS supported and managed missions on B2.0 and beyond. Provide operational feedback to NASA C3S on required updates for future software releases that improve operations. Works with Raytheon C3S on designing, implementing, and testing new builds to ensure they are satisfactory for mission operations and engineering. Provides domain-specific subject matter expertise to NASA C3S to ensure that developed and deployed systems meet mission operational needs.*

- Understand the Flight Ops concept by the OSPO MOT dealing with S/C Activities related to T&C (SOTC, CLG(DAS's), STA)
- Review and provide input on DRs to ensure that problem reports are fairly represented and successfully adjudicated
- Participate in the NASA lifecycle review process
- Witness formal verification test events when applicable
- Participate in trade studies related to T&C
- Participate in the development of future builds
- Occasionally attend Ground Projects PMR's and possible Build development events in Aurora (Possible Travel)

[2.2] C3S Operations Engineer– ***The contractor shall*** *provide systems engineering support for Ground Segment for operations testing oversight. Specifically:*

- Provide engineering support for interface support with spacecraft, instruments, space segment, and ground segment.
- Support the system operations testing activities.
- Support document reviews, preparation for proper implementation and verification of systems.
- Identify risks/issues and assist in the effort to mitigate concerns, especially for operations.
- Develop, maintain the tools necessary to assist in anomaly evaluation and resolution.

[2.3] Operations Programmer- ***The contractor shall p***rovide short-term (3 month) dedicated support to accomplish the following:

- Augment the existing "DST deconfliction tool" to include the following capabilities:
    - De-conflict NOAA-20 and DMSP in-views by offloading NOAA-20 contracts to Troll where feasible.
    - Produce downtime information for Mission Management to allow deconflicted schedule information from DMSP's scheduling system to be utilized.
    - Correctly utilize Ka-Band in-views

- Augment Mission Management tasks to utilize the downtime information in 1b
- Coordinate and conduct test activity to ensure that new operational products are mature

Subtask 3:
OSPO Operability Subtask

The contractor shall *complete final study observations and develop detailed recommendations and plans to improve DST, OSPO, and CGS Contractor communications, documentation, technical processes, associated business processes and training. The contractor shall propose an implementation plan and timetable including a set of products and other deliverables such as dashboards. Work performance for this subtask will be integrated into existing and evolving teams and may encompass any of the following areas as determined by Ground Segment Project Management and the Deployed Systems Team:*

- *Communication and Information Management*
- *Configuration Management and Business Process Documentation*
- *Mission Planning and Scheduling*
- *Ground and Flight Monitoring, Anomaly Reporting, and Trend Analysis.*

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

[redacted]

Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VI. Deliverables

Deliverables:

- Resource Management Tool
- Operational Build Checkout Plan
- Deploy Readiness Report
- Monthly DR work off report
- Monthly status report
- Weekly status report

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 61
Modification: 3
Task Name: Space Geodesy Network Development

GSMO-2 SOW Reference: 2.2, 2.3, 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	01/22/18	01/21/19	Initial task order statement of work.
1	04/28/18	01/21/19	Added SOW elements 2.4-2.6 to subtask 2
2	04/28/18	01/25/19	Added scope to elements 2.5-2.6 of subtask 2
3	01/26/19	01/25/20	Task POP Extension. Added SOW element 1.1.5 to subtask 1 and associated deliverable. Deleted SOW element 1.5.3. Modified SOW element 2.2.1 for as-built documentation.

II. Task Overview

The Space Geodesy Project (SGP) encompasses the development, deployment, operation, and maintenance of a global network of space geodetic observatories consisting of geodetic and associated instruments, a data collection and transfer system, analysis, and the public dissemination of data products required to maintain a stable terrestrial reference system, measure the Earth Orientation Parameters, and support NASA's missions and the scientific community. The scope of this task is focused on support for the deployment of the next generation NASA Space Geodesy Network (NSGN) of collocated Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR), Global Navigation Satellite Systems (GNSS), and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) stations, and the development and implementation of the next generation Space Geodesy Network Operations.

The SGP has selected the McDonald Geophysical Observatory (MGO) located near Fort Davis, TX as a new NSGN site. This task includes integration support for the VLBI station at that site, recognizing that:

- The 12m VLBI antenna is being furnished and installed by InterTronic Solutions, Inc., under a separate NASA contract.
- The VLBI signal chain is being furnished and installed by MIT Haystack Observatory, under a separate NASA contract.
- The VLBI Field System software is being furnished and installed by NVI, Inc., under a separate NASA contract.
- The permanent GNSS receivers and geodetic antennas are being furnished and installed by JPL and UNAVCO.

- The MASER for MGO is currently being maintained under the NASA SCNS contract.

Subtask 1: Covers all work associated with the development of the next generation Space Geodesy Network Operations, including the development of the Space Geodesy Network Operations Center (SGNOC) and the development of the IT network architecture for NSGN sites.

Subtask 2: Covers all work associated with the integration of a new VLBI station at the MGO in Texas.

III. Requirements

The Contractor shall be governed, for this task order, by GSMO-2 Contract Clause H.9, 52.227-17, Rights in Data-Special Works (Dec 2007) as modified by NASA FAR Supplement 1852.227-17 and GSFC 52.227-93, which will be the applicable Data Rights Clause.

1	**NSGN Operations Development (Subtask 1)**
1.1	**NSGN Requirements and Architecture Development**
1.1.1	The contractor shall support the Government led requirements flow-down for the NSGN Operations.
1.1.2	The contractor shall support the Government led generation of the NSGN Concept of Operations.
1.1.3	The contractor shall support the Government led development and documentation of the NSGN architecture.
1.1.4	The contractor shall support the development and documentation of the interfaces between the different NSGN elements, particularly the stations to SGNOC interfaces.
1.1.5	The contractor shall develop a SGNOC implementation plan that outline activities that are needed to implement specific SGNOC capabilities to include a preliminary resource loaded schedule.
1.2	**SGNOC Prototype Monitoring System**
1.2.1	The contractor shall support the Government led level 5 requirements flow-down for the SGNOC.
1.2.2	The contractor shall develop the prototype SGNOC monitoring system and support the integration of other NASA contractor developed monitoring tools into the SGNOC.
1.2.3	The contractor shall support the development of data flow and display from NSGN stations, starting with those at the GGAO, KPGO, and MGO.
1.3	**SLR Data Operations Center Move to the SPOCC**
1.3.1	The contractor shall support the move of the SLR Data Operations Center to the SGNOC in the SPOCC.
1.3.2	The contractor shall provide VM development and operations environments with NASA required IT Security protection in place.

1.3.3	The contractor shall provide secure data connectivity to the SGP and partner SLR sites (domestic and foreign).
1.4	**IVSCC Move to the SPOCC**
1.4.1	The contractor shall support the move of the IVSCC to the SGNOC in the SPOCC.
1.4.2	The contractor shall provide VM development and operations environments with NASA required IT Security protection in place.
1.4.3	The contractor shall provide secure data connectivity to IVS member sites (domestic and foreign).
1.5	**NSGN Site IT Network Engineering**
1.5.1	The contractor shall provide network engineering support for the development and implementation of changes to the existing IT network topology at GGAO and KPGO that meet the NASA, GSFC, and SGP IT security requirements.
1.5.2	The contractor shall provide network engineering support for the development and implementation of the IT network architecture and new NSGN sites, starting with MGO.
~~1.5.3~~	~~The contractor shall provide network engineering support for the development and implementation of the IT network architecture for the Norwegian SGSLR station in Ny-Ålesund.~~

2	**MGO VLBI Station Implementation (Subtask 2)**
2.1	**Prepare Integration Activity Schedule**
2.1.1	The contractor shall prepare a MGO VLBI integration activity schedule listing all activities required for the MGO VLBI installation to include; equipment procurements, integration for basic functionality, deployment, installation and test of equipment at MGO, and support for the installations of VLBI elements provided under separate NASA contracts.
2.2	**Prepare MGO Electronic Equipment Shelter and Antenna Cable Route Drawings**
2.2.1	The contractor shall prepare diagrams showing how cables will be routed from source equipment to target equipment in the EES and the antenna. The contractor shall prepare drawings to show how cables (i.e., network, power and timing) are routed from (source) equipment to the appropriate EES equipment racks or antenna locations (i.e., target). Prepare as-implemented rack diagrams, drawings, floorplans and cable connection spreadsheets.
2.3	**Equipment List Development**
2.3.1	The contractor shall develop a bill of materials (BOM) with estimated pricing of equipment, cables racks, and materials necessary to support the implementation of the MGO VLBI station. These include items such as the network, operations console/workstation and displays, equipment racks and cables/connectors, test equipment, and tools.
2.4	**Equipment Checkout and Integration Laboratory**

2.4.1	Establish equipment receiving, integration, and equipment checkout laboratory at the contractor's facility. Install NASA provided equipment racks and equipment. Procure and install NASA approved network equipment from the BOM. Test equipment for basic functionality and connect equipment to provided VLBI elements to conduct basic connectivity testing.
2.5	**Deploy VLBI Equipment to MGO**
2.5.1	The contractor shall deploy VLBI equipment to MGO**.** Disassemble all equipment in the contractor's VLBI Integration Lab, prepare equipment for shipment and safely ship equipment to MGO IAW manufacturer specifications and guidelines. Move integration activity from the contractor's facility to MGO to install the equipment. Deploy the Hydrogen Maser from vendor facility to MGO.
2.6	**Equipment Installation and Checkout**
2.6.1	The contractor shall install racks, cables, and equipment at MGO EES and antenna. Work with local MGO team to stage equipment to be installed IAW with drawings and cable connection workbook. Work with VLBI elements to connect element equipment. Procure, as needed, small parts and materials necessary for the successful implementation of the MGO equipment. Support the installation of the MGO uninterruptible power supply. Support network and computer equipment installation and checkout at MGO. Provide portable facilities at MGO to support installation activities.

IV. Government Furnished Property/Facilities and Software

NASA is providing use of the SPOCC facility and associated infrastructure as a shared resource with other missions/projects.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose any material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order. The deliverables shall include:

Completed Phase 2 of VM environment, IT security and international data connectivity in the SPOCC for the SLR Data Operations Center (DOC) by August 2019.
MGO VLBI Integration Activity Schedule (baseline) by May 30, 2018 (complete)
MGO VLBI Floor Plans, Cable Run Drawings, Equipment Cable Listing Workbook by December 2018 (plan) and August 2019 (as-built).
Equipment and materials (BOM) list for the MGO VLBI Implementation by May 30, 2018 (complete)
SGNOC Implementation Plan by December 2019.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 61
Modification: 3
Task Name: Space Geodesy Network Development

GSMO-2 SOW Reference: 2.2, 2.3, 2.4, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
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IV. Government Furnished Property/Facilities and Software

NASA is providing use of the SPOCC facility and associated infrastructure as a shared resource with other missions/projects.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose any material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

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MGO VLBI Floor Plans, Cable Run Drawings, Equipment Cable Listing Workbook by December 2018 (plan) and August 2019 (as-built).
Equipment and materials (BOM) list for the MGO VLBI Implementation by May 30, 2018 (complete)
SGNOC Implementation Plan by December 2019.

End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	2
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 September 28 2019
Modification Period of Performance:	Apri 1 2019 September 28 2019
GSMO SOW Reference:	***Section 2.4.10***

Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

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Deleted: 2018

Deleted: October

Deleted: 2018

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I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

Mod #	Start	End	Brief Description
0	Feb 01 2018	Sept 28 2018	nitial task order statement of work
1	Sep 29 2018	Sept 28 2019	Modification 1 Task Extension to continue work for Build 2 0
2	April 1 2019	Sept 28 2019	Modification 2 Add work for Software Simulator

II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

The PACE Ground Segment (GS) ogica y consists of the PACE MOC the NEN Ground Stations the SN communication sate ites and the associated terrestria network connections The MOC is the sing e ocation for a observatory command and contro and hea th and safety monitoring The MOC ensures a science data is accounted for and de ivered to the PACE SDS The MOC is the foca point for a mission p anning and schedu ing coordination with the NEN and SN assets and generation of the observatory command oads necessary to execute the mission p an and the sustainment of the observatory

The MOS wi be used by the FOT in the PACE Mission operations contro center during pre aunch testing and post aunch operationa phases During pre aunch testing the MOS wi be used for certifying scripts training mission operations personne supporting mission simu ations and initia checkouts for end to end tests/ground system va idation During the post aunch time frame the MOS is used by the FOT to verify database configurations ground system scripts te emetry pages observatory operationa oads f ight software patches maneuver p ans and to train the operations team The MOS wi be ab e to process ground products such as Abso ute Time Sequences (ATS) and Re ative Time Sequences (RTS) as we as tab e oads

The MOS consists of a spacecraft simu ator instrument simu ators (if avai ab e as GFE) and simu ation of the requisite hardware and software necessary for the f ight software to execute The GN&C Dynamic simu ator i e Goddard Dynamic Simu ator (GDS) software mode s wi be integrated as part of MOS to provide environmenta simu ation Environmenta mode ing provided by GDS inc udes: GN&C therma mechanica power and RF Comm

A commands and te emetry except hardware commands are transferred to/from the "Spacecraft F ight Computer simu ator using a simu ated Spacecraft bus The software on y simu ation of the spacecraft f ight computer wi execute the unmodified f ight software binaries to process a commands te emetry and data fi es in an identica method as in the f ight system The MOS simu ates the spacecraft F ight Computer C&DH interfaces to the externa hardware such as GN&C functiona ity (using GDS mode s) therma mechanica interfaces power etc The Spacecraft simu ator wi a so communicate with instrument simu ator if instrument simu ators are acquired from the instrument vendors The MOS contro er wi contro the startup and fau t injection for this simu ator The fau t injection wi a so be ab e to be sent via ground system script commands The MOS contro er wi have the capabi ity of check pointing and restarting the simu ation

Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: This task is for the deve opment and de ivery of a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 2 be ow

III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS)

- a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s
- b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry
- c The MOS sha operate within a RHEL 7 virtua machine environment
- d The MOS sha execute the unmodified PACE spacecraft f ight software
- e The MOS sha simu ate the f ight busses
- f

A 2 Software Simu ator

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a The contactor sha deve op a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system

B. Management Reporting

The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

C. Contractor Controlled Property

The Contractor sha assist the GSMO 2 contract managers and property custodians in maintaining the overa ist of government owned property used by the Contractor on this Task Order This support inc udes preparation and cooperation during property audits

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

There are no Government furnished faci ities equipment or software associated with this Task Order

V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

The contractor deve oping the MOS software sha comp y with a processes estab ished for the Project and de iverab e products

App icab e requirements inc ude but not imited to:

1 NPR 7120 5E NASA Space F ight 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. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

ID	Deliverable Description	Due Date
1	MOS Engineering Peer Review (EPR) Sing e Design Review	Nov 2018
2	MOS Software & Source Code Bui d 1 0	Sept 2018
3	MOS Operations and Maintenance Guide	Aug 2019
4	MOS User s Guide	May 2019
5	MOS Version Description List	May 2019
6	MOS Test P an	Feb 2019
7	MOS Software & Source Code Bui d 2 0	May 2019
8	MOS Software & Source Code Bui d 3 0	May 2020
9	MOS Software & Source Code Bui d 3 1	Jan 2021
10	PACE Power System E ectronics (PSE) Software Simu ator Monitor Card	Sept 1 2019

The Contractor sha support contents of MOS bui ds as fo ows:

MOS	Contents of Bui d	Due Date
Build 1	DLEON: cFE Scheduler Housekeeping CI-lab TO-lab File Manager CFDP SpaceWire 1553 Bus Control Data Ingest (CSS, RWAs, Torquers, TAM) Attitude Control (Safehold only) SBnet IPLEON Loader IPLEON: cFE SBnet Prototype Science Ingest Prototype Science Downlink	**Sept. 2018**
Build 2	DLEON: Command Ingest Telemetry Output Health&Safety Stored Commanding Limit Checker Power Switching Tilt platform cmds (1553?) Data Ingest (GPS, Star Camera, Prop, SADE) Attitude Control (Nadir Pointing, Delta-V, Delta-H) SA Pointing Attitude Models	**May 2019**

	IPLEON: File Manager CFDP HK Data Storage Full Science Ingest Full Science Downlink	
Build 3	DLEON: Memory Manager Memory Dwell Memory Scrub Checksum File Commander Limit Checker Attitude Control (Lunar Cal, other modes?) IPLEON: Memory Manager Memory Dwell Memory Scrub Checksum	**May 2020**
Build 3.1	Bug Fixes. Not required if no bug fixes.	**Jan. 2021**

VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones Each review may require an Engineering Peer Review and Dry Run reviews

1	Jan 2017	Mission System Requirements Review (Completed)
2	May 2018	Ground Segment System Requirements Review (GS SRR) (Completed)
3	March 2019	Mission Preliminary Design Review (MPDR)
4	February 2019	Ground Segment Preliminary Design Review (GS PDR)
5	January 2020	Mission Critical Design Review (MCDR)
6	January 2020	Ground Segment Critical Design Review (GS CDR)
7	June 2021	Mission System Integration Review (MSIR)
8	August 2021	Mission Operations Readiness Review (MOR)
9	November 2022	Launch Readiness Date (LRD)

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End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	2
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 September 28 2019
Modification Period of Performance:	Apri 1 2019 September 28 2019
GSMO SOW Reference:	***Section 2.4.10***

Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

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I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

Mod #	Start	End	Brief Description
0	Feb 01 2018	Sept 28 2018	nitial task order statement of work
1	Sep 29 2018	Sept 28 2019	Modification 1 Task Extension to continue work for Build 2 0
2	April 1 2019	Sept 28 2019	Modification 2 Add work for Software Simulator

II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

The PACE Ground Segment (GS) ogica y consists of the PACE MOC the NEN Ground Stations the SN communication sate ites and the associated terrestria network connections The MOC is the sing e ocation for a observatory command and contro and hea th and safety monitoring The MOC ensures a science data is accounted for and de ivered to the PACE SDS The MOC is the foca point for a mission p anning and schedu ing coordination with the NEN and SN assets and generation of the observatory command oads necessary to execute the mission p an and the sustainment of the observatory

The MOS wi be used by the FOT in the PACE Mission operations contro center during pre aunch testing and post aunch operationa phases During pre aunch testing the MOS wi be used for certifying scripts training mission operations personne supporting mission simu ations and initia checkouts for end to end tests/ground system va idation During the post aunch time frame the MOS is used by the FOT to verify database configurations ground system scripts te emetry pages observatory operationa oads f ight software patches maneuver p ans and to train the operations team The MOS wi be ab e to process ground products such as Abso ute Time Sequences (ATS) and Re ative Time Sequences (RTS) as we as tab e oads

The MOS consists of a spacecraft simu ator instrument simu ators (if avai ab e as GFE) and simu ation of the requisite hardware and software necessary for the f ight software to execute The GN&C Dynamic simu ator i e Goddard Dynamic Simu ator (GDS) software mode s wi be integrated as part of MOS to provide environmenta simu ation Environmenta mode ing provided by GDS inc udes: GN&C therma mechanica power and RF Comm

A commands and te emetry except hardware commands are transferred to/from the "Spacecraft F ight Computer simu ator using a simu ated Spacecraft bus The software on y simu ation of the spacecraft f ight computer wi execute the unmodified f ight software binaries to process a commands te emetry and data fi es in an identica method as in the f ight system The MOS simu ates the spacecraft F ight Computer C&DH interfaces to the externa hardware such as GN&C functiona ity (using GDS mode s) therma mechanica interfaces power etc The Spacecraft simu ator wi a so communicate with instrument simu ator if instrument simu ators are acquired from the instrument vendors The MOS contro er wi contro the startup and fau t injection for this simu ator The fau t injection wi a so be ab e to be sent via ground system script commands The MOS contro er wi have the capabi ity of check pointing and restarting the simu ation

Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: This task is for the deve opment and de ivery of a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 2 be ow

III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS)

- a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s
- b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry
- c The MOS sha operate within a RHEL 7 virtua machine environment
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V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

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App icab e requirements inc ude but not imited to:

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VIII. Reference

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9	November 2022	Launch Readiness Date (LRD)

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End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	3
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

2.4.9 Information Technology Support*,The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the* ***preparation, review, and updating of IT security procedures and processes*** *to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.*

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I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

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3	July 1 2019	May 23 2020	Modification 3 Add work for Project Security Lead & reduce work on Subtask 2

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II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

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The MOS wi be used by the FOT in the PACE Mission operations contro center during pre aunch testing and post aunch operationa phases During pre aunch testing the MOS wi be used for certifying scripts training mission operations personne supporting mission

simu ations and initia checkouts for end to end tests/ground system va idation During the post aunch time frame the MOS is used by the FOT to verify database configurations ground system scripts te emetry pages observatory operationa oads f ight software patches maneuver p ans and to train the operations team The MOS wi be ab e to process ground products such as Abso ute Time Sequences (ATS) and Re ative Time Sequences (RTS) as we as tab e oads

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Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: This task is for the deve opment and de ivery of a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 2 be ow

Subtask 3: This task is for a PACE Project T Security position Specifica y the contractor wi ensure that the T Security tasks out ined in the PACE Project Security P an during each phase of the Systems Deve opment Life Cyc e are comp eted

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III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS) (Subtask 1)

a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s

b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry

c The MOS sha operate within a RHEL 7 virtua machine environment

d The MOS sha execute the unmodified PACE spacecraft f ight software

e The MOS sha simu ate the f ight busses

f

A 2 Software Simu ator (Subtask 2) (LOE Not to Exceed 16 hrs)

a The contactor sha deve op a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system This work sha be wrapped up by the end of June 2019

A 3 PACE Project Office T Security Lead (Subtask 3)

a The contractor sha ensure that T Security tasks out ined in the PACE Project Security P an during each phase of the T Security System Deve opment Life Cyc e are comp eted

b The contractor sha work with the Subordinate System SSO and Project Management Office Management and Segment Managers to ensure T security comp iance during a phases of the T Security System Deve opment Life Cyc e which are a igned to Project Reviews

c The contractor is responsib e for providing continuous monitoring artifacts to the Subordinate System SSOs that PACE is part of

d The contractor wi work with the Subordinate System SSOs to provide PACE artifacts and participate in the annua third party assessment of each Subordinate System

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B. Management Reporting

The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

C. Contractor Controlled Property

The Contractor sha assist the GSMO 2 contract managers and property custodians in maintaining the overa ist of government owned property used by the Contractor on this Task Order This support inc udes preparation and cooperation during property audits

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

There are no Government furnished faci ities equipment or software associated with this Task Order

V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

The contractor deve oping the MOS software sha comp y with a processes estab ished for the Project and de iverab e products

App icab e requirements inc ude but not imited to:

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3 GPR 7120 99 Goddard Project Management
4 GPR 7120 5A Goddard Systems Engineering
5 GPR 7150 4 Goddard Software Engineering Requirements

VI. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

ID	Deliverable Description	Due Date
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9	MOS Software & Source Code Bui d 3 1	Jan 2021
10	PACE Power System E ectronics (PSE) Software Simu ator Monitor Card	June 30 2019

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The Contractor sha support contents of MOS bui ds as fo ows:

MOS	Contents of Bui d	Due Date
Build 1	DLEON: cFE	**Sept. 2018** **Completed**

	Scheduler Housekeeping CI-lab TO-lab File Manager CFDP SpaceWire 1553 Bus Control Data Ingest (CSS, RWAs, Torquers, TAM) Attitude Control (Safehold only) SBnet IPLEON Loader IPLEON: cFE SBnet Prototype Science Ingest Prototype Science Downlink	
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Build 3.1	Bug Fixes. Not required if no bug fixes.	**April 2021**

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VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones
Each review may require an Engineering Peer Review and Dry Run reviews

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8	**August 2021**	**Mission Operations Readiness Review (MOR)**
9	**November 2022**	**Launch Readiness Date (LRD)**

End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	3
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

2.4.9 Information Technology Support*,The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the* ***preparation, review, and updating of IT security procedures and processes*** *to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.*

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I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

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A commands and te emetry except hardware commands are transferred to/from the "Spacecraft F ight Computer simu ator using a simu ated Spacecraft bus The software on y simu ation of the spacecraft f ight computer wi execute the unmodified f ight software binaries to process a commands te emetry and data fi es in an identica method as in the f ight system The MOS simu ates the spacecraft F ight Computer C&DH interfaces to the externa hardware such as GN&C functiona ity (using GDS mode s) therma mechanica interfaces power etc The Spacecraft simu ator wi a so communicate with instrument simu ator if instrument simu ators are acquired from the instrument vendors The MOS contro er wi contro the startup and fau t injection for this simu ator The fau t injection wi a so be ab e to be sent via ground system script commands The MOS contro er wi have the capabi ity of check pointing and restarting the simu ation

Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: This task is for the deve opment and de ivery of a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 2 be ow

Subtask 3: This task is for a PACE Project T Security position Specifica y the contractor wi ensure that the T Security tasks out ined in the PACE Project Security P an during each phase of the Systems Deve opment Life Cyc e are comp eted

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III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS) (Subtask 1)

a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s

b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry

c The MOS sha operate within a RHEL 7 virtua machine environment

d The MOS sha execute the unmodified PACE spacecraft f ight software

e The MOS sha simu ate the f ight busses

f

A 2 Software Simu ator (Subtask 2) (LOE Not to Exceed 16 hrs)

a The contactor sha deve op a software simu ation (SS) of the PACE Power System E ectronics (PSE) Monitor Card (MC) capab e of communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simu ator (GDS) host computer (De Xenon server) running the LynxOS rea time operating system This work sha be wrapped up by the end of June 2019

A 3 PACE Project Office T Security Lead (Subtask 3)

a The contractor sha ensure that T Security tasks out ined in the PACE Project Security P an during each phase of the T Security System Deve opment Life Cyc e are comp eted

b The contractor sha work with the Subordinate System SSO and Project Management Office Management and Segment Managers to ensure T security comp iance during a phases of the T Security System Deve opment Life Cyc e which are a igned to Project Reviews

c The contractor is responsib e for providing continuous monitoring artifacts to the Subordinate System SSOs that PACE is part of

d The contractor wi work with the Subordinate System SSOs to provide PACE artifacts and participate in the annua third party assessment of each Subordinate System

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B. Management Reporting

The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

C. Contractor Controlled Property

The Contractor sha assist the GSMO 2 contract managers and property custodians in maintaining the overa ist of government owned property used by the Contractor on this Task Order This support inc udes preparation and cooperation during property audits

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

There are no Government furnished faci ities equipment or software associated with this Task Order

V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

The contractor deve oping the MOS software sha comp y with a processes estab ished for the Project and de iverab e products

App icab e requirements inc ude but not imited to:

1 NPR 7120 5E NASA Space F ight Program and Project Management Requirements
2 NPR 7123 BNASA 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. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

ID	Deliverable Description	Due Date
1	MOS Engineering Peer Review (EPR) Sing e Design Review	Nov 2018
2	MOS Software & Source Code Bui d 1 0	Sept 2018
3	MOS Operations and Maintenance Guide	Aug 2019
4	MOS User s Guide	May 2019
5	MOS Version Description List	May 2019
6	MOS Test P an	Feb 2019
7	MOS Software & Source Code Bui d 2 0	May 2019
8	MOS Software & Source Code Bui d 3 0	May 2020
9	MOS Software & Source Code Bui d 3 1	Jan 2021
10	PACE Power System E ectronics (PSE) Software Simu ator Monitor Card	June 30 2019

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The Contractor sha support contents of MOS bui ds as fo ows:

MOS	Contents of Bui d	Due Date
Build 1	DLEON: cFE	**Sept. 2018** **Completed**

	Scheduler Housekeeping CI-lab TO-lab File Manager CFDP SpaceWire 1553 Bus Control Data Ingest (CSS, RWAs, Torquers, TAM) Attitude Control (Safehold only) SBnet IPLEON Loader IPLEON: cFE SBnet Prototype Science Ingest Prototype Science Downlink	
Build 2	DLEON: Command Ingest Telemetry Output Health&Safety Stored Commanding Limit Checker Power Switching Tilt platform cmds (1553?) Data Ingest (GPS, Star Camera, Prop, SADE) Attitude Control (Nadir Pointing, Delta-V, Delta-H) SA Pointing Attitude Models IPLEON: File Manager CFDP HK Data Storage Full Science Ingest Full Science Downlink	**June 2019**
Build 3	DLEON: Memory Manager Memory Dwell Memory Scrub Checksum File Commander Limit Checker Attitude Control (Lunar Cal, other modes?) IPLEON: Memory Manager Memory Dwell Memory Scrub Checksum	**July 2020**
Build 3.1	Bug Fixes. Not required if no bug fixes.	**April 2021**

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VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones
Each review may require an Engineering Peer Review and Dry Run reviews

1	**Jan 2017**	**Mission System Requirements Review (Completed)**
2	**May 2018**	**Ground Segment System Requirements Review (GS SRR) (Completed)**
3	**March 2019**	**Mission Preliminary Design Review (MPDR)**
4	**February 2019**	**Ground Segment Preliminary Design Review (GS PDR)**
5	**January 2020**	**Mission Critical Design Review (MCDR)**
6	**January 2020**	**Ground Segment Critical Design Review (GS CDR)**
7	**June 2021**	**Mission System Integration Review (MSIR)**
8	**August 2021**	**Mission Operations Readiness Review (MOR)**
9	**November 2022**	**Launch Readiness Date (LRD)**

End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	4
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

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Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

2.4.9 Information Technology Support *The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the* ***preparation, review, and updating of IT security procedures and processes*** *to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.*

I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

Mod #	Start	End	Brief Description
0	Feb 01 2018	Sept 28 2018	nitial task order statement of work
1	Sep 29 2018	Sept 28 2019	Modification 1 Task Extension to continue work for Build 2 0
2	April 1 2019	Sept 28 2019	Modification 2 Add work for Software Simulator
3	July 1 2019	May 23 2020	Modification 3 Add work for Project Security Lead & reduce work on Subtask 2
4	Sept 1 2019	May 23 2020	Modification 4 Add work for key fill tool

II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

The PACE Ground Segment (GS) ogica y consists of the PACE MOC the NEN Ground Stations the SN communication sate ites and the associated terrestria network connections The MOC is the sing e ocation for a observatory command and contro and hea th and safety monitoring The MOC ensures a science data is accounted for and de ivered to the PACE SDS The MOC is the foca point for a mission p anning and schedu ing coordination with the NEN and SN assets and generation of the observatory command oads necessary to execute the mission p an and the sustainment of the observatory

The MOS wi be used by the FOT in the PACE Mission operations contro center during pre aunch testing and post aunch operationa phases During pre aunch testing the MOS wi be

used for certifying scripts training mission operations personne supporting mission simu ations and initia checkouts for end to end tests/ground system va idation During the post aunch time frame the MOS is used by the FOT to verify database configurations ground system scripts te emetry pages observatory operationa oads f ight software patches maneuver p ans and to train the operations team The MOS wi be ab e to process ground products such as Abso ute Time Sequences (ATS) and Re ative Time Sequences (RTS) as we as tab e oads

The MOS consists of a spacecraft simu ator instrument simu ators (if avai ab e as GFE) and simu ation of the requisite hardware and software necessary for the f ight software to execute The GN&C Dynamic simu ator i e Goddard Dynamic Simu ator (GDS) software mode s wi be integrated as part of MOS to provide environmenta simu ation Environmenta mode ing provided by GDS inc udes: GN&C therma mechanica power and RF Comm

A commands and te emetry except hardware commands are transferred to/from the "Spacecraft F ight Computer simu ator using a simu ated Spacecraft bus The software on y simu ation of the spacecraft f ight computer wi execute the unmodified f ight software binaries to process a commands te emetry and data fi es in an identica method as in the f ight system The MOS simu ates the spacecraft F ight Computer C&DH interfaces to the externa hardware such as GN&C functiona ity (using GDS mode s) therma mechanica interfaces power etc The Spacecraft simu ator wi a so communicate with instrument simu ator if instrument simu ators are acquired from the instrument vendors The MOS contro er wi contro the startup and fau t injection for this simu ator The fau t injection wi a so be ab e to be sent via ground system script commands The MOS contro er wi have the capabi ity of check pointing and restarting the simu ation

Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: Comp eted

Subtask 3: This task is for a PACE Project T Security position Specifica y the contractor wi ensure that the T Security tasks out ined in the PACE Project Security P an during each phase of the Systems Deve opment Life Cyc e are comp eted

Subtask 4: This task is for the deve opment of the PACE Key Fi Bridge Too The PACE Key Fi Bridge Too enab es the transfer of COMSEC keys from the key oader to the PACE S/C and the PACE Ground Cryptographic Processors

Deleted: his task is or the development and delivery o a so tware simulation (SS) o the PACE Power System Electronics (PSE) Monitor Card (MC) capable o communication with the PACE LEON processor card over SpaceWire and running on the Goddard Dynamic Simulator (GDS) host computer (Dell Xenon server) running the LynxOS real-time operating system All deliverables and requirements must ollow the guidelines in NNG17HP02C See Section V Deliveries or delivery schedule See section A 2 below

III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS) **(Subtask 1.)**

a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s
b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry
c The MOS sha operate within a RHEL 7 virtua machine environment
d The MOS sha execute the unmodified PACE spacecraft f ight software
e The MOS sha simu ate the f ight busses

A 2 Software Simu ator **(Subtask 2)**

a Work Comp eted

A 3 PACE Project Office T Security Lead **(Subtask 3)**

a The contractor sha ensure that T Security tasks out ined in the PACE Project Security P an during each phase of the T Security System Deve opment Life Cyc e are comp eted
b The contractor sha work with the Subordinate System SSO and Project Management Office Management and Segment Managers to ensure T security comp iance during a phases of the T Security System Deve opment Life Cyc e which are a igned to Project Reviews
c The contractor is responsib e for providing continuous monitoring artifacts to the Subordinate System SSOs that PACE is part of
d The contractor wi work with the Subordinate System SSOs to provide PACE artifacts and participate in the annua third party assessment of each Subordinate System

A 4 PACE Key Fi Bridge Too **(Subtask 4)**

a The contractor sha deve op and de iver the PACE Key Fi Bridge Too (See Section V De iverab es for schedu e)
b The PACE Key Fi Bridge Too wi interface with the NASA owned Key oader for receipt of NASA or PACE COMSEC keys and transfers the keys without storing them to the PACE Mission f ight RF Transponders and Ground Cryptographic processors (GCPs)
c The PACE Key Fi Bridge Too wi convert the 32 bit CRC to 16 bit CRC for each PACE or NASA key during the transfer

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B. Management Reporting

The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

C. Contractor Controlled Property

The Contractor sha assist the GSMO 2 contract managers and property custodians in maintaining the overa ist of government owned property used by the Contractor on this Task Order This support inc udes preparation and cooperation during property audits

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

The Government wi furnish a Key Loader and connection cab es

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V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

The contractor deve oping the MOS software sha comp y with a processes estab ished for the Project and de iverab e products

App icab e requirements inc ude but not imited to:

1 NPR 7120 5E NASA Space F ight Program and Project Management Requirements
2 NPR 7123 BNASA 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. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

Meeting Title and Location	Duration	Dates	Travelers
(b) (4) [redacted]	[redacted]	[redacted]	[redacted]

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VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

ID	Deliverable Description	Due Date
1	MOS Engineering Peer Review (EPR) Sing e Design Review	Nov 2018
2	MOS Software & Source Code Bui d 1 0	Sept 2018
3	MOS Operations and Maintenance Guide	Aug 2019
4	MOS User s Guide	May 2019
5	MOS Version Description List	May 2019
6	MOS Test P an	Feb 2019

7	MOS Software & Source Code Bui d 2 1	Apri 2020
8	MOS Software & Source Code Bui d 2 2	October 2020
9	MOS Software & Source Code Bui d 2 3	May 2021
9 1	MOC Software & Source Code Bui d 3 0 (Optiona Bui d)	Dec 2021
10	PACE Power System E ectronics (PSE) Software Simu ator Monitor Card (Comp eted)	June 30 2019
11	PACE Key Fi Bridge Too Engineering Unit	Sept 30 2019

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The Contractor sha support contents of MOS bui ds as fo ows:

MOS	Contents of Bui d	Due Date
Build 1	DLEON: cFE Scheduler Housekeeping CI-lab TO-lab File Manager CFDP SpaceWire 1553 Bus Control Data Ingest (CSS, RWAs, Torquers, TAM) Attitude Control (Safehold only) SBnet IPLEON Loader IPLEON: cFE SBnet Prototype Science Ingest Prototype Science Downlink	**Sept. 2018** **Completed**
Build 2	DLEON: Command Ingest Telemetry Output Health&Safety Stored Commanding Limit Checker Power Switching Tilt platform cmds (1553?) Data Ingest (GPS, Star Camera, Prop, SADE) Attitude Control (Nadir Pointing, Delta-V, Delta-H) SA Pointing Attitude Models IPLEON: File Manager CFDP HK Data Storage Full Science Ingest Full Science Downlink	**June 2019**

Build 3	DLEON: Memory Manager Memory Dwell Memory Scrub Checksum File Commander Limit Checker Attitude Control (Lunar Cal, other modes?) IPLEON: Memory Manager Memory Dwell Memory Scrub Checksum	**July 2020**
Build 3.1	Bug Fixes. Not required if no bug fixes.	**April 2021**

VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones Each review may require an Engineering Peer Review and Dry Run reviews

1	Jan 2017	Mission System Requirements Review (Completed)
2	May 2018	Ground Segment System Requirements Review (GS SRR) (Completed)
3	March 2019	Mission Preliminary Design Review (MPDR)
4	February 2019	Ground Segment Preliminary Design Review (GS PDR)
5	January 2020	Mission Critical Design Review (MCDR)
6	February 2020	Ground Segment Critical Design Review (GS & Mission CDR)
7	June 2021	Mission System Integration Review (MSIR)
8	November 2021	Mission Operations Readiness Review (MOR)
9	November 2022	Launch Readiness Date (LRD)

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End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	4
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

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Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

2.4.9 Information Technology Support *The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the* ***preparation, review, and updating of IT security procedures and processes*** *to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.*

I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

Mod #	Start	End	Brief Description
0	Feb 01 2018	Sept 28 2018	nitial task order statement of work
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II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

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The MOS consists of a spacecraft simu ator instrument simu ators (if avai ab e as GFE) and simu ation of the requisite hardware and software necessary for the f ight software to execute The GN&C Dynamic simu ator i e Goddard Dynamic Simu ator (GDS) software mode s wi be integrated as part of MOS to provide environmenta simu ation Environmenta mode ing provided by GDS inc udes: GN&C therma mechanica power and RF Comm

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Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: Comp eted

Subtask 3: This task is for a PACE Project T Security position Specifica y the contractor wi ensure that the T Security tasks out ined in the PACE Project Security P an during each phase of the Systems Deve opment Life Cyc e are comp eted

Subtask 4: This task is for the deve opment of the PACE Key Fi Bridge Too The PACE Key Fi Bridge Too enab es the transfer of COMSEC keys from the key oader to the PACE S/C and the PACE Ground Cryptographic Processors

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III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS) **(Subtask 1.)**

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A 2 Software Simu ator **(Subtask 2)**

a Work Comp eted

A 3 PACE Project Office T Security Lead **(Subtask 3)**

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d The contractor wi work with the Subordinate System SSOs to provide PACE artifacts and participate in the annua third party assessment of each Subordinate System

A 4 PACE Key Fi Bridge Too **(Subtask 4)**

a The contractor sha deve op and de iver the PACE Key Fi Bridge Too (See Section V De iverab es for schedu e)
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B. Management Reporting

The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

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

The Government wi furnish a Key Loader and connection cab es

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V. Material Procurement

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App icab e requirements inc ude but not imited to:

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2 NPR 7123 BNASA 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. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

Meeting Title and Location	Duration	Dates	Travelers
(b) (4) [redacted]	[redacted]	[redacted]	[redacted]

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VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

ID	Deliverable Description	Due Date
1	MOS Engineering Peer Review (EPR) Sing e Design Review	Nov 2018
2	MOS Software & Source Code Bui d 1 0	Sept 2018
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4	MOS User s Guide	May 2019
5	MOS Version Description List	May 2019
6	MOS Test P an	Feb 2019

7	MOS Software & Source Code Bui d 2 1	Apri 2020
8	MOS Software & Source Code Bui d 2 2	October 2020
9	MOS Software & Source Code Bui d 2 3	May 2021
9 1	MOC Software & Source Code Bui d 3 0 (Optiona Bui d)	Dec 2021
10	PACE Power System E ectronics (PSE) Software Simu ator Monitor Card (Comp eted)	June 30 2019
11	PACE Key Fi Bridge Too Engineering Unit	Sept 30 2019

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The Contractor sha support contents of MOS bui ds as fo ows:

MOS	Contents of Bui d	Due Date
Build 1	DLEON: cFE Scheduler Housekeeping CI-lab TO-lab File Manager CFDP SpaceWire 1553 Bus Control Data Ingest (CSS, RWAs, Torquers, TAM) Attitude Control (Safehold only) SBnet IPLEON Loader IPLEON: cFE SBnet Prototype Science Ingest Prototype Science Downlink	**Sept. 2018** **Completed**
Build 2	DLEON: Command Ingest Telemetry Output Health&Safety Stored Commanding Limit Checker Power Switching Tilt platform cmds (1553?) Data Ingest (GPS, Star Camera, Prop, SADE) Attitude Control (Nadir Pointing, Delta-V, Delta-H) SA Pointing Attitude Models IPLEON: File Manager CFDP HK Data Storage Full Science Ingest Full Science Downlink	**June 2019**

Build 3	DLEON: Memory Manager Memory Dwell Memory Scrub Checksum File Commander Limit Checker Attitude Control (Lunar Cal, other modes?) IPLEON: Memory Manager Memory Dwell Memory Scrub Checksum	**July 2020**
Build 3.1	Bug Fixes. Not required if no bug fixes.	**April 2021**

VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones Each review may require an Engineering Peer Review and Dry Run reviews

1	Jan 2017	Mission System Requirements Review (Completed)
2	May 2018	Ground Segment System Requirements Review (GS SRR) (Completed)
3	March 2019	Mission Preliminary Design Review (MPDR)
4	February 2019	Ground Segment Preliminary Design Review (GS PDR)
5	January 2020	Mission Critical Design Review (MCDR)
6	February 2020	Ground Segment Critical Design Review (GS & Mission CDR)
7	June 2021	Mission System Integration Review (MSIR)
8	November 2021	Mission Operations Readiness Review (MOR)
9	November 2022	Launch Readiness Date (LRD)

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End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	5
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

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Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

2.4.9 Information Technology Support *The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the* ***preparation, review, and updating of IT security procedures and processes*** *to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.*

I. Task Order History

Description of current modification (Modification 1): This is the initia task order statement of work for the PACE Mission Operations Simu ator (MOS) task

Mod #	Start	End	Brief Description
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4	Sept 1 2019	May 23 2020	Modification 4 Add work for key fill tool
5	Nov 15 2019	May 23 2020	Modification 5 adds requirements for a stand alone MOS w/ support to be delivered to the TEMPO group code 450 2

II. Background

The P ankton Aeroso C oud ocean Ecosystem (PACE) mission is a strategic c imate continuity mission that was defined in the 2010 document *Responding to the Challenge of Climate and Environmental Change: NASA s Plan for Climate Centric Architecture for Earth Observations and Applications from Space* (referred to as the "C imate nitiative) The C imate nitiative comp ements NASA s imp ementation of the Nationa Research Counci s Decada Survey of Earth Science at NASA NOAA and USGS entit ed *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*

The PACE Ground Segment (GS) ogica y consists of the PACE MOC the NEN Ground Stations the SN communication sate ites and the associated terrestria network connections The MOC is the sing e ocation for a observatory command and contro and hea th and safety monitoring The MOC ensures a science data is accounted for and de ivered to the PACE SDS The MOC is the foca point for a mission p anning and schedu ing coordination with the NEN and SN assets and generation of the observatory command oads necessary to execute the mission p an and the sustainment of the observatory

The MOS wi be used by the FOT in the PACE Mission operations contro center during pre aunch testing and post aunch operationa phases During pre aunch testing the MOS wi be used for certifying scripts training mission operations personne supporting mission simu ations and initia checkouts for end to end tests/ground system va idation During the post aunch time frame the MOS is used by the FOT to verify database configurations ground system scripts te emetry pages observatory operationa oads f ight software patches maneuver p ans and to train the operations team The MOS wi be ab e to process ground products such as Abso ute Time Sequences (ATS) and Re ative Time Sequences (RTS) as we as tab e oads

The MOS consists of a spacecraft simu ator instrument simu ators (if avai ab e as GFE) and simu ation of the requisite hardware and software necessary for the f ight software to execute The GN&C Dynamic simu ator i e Goddard Dynamic Simu ator (GDS) software mode s wi be integrated as part of MOS to provide environmenta simu ation Environmenta mode ing provided by GDS inc udes: GN&C therma mechanica power and RF Comm

A commands and te emetry except hardware commands are transferred to/from the "Spacecraft F ight Computer simu ator using a simu ated Spacecraft bus The software on y simu ation of the spacecraft f ight computer wi execute the unmodified f ight software binaries to process a commands te emetry and data fi es in an identica method as in the f ight system The MOS simu ates the spacecraft F ight Computer C&DH interfaces to the externa hardware such as GN&C functiona ity (using GDS mode s) therma mechanica interfaces power etc The Spacecraft simu ator wi a so communicate with instrument simu ator if instrument simu ators are acquired from the instrument vendors The MOS contro er wi contro the startup and fau t injection for this simu ator The fau t injection wi a so be ab e to be sent via ground system script commands The MOS contro er wi have the capabi ity of check pointing and restarting the simu ation

Subtask 1: This task is for the deve opment and de ivery of the PACE **Mission Operations Simulator (MOS)** to the PACE project The software deve opment methodo ogy wi use an iterative approach first primari y to support software deve opment and ater to support ground system va idation ground system operations training and mission simu ations A de iverab es and requirements must fo ow the guide ines in NNG17HP02C See Section V De iveries for de ivery schedu e See section A 1 be ow

Subtask 2: Comp eted

Subtask 3: This task is for a PACE Project T Security position Specifica y the contractor wi ensure that the T Security tasks out ined in the PACE Project Security P an during each phase of the Systems Deve opment Life Cyc e are comp eted

Subtask 4: This task is for the deve opment of the PACE Key Fi Bridge Too The PACE Key Fi Bridge Too enab es the transfer of COMSEC keys from the key oader to the PACE S/C and the PACE Ground Cryptographic Processors

Subtask 5 This task requires the contractor to procure integrate test and de iver a stand a one Mission Operations Simu ator for the TEMPO group code 450 2 to use in their End to End DTN deve opment integration and testing

III. Scope of Work

The contractor wi design deve op test de iver and support a software based PACE **Mission Operations Simulator (MOS)** which inc udes de ivery for use by the f ight software deve opment

team and the f ight operations team in the PACE MOC and possib y a backup MOC The comp etion of the deve opment and de ivery of the MOS Bui d 2 is p anned for May 2019 (See V De iveries section be ow)

A. Requirements

A 1 The contractor sha design deve op test and de iver a software on y spacecraft simu ator henceforth referred to as the Mission Operations Simu ator (MOS) **(Subtask 1.)**

- a The MOS sha interface with the Goddard Dynamic Simu ator (GDS) for dynamic space environment mode s
- b The MOS sha interface with the Mission Operationa TOS ground system for receiving commands and providing te emetry
- c The MOS sha operate within a RHEL 7 virtua machine environment
- d The MOS sha execute the unmodified PACE spacecraft f ight software
- e The MOS sha simu ate the f ight busses

A 2 Software Simu ator **(Subtask 2)**

- a Work Comp eted

A 3 PACE Project Office T Security Lead **(Subtask 3)**

- a The contractor sha ensure that T Security tasks out ined in the PACE Project Security P an during each phase of the T Security System Deve opment Life Cyc e are comp eted
- b The contractor sha work with the Subordinate System SSO and Project Management Office Management and Segment Managers to ensure T security comp iance during a phases of the T Security System Deve opment Life Cyc e which are a igned to Project Reviews
- c The contractor is responsib e for providing continuous monitoring artifacts to the Subordinate System SSOs that PACE is part of
- d The contractor wi work with the Subordinate System SSOs to provide PACE artifacts and participate in the annua third party assessment of each Subordinate System

A 4 PACE Key Fi Bridge Too **(Subtask 4)**

- a The contractor sha deve op and de iver the PACE Key Fi Bridge Too (See Section V De iverab es for schedu e)
- b The PACE Key Fi Bridge Too wi interface with the NASA owned Key oader for receipt of NASA or PACE COMSEC keys and transfers the keys without storing them to the PACE Mission f ight RF Transponders and Ground Cryptographic processors (GCPs)
- c The PACE Key Fi Bridge Too wi convert the 32 bit CRC to 16 bit CRC for each PACE or NASA key during the transfer

A 5 PACE Stand a one MOS **(Subtask 5)**

- a The contractor sha de iver a stand a one Mission Operations Simu ator (MOS) on a aptop computer
  - i The contractor sha procure required computer hardware and software sufficient to host and operate the MOS
- b The stand a one Mission Operations Simu ator (MOS) sha be configured to comp y with the NEN moderate contro s to achieve an Authority to Operate (ATO) as an entity within the Near Earth Network (ME) SO 9999 M GSF 3302

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c The contractor sha provide sustainment support for the stand a one MOS with updates patches and fixes

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The contractor sha provide week y status reports and support a month y review on the technica cost schedu e and operationa performance in accordance with the WBS to adequate y describe the activities of the task to the Task Monitor

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The Contractor sha assist the GSMO 2 contract managers and property custodians in maintaining the overa ist of government owned property used by the Contractor on this Task Order This support inc udes preparation and cooperation during property audits

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

The Government wi furnish a Key Loader and connection cab es

V. Material Procurement

The Contractor sha propose materia that they identify as necessary to perform the work associated with this Task Order The Task Monitor sha concur with the materia s ist prior to procurement

The contractor deve oping the MOS software sha comp y with a processes estab ished for the Project and de iverab e products

App icab e requirements inc ude but not imited to:

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2 NPR 7123 BNASA Systems Engineering Processes and Requirements
3 GPR 7120 99 Goddard Project Management
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5 GPR 7150 4 Goddard Software Engineering Requirements

VI. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

Meeting Title and Location	*Duration*	*Dates*	*Travelers*
PACE Transponder TIM #1 *THALES ALENIA SPACE, Calle Einstein, 7 (PTM)* *28760 Tres Cantos, Madrid (Spain) Completed*	*3 days*	*Sept 2019*	*1*

VII. Deliverables

The Contractor sha provide the fo owing de iverab es in support of this Task Order:

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8	November 2021	Mission Operations Readiness Review (MOR)

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9	December 2022	Project Readiness Date (PRD)

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End of Task Order Statement of Work

GSMO-2 TASK ORDER

Task No:	62
Modification:	5
Task Name:	PACE Ground Segment Support task
Task Period of Performance:	February 1 2018 May 23 2020
GSMO SOW Reference:	***Section 2.4.10***

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Section 2.4.10 Simulators *"The contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training .*

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3 GPR 7120 99 Goddard Project Management
4 GPR 7120 5A Goddard Systems Engineering
5 GPR 7150 4 Goddard Software Engineering Requirements

VI. Travel Support

The Contractor sha propose trave that they identify as necessary to perform the work associated with this Task Order

Meeting Title and Location	*Duration*	*Dates*	*Travelers*
PACE Transponder TIM #1 *THALES ALENIA SPACE, Calle Einstein, 7 (PTM)* *28760 Tres Cantos, Madrid (Spain) Completed*	*3 days*	*Sept 2019*	*1*

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Build 2	DLEON: Command Ingest Telemetry Output Health&Safety Stored Commanding	**June 2019** **Completed**

	Limit Checker Power Switching Tilt platform cmds (1553?) Data Ingest (GPS, Star Camera, Prop, SADE) Attitude Control (Nadir Pointing, Delta-V, Delta-H) SA Pointing Attitude Models IPLEON: File Manager CFDP HK Data Storage Full Science Ingest Full Science Downlink	
Build 3	DLEON: Memory Manager Memory Dwell Memory Scrub Checksum File Commander Limit Checker Attitude Control (Lunar Cal, other modes?) IPLEON: Memory Manager Memory Dwell Memory Scrub Checksum	**July 2020**
Build 3.1	Bug Fixes. Not required if there are no bug fixes.	**April 2021**

VIII. Reference

The Contractor sha support the fo owing major Ground Segment Reviews and mi estones Each review may require an Engineering Peer Review and Dry Run reviews

1	Jan 2017	Mission System Requirements Review (Completed)
2	May 2018	Ground Segment System Requirements Review (GS SRR) (Completed)
3	March 2019	Mission Preliminary Design Review (MPDR) (Completed)
4	February 2019	Ground Segment Preliminary Design Review (GS PDR) (Completed)
5	February 2020	Mission Critical Design Review (MCDR)
6	February 2020	Ground Segment Critical Design Review (GS & Mission CDR)
7	September 2021	Mission System Integration Review (MSIR)
8	November 2021	Mission Operations Readiness Review (MOR)

Deleted: January

Deleted: June

9	December 2022	Project Readiness Date (PRD)

Deleted: November

Deleted: Launch

Deleted: L

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 63
Modification: 3
Task Name: Restore-L RGE Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	04/28/2018	4/26/2019	Initial task order statement of work. 1.1, 1.2, & 1.3 moved from TO 21
1	07/01/2018	4/26/2019	add more engineering support
2	11/01/2018	4/26/2019	provide Mission Operations ConOps Timeline Support
3	3/15/2019	4/25/2020	Provide a mission readiness test lead, an IT infrastructure engineer, and extend period of performance for one year

II. Task Overview

The Restore-L RGE Support task provides engineering support for the Restore-L Ground Element (RGE) and Mission Operations

III. Requirements

1	Satellite Servicing Projects Division Support
1.1	~~The contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~ ~~The candidate shall have a strong technical base in the following areas:~~ ~~• Leadership skills for software development teams.~~ ~~• System design for a combination of new development with legacy infrastructure~~ ~~• Requirements definition for a space mission ground system~~ ~~o Overall understanding of requirement development phases~~ ~~o Guide requirement formulation process~~ ~~• Understanding how different components interface with each other in requirements and design space~~ ~~o Telemetry & Command~~ ~~o Data processing and distribution, including imagery and video~~

	~~o Mission Planning/Scheduling~~ ~~o Monitoring & Notification~~ ~~o Data Analysis~~ ~~o IT Infrastructure and Security~~ ~~• Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~ ~~• Overall expertise to guide a team in life-cycle development~~ ~~o Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~ ~~o Software CM and unit test automation~~ ~~• Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~ ~~• Previous experience leading ground software development efforts required.~~ • ~~Experience managing integrated mission schedules~~
1.2	The contractor shall provide ITPS and MPS in support of Restore-L Ground System including: • Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms • Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including o Sizing for hardware platforms (CPU, memory, disk, network) o Performance estimation given Restore data rates and Concept of Operations • Hands on training for RGE development and IT support staff for installation, configuration and operation of the products • Estimation of required hours for modifications to the products to meet Restore specific requirements • An initial tranche of hours to use for modifications to the products • Product support on-call during business hours • Delivery and upgrade support for future versions of the products on request during the Restore mission
1.3	The contractor shall provide Ground System peer review board support as required.
1.4	The contractor shall provide MOC Web Operations Tools: • Design, Development, Integration, Test, Deployment, and Sustaining Engineering support for requested tools • Tools in scope: o Rules and Constraints Database (RCDB) o Mission Ops Change Request (MOCR) o Proc Tracking Database (ProcDB) o User Authentication Module (UALite) o Discrepancy Report Database (DR)

	• Tools shall be updated for Restore-L by modifying/adding subsystems, modifying fields as needed, defining approval groups, and conforming to RGE process flow • Maintenance Manual shall be supplied • Sustaining Engineering to provide enhancements and security updates

1.5	The contractor shall provide RGE Systems Engineer in support of Restore-L Ground System:
	This is a mid to senior ground system engineer position capable of providing system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.
	The candidate shall have a strong technical base in the following areas:
	· Requirements definition and management for a mission ground element and all supporting systems
	  ○ Requirement development in the following areas
	  ▪ Space to Ground communications, with particular emphasis on Space Network and Near Earth Network interfaces and capabilities
	  ▪ Mission Control Functions, including
	  · Observatory Video, Telemetry & Command processing
	  · Ground System Processing and data distribution
	  · Mission Planning
	  · IT Infrastructure and Security
	  ▪ Guidance, Navigation and Control and Flight Dynamics
	  ○ Requirement Rationale development
	• Familiarity with DOORS requirements management system a plus
	• Development of an overall V&V plan, including verification events, verification methods, verification descriptions, and verification traces
	• Documentation development
	  ○ Experience in development and modification of Concept of Operations
	  ○ Support development of Interface Control Documents (ICD)

1.6	The contractor shall provide RGE ITI Engineer in support of Restore-L Ground System: This is a mid ground system development position with an emphasis on ground system engineering and test services for the IT Infrastructure system for the Restore-L mission ground system. This position requires experience with ground system definition, development and integration, system administration, and understanding of the full life-cycle development of a ground system for a NASA mission. Under direction from the Restore-L Ground System ITI Lead and senior IT personnel, performs as an Information Technology Infrastructure Design Engineer supporting the Satellite Servicing Projects Division (SSPD) Restore-L project. · Design, build, and support IT infrastructure for new observatory and backup control and I&T support system environments, to include the planning and

	integration of IT infrastructure that follows NASA requirements, industry standards, and best practices. · Maintains the operational environments once they have been established. · Works as a System Administrator to maintain the Restore-L ground systems (e.g., Dev Lab, MOC, RoboMOC), including implementing directorate requirements for security control and validation. · Performs system hardware research, development, design, and implementation. Makes recommendations for procurements of hardware and applications relative to the requirements of the project. · Provide support in development, maintenance, and follow through of schedules. Be able to maintain tight deadlines on implementation of required support environments. · Generate and present materials at divisional and project-level reviews. Knowledge of various networking technologies, hardware, and software. The ability to plan and coordinate implementations across multiple locations and/or interconnections with other network environments.
1.7	~~The contractor shall provide IT Security, Systems Engineering, and Ground Systems Engineering support to the RESTORE-L project~~ ~~For IT Security support:~~ ~~Support the development of the Project Protection plan.~~ ~~Ensure the level 3 security requirements are properly flowed to all the ground subsystems.~~ ~~Ensure the IT Infrastructure addresses all of the NASA and NIST security guidance and requirements.~~ ~~Update Restore-L Project Security Plan for CDR and ORR.~~ ~~Develop any Ground System IT Security documentation needed for CDR and ORR.~~ ~~Develop any IT Security presentation material needed for CDR and ORR.~~ ~~Collaborate with Restore-L project team, Code 700 and Code 400 IT Security organizations.~~
1.8	The contractor shall provide Mission Operations ConOps Timeline Support. This is a mid-level Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on Concept of Operations development, timeline and schedule management, commissioning timeline development. Experience should also include Trending, and Real-Time systems. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in Mission Planning (including Timeline and Scheduling management), Trending, and Real-Time systems. • Translating/populating/managing conversion of Mission Timeline into STK Scheduler tool.

	• Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and Ground Networks • Significant input into Mission Concept of Operations (ConOps), Mission Phase Plans, and Flight Operations Plan (FOP) • Seeking professional with ability to conduct meetings, extract information from stakeholders, and plan path to meet CDR deadline for STK scheduler conversion/baseline. • Preferred experience using KBR MPS tool and STK Scheduler • Position may evolve into a Timeline Lead or Mission Planning Lead on the Flight Operations Team (FOT).
1.9	The contractor shall provide a Restore-L Mission Readiness Test (MRT) Lead. This is a Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on development and execution of a testing program to demonstrate readiness to conduct Restore-L mission operations. The MRT Lead will be responsible for developing and baselining the Restore-L Mission Readiness Test Plan by Mission Critical Design Review (CDR). Post CDR, the MRT Lead will be responsible for planning and execution of the MRTs, including rehearsals. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in requirements management, traceability, verification and validation. DOORS experience preferred. • Requires experience in Level 2 test program development including defining stakeholders, configurations, test procedures, artifacts, requirements management, discrepancy reporting and mitigation strategies, test reporting, and leading the MRT test team. • Requires ability to lead an integrated test team with representatives from the RGE/MOC, Payload/Robot team, Bus vendor, NASA networks, FDF, and CARA. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and NASA Networks. • Requires supporting End-to-End (ETE) Test Plan development and execution; and matrixing MRTs with other mission test events to ensure all Level 2 requirements have been verified and validated. • Preferred experience in system/software development, observatory integration and test, and flight operations.
1.10	The contractor shall provide an IT Infrastructure Engineer. Duties include: • Provide efficient and effective Operations Support of all supported network servers, both physical and virtual, as necessary to meet or exceed agency's operational availability and performance requirements. • Provide for accurate, complete, and timely recording and reporting of all

		technical support-related activities, issues, and outcomes. • Support, maintain, and enhance as required, established strategies for server operations to ensure continuity of agency's business operations and timely recovery. • Collect, store, and analyze data relevant to monitored servers to perform and report accurate root causal analysis of all related issues and support trend analysis and forecasting. • Effectively manage the procurement and maintenance of all supplies, materials, and supporting software licenses and service agreements required to ensure supported network servers meet minimum performance and availability requirements. • Excellent communication, customer service, time management, conflict resolution, and problem determination/resolution skills. • Interacts with users and evaluates vendor products. • Makes recommendations to purchase hardware and software, coordinates installation and provides backup recovery. Experience includes: • Solid knowledge of Linux, operating systems concepts and extensive systems administration experience related to CentOS, RedHat and/or SuSE. • Experience with one or more of the following Windows Server administration tools: WSUS, Group Policy, Active Directory, RDP, and Windows Server troubleshooting. • GOTS/COTS application, installation, configuration, and troubleshooting; including OS hardening. • Dell Hardware installation, configuration, troubleshooting; including Server RAID Array. • Working Experience with Hyper-V and/or VMWare virtualization & cloud computing. • Working Experience with setting up & troubleshooting Networking, Routers & firewall. • Preferred certification: Security+ and OS certification, Linux+, RedHat, Microsoft, etc.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 63
Modification: 4
Task Name: Restore-L RGE Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	04/28/2018	4/26/2019	Initial task order statement of work. 1.1, 1.2, & 1.3 moved from TO 21
1	07/01/2018	4/26/2019	Add more engineering support
2	11/01/2018	4/26/2019	Provide Mission Operations ConOps Timeline Support
3	3/15/2019	4/25/2020	Provide a mission readiness test lead, an IT infrastructure engineer, and extend period of performance for one year
4	5/15/2019	4/25/2020	Split Mod 3 SOW into five subtasks

II. Task Overview

The Restore-L RGE Support task provides engineering support for the Restore-L Ground Element (RGE) Systems: Systems Management, Systems Engineering, Mission Control Systems and IT Infrastructure; and Mission Operations.

III. Requirements

1	**~~Satellite Servicing Projects Division Support~~ Restore-L Ground Element Systems Management Peer Review Support**
1.1~~3~~	The contractor shall provide Ground System peer review board support as required.
2	**Restore-L Ground Element Systems Engineering**
	This element provides for system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.
2.1 ~~1.5~~	The contractor shall provide RGE Systems Engineer in support of Restore-L Ground System: This is a mid to senior ground system engineer position capable of providing system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element. The candidate shall have a strong technical base in the following areas: · Requirements definition and management for a mission ground element and all supporting systems

	○ Requirement development in the following areas ▪ Space to Ground communications, with particular emphasis on Space Network and Near Earth Network interfaces and capabilities ▪ Mission Control Functions, including · Observatory Video, Telemetry & Command processing · Ground System Processing and data distribution · Mission Planning · IT Infrastructure and Security ▪ Guidance, Navigation and Control and Flight Dynamics ○ Requirement Rationale development • Familiarity with DOORS requirements management system a plus • Development of an overall V&V plan, including verification events, verification methods, verification descriptions, and verification traces • Documentation development ○ Experience in development and modification of Concept of Operations ○ Support development of Interface Control Documents (ICD)
3	**Restore-L Ground Element Mission Control Systems**
	This element provides for the GOTS support for design and development phases of the ground system.
3~~1~~.1	~~The contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~ ~~The candidate shall have a strong technical base in the following areas:~~ ~~• Leadership skills for software development teams.~~ ~~• System design for a combination of new development with legacy infrastructure~~ ~~• Requirements definition for a space mission ground system~~ ~~○ Overall understanding of requirement development phases~~ ~~○ Guide requirement formulation process~~ ~~• Understanding how different components interface with each other in requirements and design space~~ ~~○ Telemetry & Command~~ ~~○ Data processing and distribution, including imagery and video~~ ~~○ Mission Planning/Scheduling~~ ~~○ Monitoring & Notification~~ ~~○ Data Analysis~~ ~~○ IT Infrastructure and Security~~

	~~• Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~ ~~• Overall expertise to guide a team in life-cycle development~~ ~~○ Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~ ~~○ Software CM and unit test automation~~ ~~• Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~ ~~• Previous experience leading ground software development efforts required.~~ • ~~Experience managing integrated mission schedules~~
3~~1~~.2	The contractor shall provide ITPS and MPS in support of Restore-L Ground System including: • Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms • Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including ○ Sizing for hardware platforms (CPU, memory, disk, network) ○ Performance estimation given Restore data rates and Concept of Operations • Hands on training for RGE development and IT support staff for installation, configuration and operation of the products • Estimation of required hours for modifications to the products to meet Restore specific requirements • An initial tranche of hours to use for modifications to the products • Product support on-call during business hours • Delivery and upgrade support for future versions of the products on request during the Restore mission
3.3 ~~1.4~~	The contractor shall provide MOC Web Operations Tools: • Design, Development, Integration, Test, Deployment, and Sustaining Engineering support for requested tools • Tools in scope: ○ Rules and Constraints Database (RCDB) ○ Mission Ops Change Request (MOCR) ○ Proc Tracking Database (ProcDB) ○ User Authentication Module (UALite) ○ Discrepancy Report Database (DR) • Tools shall be updated for Restore-L by modifying/adding subsystems, modifying fields as needed, defining approval groups, and conforming to RGE process flow • Maintenance Manual shall be supplied • Sustaining Engineering to provide enhancements and security updates
~~4~~2	**Restore-L Ground Element IT Infrastructure**

	This element provides for the ground system engineering and test services for the IT Infrastructure system for the Restore-L mission, accounting for the full life-cycle development of the ground system.
4.1 ~~1.6~~	The contractor shall provide RGE ITI Engineer in support of Restore-L Ground System: This is a mid ground system development position with an emphasis on ground system engineering and test services for the IT Infrastructure system for the Restore-L mission ground system. This position requires experience with ground system definition, development and integration, system administration, and understanding of the full life-cycle development of a ground system for a NASA mission. Under direction from the Restore-L Ground System ITI Lead and senior IT personnel, performs as an Information Technology Infrastructure Design Engineer supporting the Satellite Servicing Projects Division (SSPD) Restore-L project. · Design, build, and support IT infrastructure for new observatory and backup control and I&T support system environments, to include the planning and integration of IT infrastructure that follows NASA requirements, industry standards, and best practices. · Maintains the operational environments once they have been established. · Works as a System Administrator to maintain the Restore-L ground systems (e.g., Dev Lab, MOC, RoboMOC), including implementing directorate requirements for security control and validation. · Performs system hardware research, development, design, and implementation. Makes recommendations for procurements of hardware and applications relative to the requirements of the project. · Provide support in development, maintenance, and follow through of schedules. Be able to maintain tight deadlines on implementation of required support environments. · Generate and present materials at divisional and project-level reviews. Knowledge of various networking technologies, hardware, and software. The ability to plan and coordinate implementations across multiple locations and/or interconnections with other network environments.
4.2 ~~1.7~~	~~The contractor shall provide IT Security, Systems Engineering, and Ground Systems Engineering support to the RESTORE-L project~~ ~~For IT Security support:~~ ~~Support the development of the Project Protection plan.~~ ~~Ensure the level 3 security requirements are properly flowed to all the ground subsystems.~~ ~~Ensure the IT Infrastructure addresses all of the NASA and NIST security guidance and requirements.~~ ~~Update Restore-L Project Security Plan for CDR and ORR.~~ ~~Develop any Ground System IT Security documentation needed for CDR and ORR.~~ ~~Develop any IT Security presentation material needed for CDR and ORR.~~

	~~Collaborate with Restore-L project team, Code 700 and Code 400 IT Security organizations.~~
~~1.10~~ 4.3	The contractor shall provide an IT Infrastructure Engineer. Duties include: • Provide efficient and effective Operations Support of all supported network servers, both physical and virtual, as necessary to meet or exceed agency's operational availability and performance requirements. • Provide for accurate, complete, and timely recording and reporting of all technical support-related activities, issues, and outcomes. • Support, maintain, and enhance as required, established strategies for server operations to ensure continuity of agency's business operations and timely recovery. • Collect, store, and analyze data relevant to monitored servers to perform and report accurate root causal analysis of all related issues and support trend analysis and forecasting. • Effectively manage the procurement and maintenance of all supplies, materials, and supporting software licenses and service agreements required to ensure supported network servers meet minimum performance and availability requirements. • Excellent communication, customer service, time management, conflict resolution, and problem determination/resolution skills. • Interacts with users and evaluates vendor products. • Makes recommendations to purchase hardware and software, coordinates installation and provides backup recovery. Experience includes: • Solid knowledge of Linux, operating systems concepts and extensive systems administration experience related to CentOS, RedHat and/or SuSE. • Experience with one or more of the following Windows Server administration tools: WSUS, Group Policy, Active Directory, RDP, and Windows Server troubleshooting. • GOTS/COTS application, installation, configuration, and troubleshooting; including OS hardening. • Dell Hardware installation, configuration, troubleshooting; including Server RAID Array. • Working Experience with Hyper-V and/or VMWare virtualization & cloud computing. • Working Experience with setting up & troubleshooting Networking, Routers & firewall. • Preferred certification: Security+ and OS certification, Linux+, RedHat, Microsoft, etc.
5	**Restore-L Mission Operations**

	This element accounts for all phases of mission operations from planning to ops and end of the mission.
~~1.8~~ 5.1	The contractor shall provide Mission Operations ConOps Timeline Support. This is a mid-level Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on Concept of Operations development, timeline and schedule management, commissioning timeline development. Experience should also include Trending, and Real-Time systems. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in Mission Planning (including Timeline and Scheduling management), Trending, and Real-Time systems. • Translating/populating/managing conversion of Mission Timeline into STK Scheduler tool. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and Ground Networks • Significant input into Mission Concept of Operations (ConOps), Mission Phase Plans, and Flight Operations Plan (FOP) • Seeking professional with ability to conduct meetings, extract information from stakeholders, and plan path to meet CDR deadline for STK scheduler conversion/baseline. • Preferred experience using KBR MPS tool and STK Scheduler • Position may evolve into a Timeline Lead or Mission Planning Lead on the Flight Operations Team (FOT).
~~1.9~~ 5.2	The contractor shall provide a Restore-L Mission Readiness Test (MRT) Lead. This is a Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on development and execution of a testing program to demonstrate readiness to conduct Restore-L mission operations. The MRT Lead will be responsible for developing and baselining the Restore-L Mission Readiness Test Plan by Mission Critical Design Review (CDR). Post CDR, the MRT Lead will be responsible for planning and execution of the MRTs, including rehearsals. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in requirements management, traceability, verification and validation. DOORS experience preferred. • Requires experience in Level 2 test program development including defining stakeholders, configurations, test procedures, artifacts, requirements management, discrepancy reporting and mitigation strategies, test reporting, and leading the MRT test team. • Requires ability to lead an integrated test team with representatives from the RGE/MOC, Payload/Robot team, Bus vendor, NASA networks, FDF, and CARA.

	• Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and NASA Networks. • Requires supporting End-to-End (ETE) Test Plan development and execution; and matrixing MRTs with other mission test events to ensure all Level 2 requirements have been verified and validated. • Preferred experience in system/software development, observatory integration and test, and flight operations.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 63
Modification: 5
Task Name: Restore-L RGE Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	04/28/2018	4/26/2019	Initial task order statement of work. 1.1, 1.2, & 1.3 moved from TO 21
1	07/01/2018	4/26/2019	Add more engineering support
2	11/01/2018	4/26/2019	Provide Mission Operations ConOps Timeline Support
3	3/15/2019	4/25/2020	Provide a mission readiness test lead, an IT infrastructure engineer, and extend period of performance for one year
4	5/15/2019	4/25/2020	Split Mod 3 SOW into five subtasks
5	6/24/2019	4/25/2020	ITI Engineer - 4.3

II. Task Overview

The Restore-L RGE Support task provides engineering support for the Restore-L Ground Element (RGE) Systems: Systems Management, Systems Engineering, Mission Control Systems and IT Infrastructure; and Mission Operations.

III. Requirements

1	**~~Satellite Servicing Projects Division Support~~ Restore-L Ground Element Systems Management Peer Review Support**
1.1~~3~~	The contractor shall provide Ground System peer review board support as required.
2	**Restore-L Ground Element Systems Engineering**
	This element provides for system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.
2.1 ~~1.5~~	The contractor shall provide RGE Systems Engineer in support of Restore-L Ground System: This is a mid to senior ground system engineer position capable of providing system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element. The candidate shall have a strong technical base in the following areas:

	· Requirements definition and management for a mission ground element and all supporting systems ○ Requirement development in the following areas ▪ Space to Ground communications, with particular emphasis on Space Network and Near Earth Network interfaces and capabilities ▪ Mission Control Functions, including · Observatory Video, Telemetry & Command processing · Ground System Processing and data distribution · Mission Planning · IT Infrastructure and Security ▪ Guidance, Navigation and Control and Flight Dynamics ○ Requirement Rationale development • Familiarity with DOORS requirements management system a plus • Development of an overall V&V plan, including verification events, verification methods, verification descriptions, and verification traces • Documentation development ○ Experience in development and modification of Concept of Operations ○ Support development of Interface Control Documents (ICD)
3	**Restore-L Ground Element Mission Control Systems**
	This element provides for the GOTS support for design and development phases of the ground system.
3~~1~~.1	~~The contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~ ~~The candidate shall have a strong technical base in the following areas:~~ ~~• Leadership skills for software development teams.~~ ~~• System design for a combination of new development with legacy infrastructure~~ ~~• Requirements definition for a space mission ground system~~ ~~○ Overall understanding of requirement development phases~~ ~~○ Guide requirement formulation process~~ ~~• Understanding how different components interface with each other in requirements and design space~~ ~~○ Telemetry & Command~~ ~~○ Data processing and distribution, including imagery and video~~ ~~○ Mission Planning/Scheduling~~ ~~○ Monitoring & Notification~~ ~~○ Data Analysis~~

	~~○ IT Infrastructure and Security~~ ~~• Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~ ~~• Overall expertise to guide a team in life-cycle development~~ ~~○ Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~ ~~○ Software CM and unit test automation~~ ~~• Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~ ~~• Previous experience leading ground software development efforts required.~~ • ~~Experience managing integrated mission schedules~~
3~~1~~.2	The contractor shall provide ITPS and MPS in support of Restore-L Ground System including: • Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms • Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including ○ Sizing for hardware platforms (CPU, memory, disk, network) ○ Performance estimation given Restore data rates and Concept of Operations • Hands on training for RGE development and IT support staff for installation, configuration and operation of the products • Estimation of required hours for modifications to the products to meet Restore specific requirements • An initial tranche of hours to use for modifications to the products • Product support on-call during business hours • Delivery and upgrade support for future versions of the products on request during the Restore mission
3.3 ~~1.4~~	The contractor shall provide MOC Web Operations Tools: • Design, Development, Integration, Test, Deployment, and Sustaining Engineering support for requested tools • Tools in scope: ○ Rules and Constraints Database (RCDB) ○ Mission Ops Change Request (MOCR) ○ Proc Tracking Database (ProcDB) ○ User Authentication Module (UALite) ○ Discrepancy Report Database (DR) • Tools shall be updated for Restore-L by modifying/adding subsystems, modifying fields as needed, defining approval groups, and conforming to RGE process flow • Maintenance Manual shall be supplied • Sustaining Engineering to provide enhancements and security updates
~~4~~2	**Restore-L Ground Element IT Infrastructure**

	This element provides for the ground system engineering and test services for the IT Infrastructure system for the Restore-L mission, accounting for the full life-cycle development of the ground system.
4.1 ~~1.6~~	The contractor shall provide 1 RGE ITI Engineer in support of Restore-L Ground System: This is a mid ground system development position with an emphasis on ground system engineering and test services for the IT Infrastructure system for the Restore-L mission ground system. This position requires experience with ground system definition, development and integration, system administration, and understanding of the full life-cycle development of a ground system for a NASA mission. Under direction from the Restore-L Ground System ITI Lead and senior IT personnel, performs as an Information Technology Infrastructure Design Engineer supporting the Satellite Servicing Projects Division (SSPD) Restore-L project. · Design, build, and support IT infrastructure for new observatory and backup control and I&T support system environments, to include the planning and integration of IT infrastructure that follows NASA requirements, industry standards, and best practices. · Maintains the operational environments once they have been established. · Works as a System Administrator to maintain the Restore-L ground systems (e.g., Dev Lab, MOC, RoboMOC), including implementing directorate requirements for security control and validation. · Performs system hardware research, development, design, and implementation. Makes recommendations for procurements of hardware and applications relative to the requirements of the project. · Provide support in development, maintenance, and follow through of schedules. Be able to maintain tight deadlines on implementation of required support environments. · Generate and present materials at divisional and project-level reviews. Knowledge of various networking technologies, hardware, and software. The ability to plan and coordinate implementations across multiple locations and/or interconnections with other network environments.
4.2 ~~1.7~~	~~The contractor shall provide IT Security, Systems Engineering, and Ground Systems Engineering support to the RESTORE-L project~~ ~~For IT Security support:~~ ~~Support the development of the Project Protection plan.~~ ~~Ensure the level 3 security requirements are properly flowed to all the ground subsystems.~~ ~~Ensure the IT Infrastructure addresses all of the NASA and NIST security guidance and requirements.~~ ~~Update Restore-L Project Security Plan for CDR and ORR.~~ ~~Develop any Ground System IT Security documentation needed for CDR and ORR.~~ ~~Develop any IT Security presentation material needed for CDR and ORR.~~

	~~Collaborate with Restore-L project team, Code 700 and Code 400 IT Security organizations.~~
~~1.10~~ 4.3	The contractor shall provide an IT Infrastructure Engineer. Duties include: • Provide efficient and effective Operations Support of all supported network servers, both physical and virtual, as necessary to meet or exceed agency's operational availability and performance requirements. • Provide for accurate, complete, and timely recording and reporting of all technical support-related activities, issues, and outcomes. • Support, maintain, and enhance as required, established strategies for server operations to ensure continuity of agency's business operations and timely recovery. • Collect, store, and analyze data relevant to monitored servers to perform and report accurate root causal analysis of all related issues and support trend analysis and forecasting. • Effectively manage the procurement and maintenance of all supplies, materials, and supporting software licenses and service agreements required to ensure supported network servers meet minimum performance and availability requirements. • Excellent communication, customer service, time management, conflict resolution, and problem determination/resolution skills. • Interacts with users and evaluates vendor products. • Makes recommendations to purchase hardware and software, coordinates installation and provides backup recovery. Experience includes: • Solid knowledge of Linux, operating systems concepts and extensive systems administration experience related to CentOS, RedHat and/or SuSE. • Experience with one or more of the following Windows Server administration tools: WSUS, Group Policy, Active Directory, RDP, and Windows Server troubleshooting. • GOTS/COTS application, installation, configuration, and troubleshooting; including OS hardening. • Dell Hardware installation, configuration, troubleshooting; including Server RAID Array. • Working Experience with Hyper-V and/or VMWare virtualization & cloud computing. • Working Experience with setting up & troubleshooting Networking, Routers & firewall. • Preferred certification: Security+ and OS certification, Linux+, RedHat, Microsoft, etc.
5	**Restore-L Mission Operations**

	This element accounts for all phases of mission operations from planning to ops and end of the mission.
~~1.8~~ 5.1	The contractor shall provide Mission Operations ConOps Timeline Support. This is a mid-level Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on Concept of Operations development, timeline and schedule management, commissioning timeline development. Experience should also include Trending, and Real-Time systems. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in Mission Planning (including Timeline and Scheduling management), Trending, and Real-Time systems. • Translating/populating/managing conversion of Mission Timeline into STK Scheduler tool. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and Ground Networks • Significant input into Mission Concept of Operations (ConOps), Mission Phase Plans, and Flight Operations Plan (FOP) • Seeking professional with ability to conduct meetings, extract information from stakeholders, and plan path to meet CDR deadline for STK scheduler conversion/baseline. • Preferred experience using KBR MPS tool and STK Scheduler • Position may evolve into a Timeline Lead or Mission Planning Lead on the Flight Operations Team (FOT).
~~1.9~~ 5.2	The contractor shall provide a Restore-L Mission Readiness Test (MRT) Lead. This is a Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on development and execution of a testing program to demonstrate readiness to conduct Restore-L mission operations. The MRT Lead will be responsible for developing and baselining the Restore-L Mission Readiness Test Plan by Mission Critical Design Review (CDR). Post CDR, the MRT Lead will be responsible for planning and execution of the MRTs, including rehearsals. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in requirements management, traceability, verification and validation. DOORS experience preferred. • Requires experience in Level 2 test program development including defining stakeholders, configurations, test procedures, artifacts, requirements management, discrepancy reporting and mitigation strategies, test reporting, and leading the MRT test team. • Requires ability to lead an integrated test team with representatives from the RGE/MOC, Payload/Robot team, Bus vendor, NASA networks, FDF, and CARA.

	• Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and NASA Networks. • Requires supporting End-to-End (ETE) Test Plan development and execution; and matrixing MRTs with other mission test events to ensure all Level 2 requirements have been verified and validated. • Preferred experience in system/software development, observatory integration and test, and flight operations.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 63
Modification: 6
Task Name: Restore-L RGE Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	04/28/2018	4/26/2019	Initial task order statement of work. 1.1, 1.2, & 1.3 moved from TO 21
1	07/01/2018	4/26/2019	Add more engineering support
2	11/01/2018	4/26/2019	Provide Mission Operations ConOps Timeline Support
3	3/15/2019	4/25/2020	Provide a mission readiness test lead, an IT infrastructure engineer, and extend period of performance for one year
4	5/15/2019	4/25/2020	Split Mod 3 SOW into five subtasks
5	6/24/2019	4/25/2020	ITI Engineer - 4.3
6	10/01/2019	4/25/2020	Provide for LFM - 3.3

II. Task Overview

The Restore-L RGE Support task provides engineering support for the Restore-L Ground Element (RGE) Systems: Systems Management, Systems Engineering, Mission Control Systems and IT Infrastructure; and Mission Operations.

III. Requirements

1	**~~Satellite Servicing Projects Division Support~~ Restore-L Ground Element Systems Management Peer Review Support**
1.1~~3~~	The contractor shall provide Ground System peer review board support as required.
2	**Restore-L Ground Element Systems Engineering**
	This element provides for system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.
2.1 ~~1.5~~	The contractor shall provide RGE Systems Engineer in support of Restore-L Ground System: This is a mid to senior ground system engineer position capable of providing system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element. The candidate shall have a strong technical base in the following areas:

	· Requirements definition and management for a mission ground element and all supporting systems ○ Requirement development in the following areas ▪ Space to Ground communications, with particular emphasis on Space Network and Near Earth Network interfaces and capabilities ▪ Mission Control Functions, including · Observatory Video, Telemetry & Command processing · Ground System Processing and data distribution · Mission Planning · IT Infrastructure and Security ▪ Guidance, Navigation and Control and Flight Dynamics ○ Requirement Rationale development • Familiarity with DOORS requirements management system a plus • Development of an overall V&V plan, including verification events, verification methods, verification descriptions, and verification traces • Documentation development ○ Experience in development and modification of Concept of Operations ○ Support development of Interface Control Documents (ICD)
3	**Restore-L Ground Element Mission Control Systems**
	This element provides for the GOTS support for design and development phases of the ground system.
3~~1~~.1	~~The contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~ ~~The candidate shall have a strong technical base in the following areas:~~ ~~• Leadership skills for software development teams.~~ ~~• System design for a combination of new development with legacy infrastructure~~ ~~• Requirements definition for a space mission ground system~~ ~~○ Overall understanding of requirement development phases~~ ~~○ Guide requirement formulation process~~ ~~• Understanding how different components interface with each other in requirements and design space~~ ~~○ Telemetry & Command~~ ~~○ Data processing and distribution, including imagery and video~~ ~~○ Mission Planning/Scheduling~~ ~~○ Monitoring & Notification~~ ~~○ Data Analysis~~

	~~o IT Infrastructure and Security~~ ~~• Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~ ~~• Overall expertise to guide a team in life-cycle development~~ ~~o Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~ ~~o Software CM and unit test automation~~ ~~• Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~ ~~• Previous experience leading ground software development efforts required.~~ • ~~Experience managing integrated mission schedules~~
3~~1~~.2	The contractor shall provide ITPS and MPS in support of Restore-L Ground System including: • Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms • Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including o Sizing for hardware platforms (CPU, memory, disk, network) o Performance estimation given Restore data rates and Concept of Operations • Hands on training for RGE development and IT support staff for installation, configuration and operation of the products • Estimation of required hours for modifications to the products to meet Restore specific requirements • An initial tranche of hours to use for modifications to the products • Product support on-call during business hours • Delivery and upgrade support for future versions of the products on request during the Restore mission
3.3 ~~1.4~~	The contractor shall provide MOC Web Operations Tools: • Design, Development, Integration, Test, Deployment, and Sustaining Engineering support for requested tools • Tools in scope: o Rules and Constraints Database (RCDB) o Mission Ops Change Request (MOCR) o Proc Tracking Database (ProcDB) o User Authentication Module (UALite) o Discrepancy Report Database (DR) o Large File Manager (LFM) • Tools shall be updated for Restore-L by modifying/adding subsystems, modifying fields as needed, defining approval groups, and conforming to RGE process flow • Maintenance Manual shall be supplied • Sustaining Engineering to provide enhancements and security updates

~~42~~	**Restore-L Ground Element IT Infrastructure**
	This element provides for the ground system engineering and test services for the IT Infrastructure system for the Restore-L mission, accounting for the full life-cycle development of the ground system.
4.1 ~~1.6~~	The contractor shall provide 1 RGE ITI Engineer in support of Restore-L Ground System: This is a mid ground system development position with an emphasis on ground system engineering and test services for the IT Infrastructure system for the Restore-L mission ground system. This position requires experience with ground system definition, development and integration, system administration, and understanding of the full life-cycle development of a ground system for a NASA mission. Under direction from the Restore-L Ground System ITI Lead and senior IT personnel, performs as an Information Technology Infrastructure Design Engineer supporting the Satellite Servicing Projects Division (SSPD) Restore-L project. · Design, build, and support IT infrastructure for new observatory and backup control and I&T support system environments, to include the planning and integration of IT infrastructure that follows NASA requirements, industry standards, and best practices. · Maintains the operational environments once they have been established. · Works as a System Administrator to maintain the Restore-L ground systems (e.g., Dev Lab, MOC, RoboMOC), including implementing directorate requirements for security control and validation. · Performs system hardware research, development, design, and implementation. Makes recommendations for procurements of hardware and applications relative to the requirements of the project. · Provide support in development, maintenance, and follow through of schedules. Be able to maintain tight deadlines on implementation of required support environments. · Generate and present materials at divisional and project-level reviews. Knowledge of various networking technologies, hardware, and software. The ability to plan and coordinate implementations across multiple locations and/or interconnections with other network environments.
4.2 ~~1.7~~	~~The contractor shall provide IT Security, Systems Engineering, and Ground Systems Engineering support to the RESTORE-L project~~ ~~For IT Security support:~~ ~~Support the development of the Project Protection plan.~~ ~~Ensure the level 3 security requirements are properly flowed to all the ground subsystems.~~ ~~Ensure the IT Infrastructure addresses all of the NASA and NIST security guidance and requirements.~~ ~~Update Restore-L Project Security Plan for CDR and ORR.~~ ~~Develop any Ground System IT Security documentation needed for CDR and ORR.~~

	~~Develop any IT Security presentation material needed for CDR and ORR. Collaborate with Restore-L project team, Code 700 and Code 400 IT Security organizations.~~
~~1.10~~ 4.3	The contractor shall provide an IT Infrastructure Engineer. Duties include: • Provide efficient and effective Operations Support of all supported network servers, both physical and virtual, as necessary to meet or exceed agency's operational availability and performance requirements. • Provide for accurate, complete, and timely recording and reporting of all technical support-related activities, issues, and outcomes. • Support, maintain, and enhance as required, established strategies for server operations to ensure continuity of agency's business operations and timely recovery. • Collect, store, and analyze data relevant to monitored servers to perform and report accurate root causal analysis of all related issues and support trend analysis and forecasting. • Effectively manage the procurement and maintenance of all supplies, materials, and supporting software licenses and service agreements required to ensure supported network servers meet minimum performance and availability requirements. • Excellent communication, customer service, time management, conflict resolution, and problem determination/resolution skills. • Interacts with users and evaluates vendor products. • Makes recommendations to purchase hardware and software, coordinates installation and provides backup recovery. Experience includes: • Solid knowledge of Linux, operating systems concepts and extensive systems administration experience related to CentOS, RedHat and/or SuSE. • Experience with one or more of the following Windows Server administration tools: WSUS, Group Policy, Active Directory, RDP, and Windows Server troubleshooting. • GOTS/COTS application, installation, configuration, and troubleshooting; including OS hardening. • Dell Hardware installation, configuration, troubleshooting; including Server RAID Array. • Working Experience with Hyper-V and/or VMWare virtualization & cloud computing. • Working Experience with setting up & troubleshooting Networking, Routers & firewall. • Preferred certification: Security+ and OS certification, Linux+, RedHat, Microsoft, etc.

aug5	Restore-L Mission Operations
	This element accounts for all phases of mission operations from planning to ops and end of the mission.
~~1.8~~ 5.1	The contractor shall provide Mission Operations ConOps Timeline Support. This is a mid-level Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on Concept of Operations development, timeline and schedule management, commissioning timeline development. Experience should also include Trending, and Real-Time systems. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in Mission Planning (including Timeline and Scheduling management), Trending, and Real-Time systems. • Translating/populating/managing conversion of Mission Timeline into STK Scheduler tool. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and Ground Networks • Significant input into Mission Concept of Operations (ConOps), Mission Phase Plans, and Flight Operations Plan (FOP) • Seeking professional with ability to conduct meetings, extract information from stakeholders, and plan path to meet CDR deadline for STK scheduler conversion/baseline. • Preferred experience using KBR MPS tool and STK Scheduler • Position may evolve into a Timeline Lead or Mission Planning Lead on the Flight Operations Team (FOT).
~~1.9~~ 5.2	The contractor shall provide a Restore-L Mission Readiness Test (MRT) Lead. This is a Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on development and execution of a testing program to demonstrate readiness to conduct Restore-L mission operations. The MRT Lead will be responsible for developing and baselining the Restore-L Mission Readiness Test Plan by Mission Critical Design Review (CDR). Post CDR, the MRT Lead will be responsible for planning and execution of the MRTs, including rehearsals. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in requirements management, traceability, verification and validation. DOORS experience preferred. • Requires experience in Level 2 test program development including defining stakeholders, configurations, test procedures, artifacts, requirements management, discrepancy reporting and mitigation strategies, test reporting, and leading the MRT test team.

	• Requires ability to lead an integrated test team with representatives from the RGE/MOC, Payload/Robot team, Bus vendor, NASA networks, FDF, and CARA. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and NASA Networks. • Requires supporting End-to-End (ETE) Test Plan development and execution; and matrixing MRTs with other mission test events to ensure all Level 2 requirements have been verified and validated. • Preferred experience in system/software development, observatory integration and test, and flight operations.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 63
Modification: 7
Task Name: Restore-L RGE Support

GSMO-2 SOW Reference: 2.3

I. Task Order History

Mod #	Start	End	Brief Description
0	04/28/2018	4/26/2019	Initial task order statement of work. 1.1, 1.2, & 1.3 moved from TO 21
1	07/01/2018	4/26/2019	Add more engineering support
2	11/01/2018	4/26/2019	Provide Mission Operations ConOps Timeline Support
3	3/15/2019	4/25/2020	Provide a mission readiness test lead, an IT infrastructure engineer, and extend period of performance for one year
4	5/15/2019	4/25/2020	Split Mod 3 SOW into five subtasks
5	6/24/2019	4/25/2020	ITI Engineer - 4.3
6	10/01/2019	4/25/2020	Provide for LFM - 3.3
7	10/14/2019	4/25/2020	Provide for LFM - 3.3 - (b) (4) [redacted]

II. Task Overview

The Restore-L RGE Support task provides engineering support for the Restore-L Ground Element (RGE) Systems: Systems Management, Systems Engineering, Mission Control Systems and IT Infrastructure; and Mission Operations.

III. Requirements

1	**~~Satellite Servicing Projects Division Support~~ Restore-L Ground Element Systems Management Peer Review Support**
1.1~~3~~	The contractor shall provide Ground System peer review board support as required.
2	**Restore-L Ground Element Systems Engineering**
	This element provides for system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.
2.1 ~~1.5~~	The contractor shall provide RGE Systems Engineer in support of Restore-L Ground System: This is a mid to senior ground system engineer position capable of providing system engineering support for the requirement development, interface definition, design, integration and test, verification and validation, and operation of the Restore Ground Element.

	The candidate shall have a strong technical base in the following areas: · Requirements definition and management for a mission ground element and all supporting systems ○ Requirement development in the following areas ▪ Space to Ground communications, with particular emphasis on Space Network and Near Earth Network interfaces and capabilities ▪ Mission Control Functions, including · Observatory Video, Telemetry & Command processing · Ground System Processing and data distribution · Mission Planning · IT Infrastructure and Security ▪ Guidance, Navigation and Control and Flight Dynamics ○ Requirement Rationale development • Familiarity with DOORS requirements management system a plus • Development of an overall V&V plan, including verification events, verification methods, verification descriptions, and verification traces • Documentation development ○ Experience in development and modification of Concept of Operations ○ Support development of Interface Control Documents (ICD)
3	**Restore-L Ground Element Mission Control Systems**
	This element provides for the GOTS support for design and development phases of the ground system.
3~~1~~.1	~~The contractor shall provide MCS Lead in support of Restore-L Ground System: This is a senior development lead position with a general understanding of the full life-cycle development of a ground system for a NASA mission. The person should be capable of leading a team in the design and building of the Mission Control System for a novel technology demonstration mission. The candidate should have a background in general system engineering and be proficient in managing personnel, schedules, and NASA project review developments and presentations.~~ ~~The candidate shall have a strong technical base in the following areas:~~ ~~• Leadership skills for software development teams.~~ ~~• System design for a combination of new development with legacy infrastructure~~ ~~• Requirements definition for a space mission ground system~~ ~~○ Overall understanding of requirement development phases~~ ~~○ Guide requirement formulation process~~ ~~• Understanding how different components interface with each other in requirements and design space~~ ~~○ Telemetry & Command~~ ~~○ Data processing and distribution, including imagery and video~~ ~~○ Mission Planning/Scheduling~~ ~~○ Monitoring & Notification~~

	~~o Data Analysis~~ ~~o IT Infrastructure and Security~~ ~~• Manage T&C and planning interfaces with concurrently developed robotic and flight dynamics systems.~~ ~~• Overall expertise to guide a team in life-cycle development~~ ~~o Requirements formulation, analysis, design, development, integration, testing, and post-launch support.~~ ~~o Software CM and unit test automation~~ ~~• Conduct various NASA level reviews including, design reviews, requirement reviews, integration reviews, and trade studies~~ ~~• Previous experience leading ground software development efforts required.~~ • ~~Experience managing integrated mission schedules~~
3~~1~~.2	The contractor shall provide ITPS and MPS in support of Restore-L Ground System including: • Delivery of current version of GOTS ITPS and MPS software (hence "the products") for installation on Restore's selection from supported Linux platforms • Engineering support for design phase of Restore Ground Element (RGE) to prepare for integration of the products within RGE including o Sizing for hardware platforms (CPU, memory, disk, network) o Performance estimation given Restore data rates and Concept of Operations • Hands on training for RGE development and IT support staff for installation, configuration and operation of the products • Estimation of required hours for modifications to the products to meet Restore specific requirements • An initial tranche of hours to use for modifications to the products • Product support on-call during business hours • Delivery and upgrade support for future versions of the products on request during the Restore mission
3.3 ~~1.4~~	The contractor shall provide MOC Web Operations Tools: • Design, Development, Integration, Test, Deployment, and Sustaining Engineering support for requested tools • Tools in scope: o Rules and Constraints Database (RCDB) o Mission Ops Change Request (MOCR) o Proc Tracking Database (ProcDB) o User Authentication Module (UALite) o Discrepancy Report Database (DR) o Large File Manager (LFM) • Tools shall be updated for Restore-L by modifying/adding subsystems, modifying fields as needed, defining approval groups, and conforming to RGE process flow • Maintenance Manual shall be supplied

	• Sustaining Engineering to provide enhancements and security updates
~~42~~	**Restore-L Ground Element IT Infrastructure**
	This element provides for the ground system engineering and test services for the IT Infrastructure system for the Restore-L mission, accounting for the full life-cycle development of the ground system.
4.1 ~~1.6~~	The contractor shall provide 1 RGE ITI Engineer in support of Restore-L Ground System: This is a mid ground system development position with an emphasis on ground system engineering and test services for the IT Infrastructure system for the Restore-L mission ground system. This position requires experience with ground system definition, development and integration, system administration, and understanding of the full life-cycle development of a ground system for a NASA mission. Under direction from the Restore-L Ground System ITI Lead and senior IT personnel, performs as an Information Technology Infrastructure Design Engineer supporting the Satellite Servicing Projects Division (SSPD) Restore-L project. · Design, build, and support IT infrastructure for new observatory and backup control and I&T support system environments, to include the planning and integration of IT infrastructure that follows NASA requirements, industry standards, and best practices. · Maintains the operational environments once they have been established. · Works as a System Administrator to maintain the Restore-L ground systems (e.g., Dev Lab, MOC, RoboMOC), including implementing directorate requirements for security control and validation. · Performs system hardware research, development, design, and implementation. Makes recommendations for procurements of hardware and applications relative to the requirements of the project. · Provide support in development, maintenance, and follow through of schedules. Be able to maintain tight deadlines on implementation of required support environments. · Generate and present materials at divisional and project-level reviews. Knowledge of various networking technologies, hardware, and software. The ability to plan and coordinate implementations across multiple locations and/or interconnections with other network environments. The contractor shall provide a (b) (4) [redacted] in support of Restore-L Ground System • The (b) (4) [redacted] engineer will coordinate activities for the ITI ground system team
4.2 ~~1.7~~	~~The contractor shall provide IT Security, Systems Engineering, and Ground Systems Engineering support to the RESTORE-L project~~

	~~For IT Security support:~~ ~~Support the development of the Project Protection plan.~~ ~~Ensure the level 3 security requirements are properly flowed to all the ground subsystems.~~ ~~Ensure the IT Infrastructure addresses all of the NASA and NIST security guidance and requirements.~~ ~~Update Restore-L Project Security Plan for CDR and ORR.~~ ~~Develop any Ground System IT Security documentation needed for CDR and ORR.~~ ~~Develop any IT Security presentation material needed for CDR and ORR.~~ ~~Collaborate with Restore-L project team, Code 700 and Code 400 IT Security organizations.~~
~~1.10~~ 4.3	The contractor shall provide an IT Infrastructure Engineer. Duties include: • Provide efficient and effective Operations Support of all supported network servers, both physical and virtual, as necessary to meet or exceed agency's operational availability and performance requirements. • Provide for accurate, complete, and timely recording and reporting of all technical support-related activities, issues, and outcomes. • Support, maintain, and enhance as required, established strategies for server operations to ensure continuity of agency's business operations and timely recovery. • Collect, store, and analyze data relevant to monitored servers to perform and report accurate root causal analysis of all related issues and support trend analysis and forecasting. • Effectively manage the procurement and maintenance of all supplies, materials, and supporting software licenses and service agreements required to ensure supported network servers meet minimum performance and availability requirements. • Excellent communication, customer service, time management, conflict resolution, and problem determination/resolution skills. • Interacts with users and evaluates vendor products. • Makes recommendations to purchase hardware and software, coordinates installation and provides backup recovery. Experience includes: • Solid knowledge of Linux, operating systems concepts and extensive systems administration experience related to CentOS, RedHat and/or SuSE. • Experience with one or more of the following Windows Server administration tools: WSUS, Group Policy, Active Directory, RDP, and Windows Server troubleshooting. • GOTS/COTS application, installation, configuration, and troubleshooting;

	including OS hardening. • Dell Hardware installation, configuration, troubleshooting; including Server RAID Array. • Working Experience with Hyper-V and/or VMWare virtualization & cloud computing. • Working Experience with setting up & troubleshooting Networking, Routers & firewall. • Preferred certification: Security+ and OS certification, Linux+, RedHat, Microsoft, etc.
aug5	**Restore-L Mission Operations**
	This element accounts for all phases of mission operations from planning to ops and end of the mission.
~~1.8~~ 5.1	The contractor shall provide Mission Operations ConOps Timeline Support. This is a mid-level Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on Concept of Operations development, timeline and schedule management, commissioning timeline development. Experience should also include Trending, and Real-Time systems. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc. • Requires experience in Mission Planning (including Timeline and Scheduling management), Trending, and Real-Time systems. • Translating/populating/managing conversion of Mission Timeline into STK Scheduler tool. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and Ground Networks • Significant input into Mission Concept of Operations (ConOps), Mission Phase Plans, and Flight Operations Plan (FOP) • Seeking professional with ability to conduct meetings, extract information from stakeholders, and plan path to meet CDR deadline for STK scheduler conversion/baseline. • Preferred experience using KBR MPS tool and STK Scheduler • Position may evolve into a Timeline Lead or Mission Planning Lead on the Flight Operations Team (FOT).
~~1.9~~ 5.2	The contractor shall provide a Restore-L Mission Readiness Test (MRT) Lead. This is a Mission Operations position requiring broad experience in the Systems Engineering discipline, with a focus on development and execution of a testing program to demonstrate readiness to conduct Restore-L mission operations. The MRT Lead will be responsible for developing and baselining the Restore-L Mission Readiness Test Plan by Mission Critical Design Review (CDR). Post CDR, the MRT Lead will be responsible for planning and execution of the MRTs, including rehearsals. The candidate must be able to operate with a high level of autonomy, interfacing directly with PDLs, MSE, RGE, SSL (spacecraft vendor), etc.

	• Requires experience in requirements management, traceability, verification and validation. DOORS experience preferred. • Requires experience in Level 2 test program development including defining stakeholders, configurations, test procedures, artifacts, requirements management, discrepancy reporting and mitigation strategies, test reporting, and leading the MRT test team. • Requires ability to lead an integrated test team with representatives from the RGE/MOC, Payload/Robot team, Bus vendor, NASA networks, FDF, and CARA. • Will require an in-depth knowledge of the Restore-L Servicing Vehicle (RSV), Mission ConOps, Constraints, and NASA Networks. • Requires supporting End-to-End (ETE) Test Plan development and execution; and matrixing MRTs with other mission test events to ensure all Level 2 requirements have been verified and validated. • Preferred experience in system/software development, observatory integration and test, and flight operations.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 64
Modification: 2
Task Name: ICESat-2 Spacecraft Sustaining Engineering and Anomaly Support

GSMO-2 SOW Reference: 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	11/13/2018	06/29/2019	Initial task order statement of work.
1	03/01/2019	06/29/2019	Fix the LRS anomaly and support root cause analysis
2	06/30/2019	06/27/2020	Task Mod Extension for 2019-2020 and additional Sustaining Engineering Scope

II. Task Overview

The ICESat-2 Spacecraft Sustaining Engineering and Anomaly Support task provides system engineering for the spacecraft bus and all of the spacecraft subsystems in the analysis and resolution identification of problems encountered.

Subtask 1: Covers all work associated with Anomaly Analysis and Resolution Support.
Subtask 2: Covers all work associated with Monitoring of the Mission Operations Center and Subsystem support for emergency or quick response operational and/or security modifications.
Subtask 3: Covers all work associated with Spacecraft Sustaining Engineering support.

III. Requirements

1	Anomaly Analysis and Resolution Support
1.1	The contractor shall support analysis and resolution of observatory anomalies as determined in the negotiated task modification.
1.2	The contractor shall advise the MD and the FOT regarding the impact of the identified anomaly on the affected system, systems, or the performance of the Observatory.
1.3	The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Observatory.
1.4	The contractor shall also participate in the determination of root cause as related to the spacecraft bus.
1.5	The contractor shall submit or contribute to an anomaly report containing spacecraft anomaly conditions, insights on root cause related to the spacecraft, and corrective or preventive actions for each anomaly.

1.6	The contractor shall closely coordinate efforts through all phases of Anomaly Resolution with the MD and the FOT.

2	**Mission Operations Center Anomaly and Quick Response Support**
2.1	The contractor shall support analysis and resolution of ground system anomalies as determined in the negotiated task modification.
2.2	The contractor shall advise the MD regarding the impact of the identified operations and/or security modification on the affected system or systems.
2.3	The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Mission Operations Center and the Observatory.
2.4	The contractor shall implement the agreed upon solution or remedy.
2.5	The contractor shall closely coordinate efforts through all phases of solution with the MD and the FOT.

3	**Spacecraft Sustaining Engineering Support**
3.1	The contractor shall support Sustaining Engineering as determined in the negotiated task modification.
3.2	The contractor shall advise the MD regarding the impact (technical and cost) of the identified special engineering activity on the affected system or systems.
3.3	The contractor shall provide engineering support for the spacecraft for all special engineering activities.
3.4	The contractor shall implement the agreed upon solution or remedy.
3.5	The contractor shall closely coordinate efforts through all phases of solution with the MD and the FOT.
3.6	The contractor shall support ICESat-2 Performance review meetings 2x per year to review subsystem trending and life limiting items with NASA personnel.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 64
Modification: 4
Task Name: ICESat-2 Spacecraft Sustaining Engineering and Anomaly Support

GSMO-2 SOW Reference: 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	11/13/2018	06/29/2019	Initial task order statement of work.
1	03/01/2019	06/29/2019	Fix the LRS anomaly and support root cause analysis
2	06/30/2019	06/27/2020	Task Mod Extension for 2019-2020 and additional Sustaining Engineering Scope
3	06/28/2019		Admin mod
4	10/28/2019	06/27/2020	Increase scope to support ICESat-2 anomalies

II. Task Overview

The ICESat-2 Spacecraft Sustaining Engineering and Anomaly Support task provides system engineering for the spacecraft bus and all of the spacecraft subsystems in the analysis and resolution identification of problems encountered.

Subtask 1: Covers all work associated with Anomaly Analysis and Resolution Support.
Subtask 2: Covers all work associated with Monitoring of the Mission Operations Center and Subsystem support for emergency or quick response operational and/or security modifications.
Subtask 3: Covers all work associated with Spacecraft Sustaining Engineering support.

III. Requirements

1	Anomaly Analysis and Resolution Support
1.1	The contractor shall support analysis and resolution of observatory anomalies as determined in the negotiated task modification.
1.2	The contractor shall advise the MD and the FOT regarding the impact of the identified anomaly on the affected system, systems, or the performance of the Observatory.
1.3	The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Observatory.
1.4	The contractor shall also participate in the determination of root cause as related to the spacecraft bus.

1.5	The contractor shall submit or contribute to an anomaly report containing spacecraft anomaly conditions, insights on root cause related to the spacecraft, and corrective or preventive actions for each anomaly.
1.6	The contractor shall closely coordinate efforts through all phases of Anomaly Resolution with the MD and the FOT.

2	**Mission Operations Center Anomaly and Quick Response Support**
2.1	The contractor shall support analysis and resolution of ground system anomalies as determined in the negotiated task modification.
2.2	The contractor shall advise the MD regarding the impact of the identified operations and/or security modification on the affected system or systems.
2.3	The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Mission Operations Center and the Observatory.
2.4	The contractor shall implement the agreed upon solution or remedy.
2.5	The contractor shall closely coordinate efforts through all phases of solution with the MD and the FOT.

3	**Spacecraft Sustaining Engineering Support**
3.1	The contractor shall support Sustaining Engineering as determined in the negotiated task modification.
3.2	The contractor shall advise the MD regarding the impact (technical and cost) of the identified special engineering activity on the affected system or systems.
3.3	The contractor shall provide engineering support for the spacecraft for all special engineering activities.
3.4	The contractor shall implement the agreed upon solution or remedy.
3.5	The contractor shall closely coordinate efforts through all phases of solution with the MD and the FOT.
3.6	The contractor shall support ICESat-2 Performance review meetings 2x per year to review subsystem trending and life limiting items with NASA personnel.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 65
Modification: 1
Task Name: XRISM/Resolve I&T Support

GSMO-2 SOW Reference: 2.3.2.4

I. Task Order History

Description of current modification (Modification 1): This task order initiates the period of performance for the continuance of a Senior Test Conductor and the addition of a Network Engineer/IT security person to support the Integration and Test effort, for the XRISM/Resolve Instrument.

Mod #	Start	End	Brief Description
0	08/25/2018	7/27/2019	Initial task order statement of work
1	04/01/2019	7/27/2019	Add IT security Support

II. Task Overview

This task is for XRISM/Resolve Instrument support here at GSFC, and continued support for post-ship testing in Japan.

The I&T effort at GSFC is unique in that instrument subsystems are assembled and tested in GSFC facilities, then de-integrated for shipment to JAXA. The final Instrument I&T will be performed by JAXA in Japan. The Ground Data System will consist of ASIST, and will utilize heritage material from ASTRO-H. As this is a small team environment personnel will be required to perform their primary duties, and help out with other duties as necessary.

III. Scope of Work

The contractor shall provide test conductor support with experience developing pages, databases, scripts and configuration of the ASIST Ground Data System for Integration and Testing of flight projects. In addition, experience with the ASTRO-E2 and/or ASTRO-H I&T projects or other JAXA-related programs is helpful.

Modification 1

In addition to the above, the contractor shall provide Network Engineering/Information Technology(IT) support to the project. This person shall be the POC for all project related IT security issues. They will be responsible for the design, development and implementation of the XRISM Test Network, ensuring all Agency IT requirements are met.

A. Requirements

The contractor shall provide I&T TC support.

The contractor shall provide I&T Network Engineering support.

The technical point-of-contact for i [redacted]

B. Management Reporting

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS(s) to adequately describe the activities of the task to the Task Monitor.

C. Contractor Controlled Property

The contractor shall assist the GSMO contract managers and property custodians in maintaining the overall list (NPROP) of government owned property used by the Contractor on this Task Order. This support includes preparation and cooperation during property audits.

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

The government will provide some civil servant support furnish cleanroom and associated test areas, as well as test systems and other I&T GSE

The contractor shall provide Systems Administration service and support equipment required for both onsite & offsite contractor functions

V. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VI. Travel Support

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

There is no travel requirements anticipated during the period of performance.

VII. Deliverables

ASIST Database
ASIST Displays

ASIST Scripts
Weekly and monthly status reports

IT Security Plan
Network Configuration Diagram

GSMO TASK ORDER

Task No: **65**
Modification: ~~0~~ ~~1~~ 3
Task Name: XRISM/Resolve I&T Support
GSMO SOW Reference: 2.3.2.4

I. Task Order History

Description of current modification (Modification 1): This task order initiates the period of performance for the continuance of a Senior Test Conductor and the addition of a Network Engineer/IT security person to support the Integration and Test effort, for the XRISM/Resolve Instrument.

Mod #	Start	End	Brief Description
0	08/01/2018	**07**/27/2019	Initial task order statement of work
1	04/01/2019	07/27/2019	Add IT security Support
2	06/20/2019		Admin Mod
3	07/28/2019	07/25/2020	1-year POP extension

II. Background

This task is for XRISM/Resolve Instrument support here at GSFC, and continued support for post-ship testing in Japan.

The I&T effort at GSFC is unique in that instrument subsystems are assembled and tested in GSFC facilities, then deintegrated for shipment to JAXA. The final Instrument I&T will be performed by JAXA in Japan. The Ground Data System will consist of ASIST, and will utilize heritage material from ASTRO-H. As this is a small team environment personnel will be required to perform their primary duties, and help out with other duties as necessary.

III. Scope of Work

The contractor shall provide test conductor support with experience developing pages, databases, scripts and configuration of the ASIST Ground Data System for Integration and Testing of flight projects. In addition, experience with the ASTRO-E2 and/or ASTRO-H I&T projects or other JAXA-related programs is helpful.

Modification 1

In addition to the above, the contractor shall provide Network Engineering/Information Technology(IT) support to the project. This person shall be the POC for all project

related IT security issues. They will be responsible for the design, development and implementation of the XRISM Test Network, ensuring all Agency IT requirements are met.

Modification 3

The contractor shall provide the above-mentioned services for the duration of the POP extension to support work detailed in section A (Requirements) of this document below.

A. Requirements

The contractor shall continue to provide I&T TC support.

The contractor shall continue to provide I&T Network Engineering support.

The technical point-of-contact for is [redacted]

B. Management Reporting

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS(s) to adequately describe the activities of the task to the Task Monitor.

C. Contractor Controlled Property

The contractor shall assist the GSMO contract managers and property custodians in maintaining the overall list (NPROP) of government owned property used by the Contractor on this Task Order. This support includes preparation and cooperation during property audits.

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

The government will provide some civil servant support furnish cleanroom and associated test areas, as well as test systems and other I&T GSE

The contractor shall provide Systems Administration service and support equipment required for both onsite & offsite contractor functions

V. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VI. Travel Support

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

~~There is no travel requirements anticipated during the period of performance.~~

Modification 2

(b) (4) [redacted]

VII. Deliverables

From the TC:
ASIST Database
ASIST Displays
ASIST Scripts

From the IT Engineer:
Network diagram
Security plan

Weekly and monthly status reports

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 66
Modification: 1
Task Name: CCSDS Cross Support and Technical Editor Services

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GSMO-2 SOW Reference: 2.1, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	08/25/2018	08/24/2019	Initial task order statement of work.
1	01/14/2019	08/24/2019	Increase support level to match the increase in number of documents per year to edit and manage, train junior editor

The scope of work in this task was previously managed as Task 037, Subtask 2.

II. Task Overview

The Consultative Committee for Space Data Systems (CCSDS) Cross Support Service Management team supports the development of international space data standards to promote interoperability and cross support amongst cooperating space agencies enabling multi-agency spaceflight collaboration and new capability for future missions.

The task also includes activities of the CCSDS Chief Technical Editor for the editing, maintenance, and updating of international space data systems documents and the tracking of all CCSDS publications.

III. Requirements

	CCSDS Cross Support Service Management
A1	The contractor shall support the development of international space data standards to promote interoperability and cross support amongst cooperating space agencies enabling multi-agency spaceflight collaboration and new capability for future missions.
A2	The contractor shall provide technical expertise in the discipline of Service Management.
A3	The contractor shall participate and support the CCSDS technical working group – Cross Support Service Management.
A4	The contractor shall support the development of international space standards, which address arranging, scheduling, controlling, and monitoring Telemetry, Tracking, and Commanding services.

	CCSDS Chief Technical Editor Activities
B1	The contractor shall establish review schedules, initiate international reviews by distributing review announcements to the CCSDS reviewer categories, and release all review materials, including review documents, Review Item Disposition (RID) initiation forms, and contact information for CCSDS, NASA, and NASA Center review coordinators. Release is by distribution via electronic media from the CCSDS Web site.
B2	The contractor shall work closely with other Secretariat support staff to assure that the technical content of the CCSDS Web site is current and complete.
B3	The contractor shall track and report monthly on the progress/status of CCSDS documents that have been delivered to the Secretariat for processing or are maintained by the Secretariat.
B4	(b) (4) [redacted]
B5	The contractor shall, at every CCSDS Technical Plenary meeting, conduct a training course on CCSDS processes and methods for developing CCSDS standards.
B6	The contractor shall attend CCSDS management meetings as requested either in-person or via telecon as appropriate. This includes bi-weekly telecons of the NASA Data Standards Steering Group (NDSSC) and the bi-annual telecons or meetings of the NASA Data Standards Working Group (NDSWG).
B7	The contractor shall provide document-development support to CCSDS members on an as-needed basis.
B8	The contractor shall create and initiate polls for CESG and CMC approval to release CCSDS documents for international review or publication; oversee resolution of any conditions for approval contained in the poll results.
B9	The contractor shall support the training of supplemental team member(s) in the area of technical editing and lifecycle document management. Note that the additional support may or may not be added under this task or contractor.
B10	The contractor shall review submitted documents and provide technical editing services prior to their release for formal review. It is understood that the workload in this area will vary throughout the year depending on the backlog of submitted documents.

IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

All travel shall be approved by NASA and the contractor prior to travel.

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]
[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 66
Modification: 2
Task Name: CCSDS Cross Support and Technical Editor Services

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GSMO-2 SOW Reference: 2.1, 2.6

I. Task Order History

Mod #	Start	End	Brief Description
0	08/25/2018	08/24/2019	Initial task order statement of work.
1	01/14/2019	08/24/2019	Increase support level to match the increase in number of documents per year to edit and manage, train junior editor
2	8/25/2019	8/29/2020	Extend period of performance; Adding element A5 to the Requirements.

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The scope of work in this task was previously managed as Task 037, Subtask 2.

II. Task Overview

The Consultative Committee for Space Data Systems (CCSDS) Cross Support Service Management team supports the development of international space data standards to promote interoperability and cross support amongst cooperating space agencies enabling multi-agency spaceflight collaboration and new capability for future missions.

The task also includes activities of the CCSDS Chief Technical Editor for the editing, maintenance, and updating of international space data systems documents and the tracking of all CCSDS publications.

III. Requirements

	CCSDS Cross Support Service Management
A1	The contractor shall support the development of international space data standards to promote interoperability and cross support amongst cooperating space agencies enabling multi-agency spaceflight collaboration and new capability for future missions.
A2	The contractor shall provide technical expertise in the discipline of Service Management.
A3	The contractor shall participate and support the CCSDS technical working group – Cross Support Service Management.

A4	The contractor shall support the development of international space standards, which address arranging, scheduling, controlling, and monitoring Telemetry, Tracking, and Commanding services.
A5	The contractor shall present ideas for enhanced support within the scope of the assigned working group. This could include concepts for prototypes and tool development, increased interaction with NASA missions, and technical studies beyond the normal working group support level. These ideas will be used for NASA Data Standards planning and may or may not result in additional funding for this task.
	CCSDS Chief Technical Editor Activities
B1	The contractor shall establish review schedules, initiate international reviews by distributing review announcements to the CCSDS reviewer categories, and release all review materials, including review documents, Review Item Disposition (RID) initiation forms, and contact information for CCSDS, NASA, and NASA Center review coordinators. Release is by distribution via electronic media from the CCSDS Web site.
B2	The contractor shall work closely with other Secretariat support staff to assure that the technical content of the CCSDS Web site is current and complete.
B3	The contractor shall track and report monthly on the progress/status of CCSDS documents that have been delivered to the Secretariat for processing or are maintained by the Secretariat.
B4	(b) (4) [redacted]
B5	The contractor shall, at every CCSDS Technical Plenary meeting, conduct a training course on CCSDS processes and methods for developing CCSDS standards.
B6	The contractor shall attend CCSDS management meetings as requested either in-person or via telecon as appropriate. This includes bi-weekly telecons of the NASA Data Standards Steering Group (NDSSC) and the bi-annual telecons or meetings of the NASA Data Standards Working Group (NDSWG).
B7	The contractor shall provide document-development support to CCSDS members on an as-needed basis.
B8	The contractor shall create and initiate polls for CESG and CMC approval to release CCSDS documents for international review or publication; oversee resolution of any conditions for approval contained in the poll results.
B9	The contractor shall support the training of supplemental team member(s) in the area of technical editing and lifecycle document management. Note that the additional support may or may not be added under this task or contractor.
B10	The contractor shall review submitted documents and provide technical editing services prior to their release for formal review. It is understood that the workload in this area will vary throughout the year depending on the backlog of submitted documents.

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IV. Government Furnished Facilities, Equipment, and Software

There are no Government furnished facilities, equipment, or software associated with this Task Order.

V. Travel

All travel shall be approved by NASA and the contractor prior to travel.

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

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VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 67
Modification: 1
Task Name: Restore-L T&C conversion effort for I&T

GSMO-2 SOW Reference: 2.4.1

I. Task Order History

Mod #	Start	End	Brief Description
0	9/4/18	8/24/19	Initial task order statement of work.
1	8/25/19	8/29/20	Continuation of support

II. Task Overview

The *Restore-L T&C conversion effort for I&T* task provides leadership of the planning, coordination and implementation of the conversion between the Spacecraft vendor proprietary T&C system and the Restore-L T&C system (ASIST - to be used in Restore Servicing Vehicle [RSV] I&T and on-orbit operations). Involves converting T&C databases, pages, procs, scripts, etc..

Subtask 1: Covers all work associated with the task overview above. *Only one subtask anticipated.*

III. Requirements

1	**Restore-L T&C Conversion effort for I&T**
1.1	**Coordination**
1.1.1	The contractor shall work with appropriate Spacecraft vendor point(s) of contact, in-person and remotely, to obtain familiarity with Spacecraft vendor T&C system.
1.1.2	The contractor shall establish a Non-Disclosure Agreement (NDA) with the Spacecraft vendor to handle proprietary vendor information.
1.2	**Planning**
1.2.1	The contractor shall generate a documented plan and process for conversion of the vendor T&C system to ASIST.
1.2.2	The contractor shall generate an implementation schedule and identify all resources needed, estimating associated costs.
1.2.3	The contractor shall work with the Restore-L Project to assure the plan meets the mission needs by presenting plans and participating in reviews.
1.3	**Implementation**
1.3.1	The contractor shall perform the conversions required to support the RSV I&T phase at GSFC.

1.3.2	The contractor shall test all conversions against a Spacecraft simulator and/or the system-level Flatsat.
1.3.3	The contractor shall support, upon Spacecraft delivery to GSFC, the initial Spacecraft Reference Performance Test performed using ASIST.
1.3.4	The contractor shall support I&T testing throughout the duration of RSV I&T, including at the launch site.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 67
Modification: 2
Task Name: Restore-L T&C conversion and simulator support for I&T

GSMO-2 SOW Reference: 2.4.1

I. Task Order History

Mod #	Start	End	Brief Description
0	9/4/18	8/24/19	Initial task order statement of work.
1	8/25/19	8/29/20	Continuation of support
2	10/7/19	8/29/20	Add simulator support

II. Task Overview

The *Restore-L T&C conversion and simulator support for I&T* task provides

1) Leadership of the planning, coordination and implementation of the conversion between the Spacecraft vendor proprietary T&C system and the Restore-L T&C system (ASIST - to be used in Restore Servicing Vehicle [RSV] I&T and on-orbit operations). Involves converting T&C databases, pages, procs, scripts, etc..
2) Design, development, integration and test support for the Video Distribution and Storage Unit (VDSU) emulator, a component of the RESTORE-L Servicing Payload Electrical Interface Simulator (SPEIS), and Servicing Payload Software Simulator (SPSS)

Subtask 1: Covers all work associated with the task overview above. *Only one subtask anticipated.*

III. Requirements

1	**Restore-L T&C Conversion effort for I&T**
1.1	**Coordination**
1.1.1	The contractor shall work with appropriate Spacecraft vendor point(s) of contact, in-person and remotely, to obtain familiarity with Spacecraft vendor T&C system.
1.1.2	The contractor shall establish a Non-Disclosure Agreement (NDA) with the Spacecraft vendor to handle proprietary vendor information.
1.2	**Planning**
1.2.1	The contractor shall generate a documented plan and process for conversion of the vendor T&C system to ASIST.
1.2.2	The contractor shall generate an implementation schedule and identify all resources needed, estimating associated costs.

1.2.3	The contractor shall work with the Restore-L Project to assure the plan meets the mission needs by presenting plans and participating in reviews.
1.3	**Implementation**
1.3.1	The contractor shall perform the conversions required to support the RSV I&T phase at GSFC.
1.3.2	The contractor shall test all conversions against a Spacecraft simulator and/or the system-level Flatsat.
1.3.3	The contractor shall support, upon Spacecraft delivery to GSFC, the initial Spacecraft Reference Performance Test performed using ASIST.
1.3.4	The contractor shall support I&T testing throughout the duration of RSV I&T, including at the launch site.
2	**RESTORE-L Simulator Support**
2.1	**Documentation and Review**
2.1.1	The contractor shall review, provide input, and update simulator documentation including but not limit to requirements, design specification, integration and test plan, user guide, version description document as coordinated with TM.
2.1.2	The contractor shall participate in the simulator review preparation and presentation such as (but not limit to) engineering peer review, test readiness review, pre-ship review as coordinated with TM
2.2	**Development, Integration and Test**
2.2.1	The contractor shall design, develop, and test VDSU simulation to meet requirements specified in the SPEIS/SPSS system requirement document
2.2.2	The contractor shall perform integration and test of VDSU simulation with SPEIS/SPSS as coordinated with TM.
2.2.3	The contractor shall develop test procedures necessary to perform requirement verification for VDSU simulation as coordinated with TM
	The contractor shall support the development and execution of SPEIS acceptance test procedure (requirement verification) as coordinated with TM
2.2.4	The contractor shall participate in technical meetings, reviews, and technical working groups as coordinated with TM to communicate/coordinate/resolve technical issues with stakeholders.
2.3	**User and Operation Support**
2.3.1	The contractor shall provide training for users in installing, configuring, running, and maintaining VDSU emulator as coordinated with TM.
2.3.2	The contractor shall support installation and integration of VDSU emulator into user/operation infrastructure
2.3.3	The contractor shall support VDSU emulator operation by providing oversight of execution and troubleshooting as coordinated with TM

Commented [SP1]: Highlighted new items in yellow

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 70
Modification: 2
Task Name: Landsat 9 Mission Operations Readiness Support

GSMO-2 SOW Reference: 3.2

I. Task Order History

Mod #	Start	End	Brief Description
0	10/01/18	9/28/2019	Initial task order statement of work.
1	10/16/18		Admin change
2	9/29/19	9/26/2020	One year task extension

II. Task Overview

The Landsat 9 Mission Operations Readiness Support task provides technical engineering support for the mission readiness activities, the launch campaign and commissioning of the L9 observatory prior to handover to USGS. The mission readiness activities include, but are not limited to, execution of Mission Readiness Tests (MRTs), Network Readiness Tests (NRTs), Connectivity Tests (CTs), and Mission Simulations.

Landsat 9 was fast-tracked for a December 2020 launch.

III. Requirements

1	Landsat 9 Mission Operations Readiness Support
1.0	The contractor shall perform support services for Landsat-9 mission readiness, launch and commissioning and report to the Landsat-9 Mission Operations Readiness Manager
2.0	The contractor shall conduct Mission Simulations, including the injection of realistic anomalies, of the Landsat-9 observatory in order to assess the readiness of the team
2.1	The contractor shall work with the Flight Operations Team shall create the scripts required for the setup of the simulator
2.1	The contractor shall work with the spacecraft and instrument vendors to create scripts to inject realistic anomalies
2.2	The contractor shall provide an assessment of the team's performance during the Mission Simulation
2.3	The Contractor shall manage the scheduling and usage of all L9 simulators
3.0	The Contractor shall provide a Flight System Test Lead
3.1	The Contractor shall develop the Integration Mission Timeline

IV. Government Furnished Property/Facilities and Software

There is Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

Government Furnished Property/Facilities Description
The Government will provide office area or support room will be provided for support personnel during the build-out.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The contractor shall include an estimate for this local travel as part of their response to this SOW.

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The list of task deliverables should include:

ID	Deliverable Description	Due Date
1	Technical briefings and presentations	As requested
2	Status Reports	Weekly
3	Provide infrastructure configuration management and documentation in the form of "As Built" drawings (if applicable).	End of Task

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 71
Modification: 0
Task Name: Next Generation Ground Segment Systems Engineering

GSMO-2 SOW Reference: 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	1-Jan-19	26-Apr-19	Initial task order statement of work.

II. Task Overview

The Next Generation (Gen) Ground Segment Systems Engineering (SE) task provides SE support to assist the Space Network (SN) Project with the Next Gen Ground Segment. The Next Gen Ground Segment will support the Space Communications and Navigation (SCaN) Next Generation Relay, consisting of both optical and RF services, and direct-to-earth optical services. The contractor will provide SE services for the Next Gen Ground Segment development effort. Experience in optical communication systems is preferred but not required.

Subtask 1: Covers SE support of the Next Gen Ground Segment within the SN Project.

III. Requirements

1	**Next Gen Ground Segment SE Support within the SN Project**
1.1	**General SE support**
1.1.1	The contractor shall provide SE support as needed and appropriate within the Next Gen Ground Segment development effort. The level and type of support will vary per development activity, as agreed upon with the task monitor.
1.1.2	The contractor shall review and critique documents of interest to the Next Gen Ground Segment development effort, as coordinated with the task monitor.
1.1.3	As coordinated with the task monitor, the contractor shall support development of a concept of operations for the Next Gen Ground Segment.
1.1.4	As coordinated with the task monitor, the contractor shall support development of a preliminary architecture description for the Next Gen Ground Segment.
1.1.5	As coordinated with the task monitor, the contractor shall support development of system requirements for the Next Gen Ground Segment.
1.1.6	The contractor shall support the preparations for and execution of the Next Gen Ground Segment Concept Review.
1.2	**SE collaboration with other participants**

1.2.1	The contractor shall provide the SE support described in 1.1 in collaboration with assigned civil servants and contractors on the effort.
1.2.2	The contractor shall support SE-related technical meetings, as coordinated with the task monitor.
1.2.3	The contractor shall complete and adhere to Non Disclosure Agreements (NDAs) with participating contractors, as required, in order to fulfill its role as a member of the team.

IV. Government Furnished Property/Facilities and Software

There is no Government-Furnished Property/Facilities (GFP/GFF) associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The contractor shall propose any travel considered necessary to perform the work associated with this Task Order.

VI. Material Procurement

The contractor shall propose any materials considered necessary to perform the work associated with this Task Order.

VII. Deliverables

ID	Deliverable Description	Due Date
1	**Next Gen Ground Segment Concept of Operations Inputs** – Inputs to a preliminary concept of operations for the Next Gen Ground Segment.	Initial version 1 month after receipt of task order (ARTO); updates at least monthly and as coordinated with the government team
2	**Next Gen Ground Segment Architecture Description Inputs** – Inputs to a preliminary architecture description for the Next Gen Ground Segment.	3 months ARTO; updates at least

		monthly and as coordinated with the government team.
3	**Next Gen Ground Segment Requirements Inputs** – Inputs, including complete, concise requirements statements, for the preliminary Next Gen Ground Segment system-level requirements set in preparation for the Concept Review.	6 months ARTO; updates at least monthly and as coordinated with the government team
4	**Next Gen Ground Segment Concept Review Inputs** – Inputs to Presentation materials associated with the Concept Review.	Working drafts bi-weekly and final 7 months ARTO
5	**Monthly Cost Review Reports and Briefings –** Status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this task order.	Monthly, generally within one week of delivery of the associated NASA 533M Report unless otherwise scheduled with the task monitor
6	**Task Progress Reports** – Progress report of all work accomplished during each week of task order performance and projected work activities to be performed during the next reporting period.	Weekly

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 72
Modification: 0
Task Name: LISA Management Support

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	03/01/2019	02/22/2020	Initial task order statement of work.

II. Task Overview

The Contractor shall provide instrument and project management support, with conformance to appropriate practices and specifications (see the NPR 7120.5 NPR 7120.5, NASA Space Flight Program and Project Management Requirements). Support shall include but not be limited to: developing and tracking technology development milestones, developing cost and schedule estimates, managing tracking and reporting on cost and schedule, implementing risk management, supporting lifecycle and independent peer reviews, providing weekly and monthly reporting, and supporting ESA's lifecycle reviews and mission development.

The Laser Interferometer Space Antenna (LISA) Project is an international collaboration between NASA and the European Space Agency (ESA) to build a space-based, gravitational wave observatory. As a junior partner, NASA is developing and delivering mission enabling technologies including telescopes, a laser system, a Charge Management System, a Phasemeter and Micro-thrusters.

Required skills/knowledge – Instrument and project management experience working with international partners.

III. Requirements

1	LISA Management Support
1.1	The Contractor shall provide instrument and project management support, with conformance to appropriate practices and specifications (see the NPR 7120.5 NPR 7120.5, NASA Space Flight Program and Project Management Requirements). Support shall include but not be limited to: developing and tracking technology development milestones, developing cost and schedule estimates, managing tracking and reporting on cost and schedule, implementing risk management, supporting lifecycle and independent peer reviews, providing weekly and monthly reporting, and supporting ESA's lifecycle reviews and mission development.

1.2	The contractor shall staff this work item with the appropriate skill mix and staffing level for the work.
1.3	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.
1.4	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. NOTE: There will not be any handling of classified data.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

Location	*Duration*	*Dates*
(b) (4) [redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 72
Modification: 2
Task Name: LISA Management Support

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	03/01/2019	02/22/2020	Initial task order statement of work.
1	12/16/2019		Admin Mod
2	02/23/2020	02/27/2021	Extend task for one year

II. Task Overview

The Contractor shall provide instrument and project management support, with conformance to appropriate practices and specifications (see the NPR 7120.5 NPR 7120.5, NASA Space Flight Program and Project Management Requirements). Support shall include but not be limited to: developing and tracking technology development milestones, developing cost and schedule estimates, managing tracking and reporting on cost and schedule, implementing risk management, supporting lifecycle and independent peer reviews, providing weekly and monthly reporting, and supporting ESA's lifecycle reviews and mission development.

The Laser Interferometer Space Antenna (LISA) Project is an international collaboration between NASA and the European Space Agency (ESA) to build a space-based, gravitational wave observatory. As a junior partner, NASA is developing and delivering mission enabling technologies including telescopes, a laser system, a Charge Management System, a Phasemeter and Micro-thrusters.

Required skills/knowledge – Instrument and project management experience working with international partners.

III. Requirements

1	LISA Management Support
1.1	The Contractor shall provide instrument and project management support, with conformance to appropriate practices and specifications (see the NPR 7120.5 NPR 7120.5, NASA Space Flight Program and Project Management Requirements). Support shall include but not be limited to: developing and tracking technology development milestones, developing cost and schedule estimates, managing tracking and reporting on cost and schedule, implementing risk management, supporting lifecycle and

	independent peer reviews, providing weekly and monthly reporting, and supporting ESA's lifecycle reviews and mission development.
1.2	The contractor shall staff this work item with the appropriate skill mix and staffing level for the work.
1.3	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.
1.4	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. NOTE: There will not be any handling of classified data.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

Location	*Duration*	*Dates*
(b) (4) [redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 73
Modification: 0
Task Name: LOCNESS Comm Data Systems Support

GSMO-2 SOW Reference: 2.1, 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	03/18/2019	09/28/2019	Initial task order statement of work.

II. Task Overview

This task shall develop and document an end to end, well-coordinated system-wide view of the data flow through the relay network system. This effort is intended to mitigate the risk of a miscommunication of requirements, design conflict, incompatibility, or other negative impact between LOCNESS subsystems and disciplines.

The Laser Optical Near-Earth Satellite System (LOCNESS) Project at GSFC is to develop, procure and launch a space-based, operational laser optical communications relay satellite utilizing next generation optical communication technology for space-to-ground links, user links, and relay crosslinks. LOCNESS consists of the optical comm payload and the spacecraft (bus) (with a ka-band comm) to provide user relay services. The optical comm payload consists of four (4) optical relay terminals and payload electronics.

III. Requirements

1	**LOCNESS Comm Data Systems Support**
1.1	**Senior Communications Engineering support**
1.1.1	The contractor shall provide Senior Communications Engineering support to the LOCNESS Project.
1.1.2	The contractor shall define and maintain a baselined definition of protocol stack later definitions for the various segments of communication links to, from, and through the LOCNESS.
1.1.3	The contractor shall maintain and develop a complete knowledge and understanding of the full end to end data flow of user data through the LOCNESS flight and ground systems, as well as Command and Telemetry data to/from the LOCNESS payload. This includes ground systems, flight systems, and user-based systems.
1.1.4	The contractor shall work with the LOCNESS team to communicate and coordinate end-to-end data flow and data path considerations into the design process of various sub-systems within LOCNESS.

1.1.5	The contractor shall directly support the software and firmware development efforts for LOCNESS flight payload, while bringing the perspective of overall data flow and communication stack layers to infuse into the software and firmware designs.
1.1.6	The contractor shall support the LOCNESS Project technical team meetings, design reviews, in-house and out-of-house proposals included but not limited to various systems designs, systems standard interface and requirements, and standard of test and verification approach.
1.1.7	The contractor shall assess proposed Software Defined Network solutions for NextGen Optical Comm and application for the LOCNESS Relay Node. This includes implementation of Delayed/Disruption Tolerant Networking (DTN).
~~1.1.8~~	~~The contractor shall staff this work item with the appropriate skill mix and staffing level of one full-time equivalent for the work.~~
1.2	**Risk Management and Best Practices**
1.2.1	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.
1.3	**Reporting Requirements**
1.3.1	The contractor shall generate Performance Reports bi-weekly. The report shall include, as a minimum, a summary of the weeks highlights/accomplishments, milestones/schedule/deliverables, risks and customer meetings.
1.3.2	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 monthly cost reporting in accordance with the WBS. The contractor, including subcontractors, shall be available to attend monthly status meetings.
1.4	**Security Requirements**
1.4.1	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 be no handling of classified data.

Required skills/knowledge:

- Experience with developing Space Flight software and/or firmware applications
- Experience with space communication and navigation systems
- Familiarity with optical communication fundamentals
- Experience with data transfer systems, high data rate physical layer solutions, common link protocols, comm related encoding / interleaving schemes and implementations.

IV. Government Furnished Property/Facilities and Software

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.

V. Travel

The Contractor shall propose additional travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

There are no procurements associated with this Task Order.

VII. Deliverables

The Contractor shall provide status reports as noted in the Reporting Requirements (refer to requirements section 1.3).

The following table provides a listing of deliverable item/milestone with expected due date that should be included. Any changes to this will be coordinated with TM.

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

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 74
Modification: 0
Task Name: ESC Space Support

GSMO-2 SOW Reference: 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	03/01/2019	2/22/2020	Initial task order statement of work.

II. Task Overview

This task provides experienced engineering and space support for Code 450 (Exploration and Space Communications Projects (ESC) Division), to help manage Code 450 owned space between multiple buildings at GSFC. Coordination and planning with multiple stakeholders will be required, as well as reporting on the monthly status of all Code 450 space.

III. Requirements

1	Managing ESC Space support
1.1	The contractor shall manage the ESC Office Space in Bldg. 25 for Code 450.
1.2	The contractor shall act as an alternate FOM for building 25.
1.3	The contractor shall provide monthly reports to status the office space occupancy.
1.4	The contractor shall plan the Optical Communications lab utilization for existing space within Bldg. 25.
1.5	The contractor shall provide an ESC Space Coordinator for multiple buildings
1.6	The contractor shall provide Facilities Infrastructure concept design, implementation, and upgrades (superstructure, power, HVAC, finishings/furnishing)
1.7	The contractor shall meet regularly with ESC Space Management team

Staff needs to be senior level and experienced with facilities management at GSFC. One subject matter expert is required, and possibly one senior systems engineer as needed.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

No Travel is required.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The following table provides a listing of deliverable item/milestone with expected due date that should be included. Any changes to this will be coordinated with TM.

Building 25 ESC space occupancy	Monthly

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 74
Modification: 1
Task Name: ESC Space Support

GSMO-2 SOW Reference: 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	03/01/2019	2/22/2020	Initial task order statement of work.
1	05/10/2019	2/22/2020	Implement Requirement 1.6 for described Code 450 support areas

II. Task Overview

This task provides experienced engineering and space support for Code 450, to help manage Code 450 owned space between multiple buildings at GSFC. Coordination and planning with multiple stakeholders will be required, as well as reporting on the monthly status of all Code 450 space.

The contractor shall procure needed materials to update Code 450 support areas (B12/E026 A, B, C, D, E, B25/S105E).

III. Requirements

1	Managing ESC Space support
1.1	The contractor shall manage the ESC Office Space in Bldg. 25 for Code 450.
1.2	The contractor shall act as an alternate FOM for building 25.
1.3	The contractor shall provide monthly reports to status the office space occupancy.
1.4	The contractor shall plan the Optical Communications lab utilization for existing space within Bldg. 25.
1.5	The contractor shall provide an ESC Space Coordinator for multiple buildings
1.6	The contractor shall provide Facilities Infrastructure concept design, implementation, and upgrades (superstructure, power, HVAC, finishings/furnishing)
1.7	The contractor shall meet regularly with ESC Space Management team

Staff needs to be senior level and experienced with facilities management at GSFC. One subject matter expert is required, and possibly one senior systems engineer as needed.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

Local travel to material suppliers as needed.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The following table provides a listing of deliverable item/milestone with expected due date that should be included. Any changes to this will be coordinated with TM.

Building 25 ESC space occupancy	Monthly

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 76
Modification: 0
Task Name: Network Architecture Research
GSMO-2 SOW Reference: 2, 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/24/2019	09/28/2019	Initial task order statement of work.

II. Task Overview

The Network Architecture Research task provides support to perform the research required.

Subtask 1: Covers all work associated with network architecture technology research and development.

The contractor shall provide research and implementation insight to inform NASA investigations into a netcentric approach to our space communication networks, with a special emphasis on the difference between link service providers and network service providers. This work shall take into account existing NASA network operations and an understanding of terrestrial networks.

Netcentric is an approach which is defined as:

- connecting all participants to a common network, where by the heirarchy is flattened, which increases operational abilities, increases the speed of decision making, and standardises interfaces
- considers new and innovative network architectures which enable new operating modes

All work shall be GSFC Proprietary. If any software is delivered, it shall follow standard GSFC software engineering processes, including configuration management and supporting documentation.

The analysis shall detail network implementations and technologies that can be applied to achieve NASA objectives (from publically available and published materials and discussions with NASA). The implementation shall show how a netcentric implementation could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and mobile destinations. The contractor shall provide insights into technologies that may be infused into NASA systems based on prior domain experience, analogues or other evidence.

Required skills/knowledge

- Excellent knowledge of computer networking, including autonomous dynamic routing
- Excellent knowledge of space networking, including NASA GSFC's Space Mobile Network (SMN) framework
- Excellent knowledge of TCP/IP-based network monitoring and management
- Excellent knowledge of Software Defined Networking (SDN)
- Excellent knowledge of Temporospatial Software Defined Networking (TS-SDN)
- Excellent knowledge of Delay/Disruption Tolerant Networking (DTN)
- Good knowledge of existing GSFC networks (both ground/terrestrial networks and space networks)

III. Requirements

1	**Network Architecture Research**
1.1	**Develop architectures for a netcentric approach**
1.1.1	The contractor shall develop and document a netcentric approach and analysis given existing space communication architectures.
1.1.2	If any software is developed, the contractor shall follow standard GSFC software engineering processes, include configuration management and supporting documentation.
1.2	**Demonstrate netcentric approach in a SMN scenario**
1.2.1	The contractor shall demonstrate how netcentric technologies can be applied to achieve SMN objectives.
1.2.2	The contractor shall demonstrate how netcentric could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and mobile destinations.
1.3	**Recommendation for next steps**
1.3.1	The contractor shall provide a recommendation for next steps towards maturing and infusing netcentric technologies.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order, including a preliminary draft of the concept and final presentation of the concept during this time period.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 76
Modification: 1
Task Name: Network Architecture Research
GSMO-2 SOW Reference: 2, 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/24/2019	09/28/2019	Initial task order statement of work.
1	09/29/2019	04/25/2020	Extension through April 2020.

II. Task Overview

The Network Architecture Research task provides support to perform the research required.

Subtask 1 / Part 1 (Included in MOD00)

Covers all work associated with network architecture technology research and development.

The contractor shall provide research and implementation insight to inform NASA investigations into a netcentric approach to our space communication networks, with a special emphasis on the difference between link service providers and network service providers. This work shall take into account existing NASA network operations and an understanding of terrestrial networks.

Netcentric is an approach which is defined as:

- connecting all participants to a common network, where by the heirarchy is flattened, which increases operational abilities, increases the speed of decision making, and standardises interfaces
- considers new and innovative network architectures which enable new operating modes

All work shall be GSFC Proprietary. If any software is delivered, it shall follow standard GSFC software engineering processes, including configuration management and supporting documentation.

The analysis shall detail network implementations and technologies that can be applied to achieve NASA objectives (from publically available and published materials and discussions with NASA). The implementation shall show how a netcentric implementation could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and

mobile destinations. The contractor shall provide insights into technologies that may be infused into NASA systems based on prior domain experience, analogues or other evidence.

Subtask 1 / Part 2 – Systems Analysis (NEW IN MOD01)

Covers work on extending detailed descriptions future networking systems through system analysis.

This activity shall continue the conceptual analysis begun under subtask 1 and continue it by employing system engineering principles to implement the concepts into a framework which captures dependencies and implications of future networking architectures.

This analysis shall involve the network management, network control, and service orchestration covering protocols, such as TCP/IP, DTN, among others.

This activity may involve starting numerical simluations and analysis to augment conceptual designs if required during the course of the discussion early FY2020.

Required skills/knowledge

- Excellent knowledge of computer networking, including autonomous dynamic routing
- Excellent knowledge of space networking, including NASA GSFC's Space Mobile Network (SMN) framework
- Excellent knowledge of TCP/IP-based network monitoring and management
- Excellent knowledge of Software Defined Networking (SDN)
- Excellent knowledge of Temporospatial Software Defined Networking (TS-SDN)
- Excellent knowledge of Delay/Disruption Tolerant Networking (DTN)
- Good knowledge of existing GSFC networks (both ground/terrestrial networks and space networks)

Subtask 2 / Part 1 – Systems Engineering (NEW IN MOD01)

The contractor shall provide overall Systems Engineering support to the DTN Project. Support will be provided in all areas of Systems Engineering including:

1. **Operations Concept Development support** including developing the operations concepts and scenarios; preparing/reviewing mission operations concepts in regards to the intended functionality and interfaces; participating in user interface meetings.
2. **Architecture and Design** including generating and maintaining system and subsystem concepts, architecture, and design diagrams; conducting trades studies; facilitating and supporting design reviews.
3. **Requirements Analysis, identification and management** including

generating/managing/reviewing requirements; conduction requirements traceability; reviewing technical specifications and submitting comments and recommendations; managing requirements in DOORs or requirements management tool.

4. **Validation and Verification** including generating and reviewing Verification Plans; Ensuring that technical design meets the requirements; manage error and margin budgets;
5. **Interface Control Documents** including reviewing and analyzing design interfaces; identifying interface control requirements for engineering and design of components and subsystems, preparing ICD documents and verifying proper implementation for between elements.
6. **Reviews** including preparing slide packages for milestone reviews like SRR, PDR, and CDR.

III. Requirements

1	**Network Architecture Research**
1.1	**Develop architectures for a netcentric approach**
1.1.1	The contractor shall develop and document a netcentric approach and analysis given existing space communication architectures.
1.1.2	If any software is developed, the contractor shall follow standard GSFC software engineering processes, include configuration management and supporting documentation.
1.2	**Demonstrate netcentric approach in a SMN scenario**
1.2.1	The contractor shall demonstrate how netcentric technologies can be applied to achieve SMN objectives.
1.2.2	The contractor shall demonstrate how netcentric could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and mobile destinations.
1.3	**Recommendation for next steps**
1.3.1	The contractor shall provide a recommendation for next steps towards maturing and infusing netcentric technologies.

2	**Systems Engineering**
2.1	**Conduct analysis**
2.1.1	The contractor shall further this line of research by performing system engineering analysis
2.2	**Potential simulations**
2.2.1	If chosen by the government, the contractor shall perform simulations to illustrate and build out the data and principles required for analysis

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

Subtask 1

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order, including a preliminary draft of the concept and final presentation of the concept during this time period.

Subtask 2

Item	Due Date
Monthly Technical Progress Report	5th of the Month
Monthly Financial 533 Report	5th of the Month
Final Task Report	15 days prior to task end date
Weekly Status Report (Sr. Engineers provide status on activities, risks, observations & on-going tasks to the respective element leads)	COB Tuesday for the week ending on Tuesday.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 76
Modification: 2
Task Name: Network Architecture Research
GSMO-2 SOW Reference: 2, 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	06/24/2019	09/28/2019	Initial task order statement of work.
1	09/29/2019	04/25/2020	Extension through April 2020.
2	10/28/2019	04/25/2020	Add Subtask 3 for system engineering support for DTN project.

II. Task Overview

The Network Architecture Research task provides support to perform the research required.

Subtask 1 / Part 1 (Included in MOD00)

Covers all work associated with network architecture technology research and development.

The contractor shall provide research and implementation insight to inform NASA investigations into a netcentric approach to our space communication networks, with a special emphasis on the difference between link service providers and network service providers. This work shall take into account existing NASA network operations and an understanding of terrestrial networks.

Netcentric is an approach which is defined as:

- connecting all participants to a common network, where by the heirarchy is flattened, which increases operational abilities, increases the speed of decision making, and standardises interfaces
- considers new and innovative network architectures which enable new operating modes

All work shall be GSFC Proprietary. If any software is delivered, it shall follow standard GSFC software engineering processes, including configuration management and supporting documentation.

The analysis shall detail network implementations and technologies that can be applied to achieve NASA objectives (from publically available and published materials and discussions with NASA). The implementation shall show how a

netcentric implementation could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and mobile destinations. The contractor shall provide insights into technologies that may be infused into NASA systems based on prior domain experience, analogues or other evidence.

Subtask 1 / Part 2 – Systems Analysis (NEW IN MOD01)

Covers work on extending detailed descriptions future networking systems through system analysis.

This activity shall continue the conceptual analysis begun under subtask 1 and continue it by employing system engineering principles to implement the concepts into a framework which captures dependencies and implications of future networking architectures.

This analysis shall involve the network management, network control, and service orchestration covering protocols, such as TCP/IP, DTN, among others.

This activity may involve starting numerical simluations and analysis to augment conceptual designs if required during the course of the discussion early FY2020.

Required skills/knowledge

- Excellent knowledge of computer networking, including autonomous dynamic routing
- Excellent knowledge of space networking, including NASA GSFC's Space Mobile Network (SMN) framework
- Excellent knowledge of TCP/IP-based network monitoring and management
- Excellent knowledge of Software Defined Networking (SDN)
- Excellent knowledge of Temporospatial Software Defined Networking (TS-SDN)
- Excellent knowledge of Delay/Disruption Tolerant Networking (DTN)
- Good knowledge of existing GSFC networks (both ground/terrestrial networks and space networks)

Subtask 2 / Part 1 – Systems Engineering (NEW IN MOD01)

The contractor shall provide overall Systems Engineering support to the DTN Project. Support will be provided in all areas of Systems Engineering including:

1. **Operations Concept Development support** including developing the operations concepts and scenarios; preparing/reviewing mission operations concepts in regards to the intended functionality and interfaces; participating in user interface meetings.
2. **Architecture and Design** including generating and maintaining system and subsystem concepts, architecture, and design diagrams; conducting trades studies;

facilitating and supporting design reviews.

3. **Requirements Analysis, identification and management** including generating/managing/reviewing requirements; conduction requirements traceability; reviewing technical specifications and submitting comments and recommendations; managing requirements in DOORs or requirements management tool.
4. **Validation and Verification** including generating and reviewing Verification Plans; Ensuring that technical design meets the requirements; manage error and margin budgets;
5. **Interface Control Documents** including reviewing and analyzing design interfaces; identifying interface control requirements for engineering and design of components and subsystems, preparing ICD documents and verifying proper implementation for between elements.
6. **Reviews** including preparing slide packages for milestone reviews like SRR, PDR, and CDR.

Subtask 3 / Part 1 – Systems Engineering (NEW IN MOD02)

The contractor shall provide overall Systems Engineering support to the DTN Project. Support will be provided in all areas of Systems Engineering including:

1. **Operations Concept Development support** including developing the operations concepts and scenarios; preparing/reviewing mission operations concepts in regards to the intended functionality and interfaces; participating in user interface meetings.
2. **Architecture and Design** including generating and maintaining system and subsystem concepts, architecture, and design diagrams; conducting trades studies; facilitating and supporting design reviews.
3. **Requirements Analysis, identification and management** including generating/managing/reviewing requirements; conduction requirements traceability; reviewing technical specifications and submitting comments and recommendations; managing requirements in DOORs or requirements management tool.
4. **Validation and Verification** including generating and reviewing Verification Plans; Ensuring that technical design meets the requirements; manage error and margin budgets;
5. **Interface Control Documents** including reviewing and analyzing design interfaces; identifying interface control requirements for engineering and design of components and subsystems, preparing ICD documents and verifying proper implementation for between elements.
6. **Reviews** including preparing slide packages for milestone reviews like SRR, PDR, and CDR.

III. Requirements

1	Network Architecture Research

1.1	**Develop architectures for a netcentric approach**
1.1.1	The contractor shall develop and document a netcentric approach and analysis given existing space communication architectures.
1.1.2	If any software is developed, the contractor shall follow standard GSFC software engineering processes, include configuration management and supporting documentation.
1.2	**Demonstrate netcentric approach in a SMN scenario**
1.2.1	The contractor shall demonstrate how netcentric technologies can be applied to achieve SMN objectives.
1.2.2	The contractor shall demonstrate how netcentric could be employed to perform autonomous dynamic routing (path setup, execution, and tear down) between static terrestrial sources and mobile destinations.
1.3	**Recommendation for next steps**
1.3.1	The contractor shall provide a recommendation for next steps towards maturing and infusing netcentric technologies.

2	**Systems Engineering**
2.1	**Conduct analysis**
2.1.1	The contractor shall further this line of research by performing system engineering analysis
2.2	**Potential simulations**
2.2.1	If chosen by the government, the contractor shall perform simulations to illustrate and build out the data and principles required for analysis

3	**Systems Engineering**
3.1	**DTN Project support**
3.1.1	The contractor shall provide overall Systems Engineering support to the DTN Project.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

Subtask 1

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order, including a preliminary draft of the concept and final presentation of the concept during this time period.

Subtask 2

Item	Due Date
Monthly Technical Progress Report	5th of the Month
Monthly Financial 533 Report	5th of the Month
Final Task Report	15 days prior to task end date
Weekly Status Report (Sr. Engineers provide status on activities, risks, observations & on-going tasks to the respective element leads)	COB Tuesday for the week ending on Tuesday.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 77
Modification: 0
Task Name: Engineering Support of Mass Spectrometers for Solar System Exploration

GSMO-2 SOW Reference: **2.0 Mission Ground System Development**
2.1 Systems Engineering
3.0 Mission Operations
3.1 Systems Engineering

I. Task Order History

Mod #	Start	End	Brief Description
0	08/12/2019	08/29/2020	Initial task order statement of work

II. Task Overview

The "Engineering Support of Mass Spectrometers for Solar System Exploration" task provides Systems Engineering support for the development of mass spectrometers and other instrumentation as well as associated ground support infrastructure by the Solar System Exploration Division, Code 690.

This task mod (Mod 00) is one year in duration and initiates Systems Engineering work encompassing a single, discrete effort via one subtask, as described below.

Subtask 1: Provide engineering support to generate, align and communicate technical requirements during the development of the Lunar Environment Monitoring Station (LEMS).

III. Requirements

1	**LEMS Instrument Development**
1.1	**Engineering Support**
1.1.1	The contractor shall: 1. Define/communicate technical requirements for the LEMS instrument including verification and environmental for communication to the host platform at time of delivery 2. Support/lead/schedule technical discussions as necessary and present technical recommendations or solutions to support the Project Manager

	and Instrument Principal Investigator 3. Ensure technical requirements alignment between all subsystems of the LEMS instrument. 4. Develop/track any risks associated with the LEMS instrument through development 5. Provide engineering technical input to support the Project Manager and Instrument PI in the generation of required monthly reporting during the LEMS instrument development.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order. The Contractor will be responsible for IT assets located in the SPOCC (Bldg. 32, Room C101C) and in development labs supporting SPOCC tenant missions (including in the CRIF in GSFC Bldg.7), but will not have any responsibilities pertaining to facility property or building structure.

There is no Government-Furnished Computer Software (GFCS) associated with this task.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

Travel Description	# Travelers	Duration	Time Frame
(b) (4) [redacted]	[redacted]	[redacted]	[redacted]

VI. Material Procurement

No procurements are anticipated during the period of performance of this task.

VII. Deliverables

The Contractor shall provide brief monthly status reports on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 78
Modification: 0
Task Name: JPSS Trending and Analysis Tool for the JPSS Flight Project

GSMO-2 SOW Reference: 2.3.2.4

I. Task Order History

Mod #	Start	End	Brief Description
0	08/14/2019	05/23/2020	Initial task order statement of work.

II. Task Overview

The JPSS Trending and Analysis Tool for the JPSS Flight Project task develops and delivers a JPSS trending and analysis tool that supports the need of the Flight Readiness group for product development, JCTs and MRs for JPSS-2. The trending and analysis tool will be hosted on government equipment that is already operational at the following locations:

- Greentech IV facility in Lanham, MD,
- Raytheon factory in Riverdale, MD,
- NOAA Satellite Operations Facility (NSOF) in Suitland, MD.

Subtask 1: Work Breakdown Structure (WBS): 2.4.4: Proof of Concept Implementation.
Subtask 2: WBS 2.6: Initial Integration and Test.
Subtask 3: WBS 2.6: Full Integration and Test.
Subtask 4: WBS 3.7.2: Sustaining Engineering.

III. Requirements

1	**Proof of Concept Implementation** (Duration: 2 months)
1.1	The contractor shall develop the trending and analysis tool customizations for the JPSS-2 satellite on contractor's hardware and at the contractor's development facility.
1.2	The contractor shall provide a Flight Readiness group that will provide a) JPSS-2 formatted data sets to support the customization of the tool b) JPSS-2 Command and Telemetry Database c) Extended Application Packet Format from 474-00001-06 Common Data Format Control Book and d) 472-00372 JPSS Command and Telemetry Database (CTDB) Schema.
1.3	The contractor shall verify that the tool meets the desired functionality and performance as defined in the requirements document (472-00821 JPSS MOST Trending and Analysis System Requirements EAR.docx.

2	**Initial Integration and Test** (Duration: 1 month)
2.1	The contractor shall integrate the tool on the government JPSS Flight Vehicle Test Suite (FVTS) hardware and infrastructure at the Greentech IV facility in Lanham, MD.
2.2	The contractor shall procure required licenses to support the JPSS Trending and Analysis tool.
2.3	The contractor shall transfer all licenses at the conclusion of the task.
2.4	The contractor shall verify that the system interfaces are configured and that the tool performs to the same defined functionality and performance as defined in the proof of concept (subtask 001).
2.5	The contractor shall support the Flight Readiness group to evaluate the integrated tool to confirm system functional and performance requirements.

3	**Full Integration and Test** (Duration: 2 months)
3.1	The contractor shall support the full integration of the tool on the government JPSS FVTS hardware and infrastructure at the Raytheon facility in Riverdale, MD.
3.2	The contractor shall verify that the system interfaces are configured and the tool performs to the same defined functionality and performance as defined in the initial integration and test phase (subtask 002).
3.3	The contractor shall upgrade the tool to meet any mutually agreed requirements that were deferred from the initial design and test phases (subtasks 001 and 002).
3.4	The contractor shall support the Flight Readiness group to evaluate the deferred functional and performance requirements.
3.5	The contractor shall provide training and a user manual as part of the delivery of the JPSS trending and analysis tool.

4	**Sustainment Engineering** (Duration: 5 months)
4.1	The contractor shall provide full integration of the tool on the government JPSS FVTS hardware and infrastructure at the NSOF in Suitland, MD.
4.2	The contractor shall provide sustainment support for the integrated trending and analysis tool to ensure the tool continues to be available for the use of the Flight Readiness group in support of the Mission Readiness activities (JCTs, MRs).
4.3	The contractor shall sustain the tool and deliver patches etc. based on defects and/or deficiencies in the tool identified by the Flight Readiness group.
4.4	The contractor shall support the Flight Readiness group to apply required system or security updates that may be needed.

IV. Government Furnished Property/Facilities and Software

The JPSS Trending and Analysis tool will be hosted on Government hardware and architecture during subtask 002 and beyond where existing versions of various relevant software packages shall be maintained. The contractor shall ensure that all contractor users of the tool complete the GSFC required security-related training courses.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

The list of task deliverables should include:

Ref#	Deliverables	Due Date
1	Performance/Status Reports	Monthly
2	JPSS Trending and Analysis Tool	2 months after contract award
3	Updates/Patches to the tool	As required
4	Tool Training	4 months after contract award
5	User's Manual	5 months after contract award
3	End-of-task Report	End of task

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

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 80
Modification: 0
Task Name: Landsat 9 Mission Operations Timeline Support

GSMO-2 SOW Reference: 2.1.

I. Task Order History

Mod #	Start	End	Brief Description
0	9/15/19	9/26/20	Initial task order statement of work.

II. Task Overview

The Landsat 9 Mission Operations Timeline Support task specifies the support required for the Mission Operations Readiness Team, specifically for a launch and commissioning timeline which will be used during mission readiness events through the launch and commissioning campaign of the L9 observatory prior to handover to USGS. The mission readiness activities include, but are not limited to, execution of Mission Readiness Tests (MRTs) and Mission Simulations.

III. Requirements

1	Timeline Management Tool
1.1	The contractor shall provide the Timeline Management Tool (TMT).
1.2	The contractor shall implement the Landsat 9 commissioning timeline as per the Mission Operations Readiness Manager's guidance.
1.3	The contractor shall implement test specific timeline instantiations required for Landsat 9 mission readiness activities.
1.4	The contractor shall develop Landsat 9 mission-specific TMT configurations and inputs.
1.5	The contractor shall participate in Landsat 9 mission readiness events that require the timeline tool, managing the timeline tool making sure that it is configured properly and that all approved changes are made during the event.
1.6	The contractor shall answer questions regarding setup, configuration, and use of the timeline tool.
1.7	The contractor shall provide training including providing examples of inputs and demonstrations of capabilities (e.g. sample events inputs or activity templates demonstrating some feature or use case).
1.8	The contractor shall troubleshoot issues (e.g. feature "Y" isn't working as expected, correspond with customer engineers via forum or e-mail to identify cause of problem and explore solutions).

1.9	The contractor shall, as needed, provide non-recurring engineering; that is, adding new features to TMT that might be required for the Landsat 9 project. The contractor will provide an estimated level of effort for any new feature, and proceed with implementation only after receiving concurrence to proceed.
1.10	The contractor shall provide sustaining engineering: Fixing software bugs and providing informal ("engineering") and formal patch releases.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this task for which the contractor shall be accountable for.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order. The contractor shall include an estimate for this local travel as part of their response to this SOW.

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The list of task deliverables should include:

ID	Deliverable Description	Due Date
1	Technical briefings and presentations	As requested
2	Status Reports	Weekly
3	Landsat 9 commissioning timeline	As requested
4	Landsat 9 mission readiness event timelines	As requested

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 81
Modification: 0
Task Name: Post POES/MetOp Project Instrument On-Orbit Vendor Support

GSMO-2 SOW Reference: 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	10/01/2019	09/26/2020	Initial task order statement of work.

II. Task Overview

The POES/MetOp Project is ending after more that thirty (30) years as a NASA Goddard Space Flight Center Fight Project. NOAA, the Projects customer has requested continuing instrument support of on orbit assets through FY2023. This Instrument On-Orbit Vendor Support task provides POES/MetOp instrument sustaining engineering requirements through agreements with (b) (4) [redacted] NGAS is the Original Equipment Manufacturer (OEM) for the Advanced Microwave Sounding Unit (AMSU) A1 and A2 instruments (b) (4) [redacted] is the OEM for the Advanced Very High Resolution Radiometer (AVHRR) and the High Resolution Infrared Sounder (HIRS). The word "contractor(s)" used below in the requirements section of the SOW refers to (b) (4) [redacted], the Original Equipment Manufacturer (OEM) for the AMSU A1 and A2, the AVHRR and the HIRS, and (b) (4) [redacted] for the SEM, as applicable.

III. Requirements

1	POES/MetOp Instruments On-Orbit Support
1.1	The contractor(s) shall provide instrument support to on-orbit instrument activities for the POES NOAA-15, NOAA-18 and NOAA-19 and MetOp-A, MetOp-B and MetOp-C satellites that include on orbit performance and anomaly monitoring and investigations; End of Life (EOL) testing; maintainance of the Instrument Engineering Models to assist, as required, with maintaining personnel proficiency, investigations and technical questions. The contractor(s) shall provide points of contact (POC) and a back-up POC to the Task Monitor whose availability is active and current.
1.2	**Anomaly Investigation Support**
1.2.1	The contractor(s) shall support and provide on orbit instrument anomaly investigations for the POES NOAA-15, NOAA-18 and NOAA-19 and MetOp-A, MetOp-B and MetOp-C satellites for both NOAA and EUMETSAT investigations.

1.2.2	The contractor(s) shall provide meeting support that includes preparation and participation, as required, in monthly NOAA Polar Spacecraft Anomaly Review Board (PSCARB) meetings.
1.2.3	The contractor(s) shall provide/retrieve related documentation as requested.
1.2.4	The contractor(s) shall support NOAA and EUMESAT investigations and "tiger teams" as required.
1.3	**Personnel and Hardware Proficiency**
1.3.1	To help support anomaly investigations, the contractor(s) shall maintain the proficiency of personnel and hardware (GSE, etc.) in order to perform annual Limited Performance Testing (LPT) of the AMSU, AVHRR and SEM EMs.
1.4	**POES/MetOp Instrument Engineering Models (EM)**
1.4.1	The contractor(s) shall maintain and store the Instrument Engineering Models (EM). This includes retention and maintaining Ground Support Equipement required to test, troubleshoot, lift, move, rework, reassemble and functionally evaluate the EMs.
1.4.2	The contractor(s) shall maintain GSE required to perform an EM LPT.

IV. Government Furnished Property/Facilities and Software

All property required to perform this task will be identified and maintained in the GSMO-2 Property Database.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 81
Modification: 1
Task Name: Post POES/MetOp Project Instrument On-Orbit Vendor Support

GSMO-2 SOW Reference: 3.1, 3.7

I. Task Order History

Mod #	Start	End	Brief Description
0	10/01/2019	09/26/2020	Initial task order statement of work.
1	11/01/2019	09/26/2020	Add the AVHRR OEM : (b) (4) [redacted]

II. Task Overview

The POES/MetOp Project is ending after more that thirty (30) years as a NASA Goddard Space Flight Center Fight Project. NOAA, the Projects customer has requested continuing instrument support of on orbit assets through FY2023. This Instrument On-Orbit Vendor Support task provides POES/MetOp instrument sustaining engineering requirements through agreements with (b) (4) [redacted] is the Original Equipment Manufacturer (OEM) for the Advanced Microwave Sounding Unit (AMSU) A1 and A2 instruments. (b) (4) [redacted] is the OEM for the Advanced Very High Resolution Radiometer (AVHRR) and the High Resolution Infrared Sounder (HIRS). The word "contractor(s)" used below in the requirements section of the SOW refers to (b) (4) [redacted], the Original Equipment Manufacturer (OEM) for the AMSU A1 and A2, the AVHRR and the HIRS, and (b) (4) [redacted] for the SEM, as applicable.

III. Requirements

1	POES/MetOp Instruments On-Orbit Support
1.1	The contractor(s) shall provide instrument support to on-orbit instrument activities for the POES NOAA-15, NOAA-18 and NOAA-19 and MetOp-A, MetOp-B and MetOp-C satellites that include on orbit performance and anomaly monitoring and investigations; End of Life (EOL) testing; maintainance of the Instrument Engineering Models to assist, as required, with maintaining personnel proficiency, investigations and technical questions. The contractor(s) shall provide points of contact (POC) and a back-up POC to the Task Monitor whose availability is active and current.
1.2	**Anomaly Investigation Support**
1.2.1	The contractor(s) shall support and provide on orbit instrument anomaly investigations for the POES NOAA-15, NOAA-18 and NOAA-19 and MetOp-A, MetOp-B and MetOp-C satellites for both NOAA and EUMETSAT investigations.

1.2.2	The contractor(s) shall provide meeting support that includes preparation and participation, as required, in monthly NOAA Polar Spacecraft Anomaly Review Board (PSCARB) meetings.
1.2.3	The contractor(s) shall provide/retrieve related documentation as requested.
1.2.4	The contractor(s) shall support NOAA and EUMESAT investigations and "tiger teams" as required.
1.3	**Personnel and Hardware Proficiency**
1.3.1	To help support anomaly investigations, the contractor(s) shall maintain the proficiency of personnel and hardware (GSE, etc.) in order to perform annual Limited Performance Testing (LPT) of the AMSU, AVHRR and SEM EMs.
1.4	**POES/MetOp Instrument Engineering Models (EM)**
1.4.1	The contractor(s) shall maintain and store the Instrument Engineering Models (EM). This includes retention and maintaining Ground Support Equipement required to test, troubleshoot, lift, move, rework, reassemble and functionally evaluate the EMs.
1.4.2	The contractor(s) shall maintain GSE required to perform an EM LPT.

IV. Government Furnished Property/Facilities and Software

All property required to perform this task will be identified and maintained in the GSMO-2 Property Database.

V. Travel

The Contractor shall propose travel that they identify as necessary to perform the work associated with this Task Order.

The proposed travel should include:

(b) (4) [redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 82
Modification: 0
Task Name: LEMNOS Project Communications Data Systems Support

GSMO-2 SOW Reference: 2.1, 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	09/18/2019	09/26/2020	Initial task order statement of work.

II. Task Overview

This task shall provide for the technology development insight, end-to-end testing and evaluation of of various optical and RF communications developments at GSFC for both flight and ground based systems. This effort is intended to mitigate the risk of a miscommunication of requirements, design conflict, incompatibility, or other negative impact between subsystems and disciplines.

The **Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS)** Project at GSFC, in partnership with industry, is to develop, procure, test, evaluate and launch space-based, laser optical communications systems utilizing advanced state-of-the-art optical communication technology enabling high-speed space-to-ground links, mission user links, and comm relay satellite links. The **Orion Artemis-2 Optical Communications System (O2O)** project, managed by LEMNOS, leverages optical communications technology for use on the next-generation Orion Multi-Purpose Crew Vehicle in support of NASA's efforts to return back to the moon.

III. Requirements

1	**LEMNOS Comm Data Systems Support**
1.1	**Senior Communications Engineering support**
1.1.1	The contractor shall provide Senior Communications Engineering support to the LEMNOS Project.
1.1.2	The contractor shall conduct evaluations of the LEMNOS Software Baseline.
1.1.3	The contractor shall maintain and develop a working knowledge and understanding of the full end to end data flow of user data through the LEMNOS flight and ground systems, as well as Command and Telemetry data to/from the O2O optical comm payload onboard Orion crew vehicle.
1.1.4	The contractor shall work with the LEMNOS team to communicate and coordinate end-to-end data flow and data path considerations into the design process of various comm sub-systems under development within LEMNOS.

1.1.5	The contractor shall directly support the software and firmware development and verification efforts for LEMNOS O2O optical comm Controller Electronics (CE) Software Development Unit (SDU), while bringing the perspective of overall data flow and communication stack layers to infuse into the software and firmware designs.
1.1.6	The contractor shall support the LEMNOS Project technical team meetings, design reviews, in-house and out-of-house proposals included but not limited to various systems designs, systems interfaces and requirements, and test and verification approaches/methodolgies.
1.1.7	The contractor shall assess and conduct evaluations of the Engineering Development Unit (EDU)software for the Space Regenerative Processor.
1.2	**Risk Management and Best Practices**
1.2.1	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.
1.3	**Reporting Requirements**
1.3.1	The contractor shall generate monthly Performance Status Reports to adequately describe the technical activities and schedule progress. The report shall include, as a minimum, a summary of highlights/accomplishments, milestones/schedule/deliverables, and status of risks/issues and action items. The contractor shall upon request provide inputs to the LEMNOS Mission Systems Engineer's (MSE) weekly technical status reports.
1.3.2	The contractor shall provide monthly cost reporting in accordance with the WBS.
1.4	**Security Requirements**
1.4.1	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 be no handling of classified data.

Required skills/knowledge:

- Experience with developing and testing flight software and/or firmware applications
- Experience with space and ground based communication & data handling systems
- Familiarity with laser optical communication fundamentals
- Working knowledge of NASA flight software development and testing standards
- Experience with data transfer systems, high data rate physical layer solutions, common link protocols, comm related encoding /interleaving schemes, comm modulations and implementations.

IV. Government Furnished Property/Facilities and Software

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.

V. Travel

The Contractor should expect occasional overnight travel upon direction from the TM. The Contractor shall propose additional travel that they identify as necessary to perform the work associated with this Task Order.

VI. Material Procurement

There are no procurements associated with this Task Order.

VII. Deliverables

The Contractor shall provide status reports as noted in the Reporting Requirements (refer to requirements section 1.3).

The following table provides a listing of deliverable item/milestone with expected due date that should be included. Any changes to this will be coordinated with TM.

Ref#	Deliverables	Due Date
1	Cost Reports	Monthly
2	Performance Status Reports	Monthly
3	Technical Evaluation and Test Reports	As Required
4	End-of-task Report	End of task

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 86
Modification: 0
Task Name: Optical Communication Systems Engineering

GSMO-2 SOW Reference: 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	03/16/20	09/26/20	Initial task order statement of work.

II. Task Overview

This task order includes two subtasks:

- Subtask 1 – General Optical Communication Systems Engineering
  The purpose of this subtask is to provide systems engineering support to optical communication ground segment development activities within the Space Network (SN) Project. This support will include the technical guidance of and participation in the conduct of engineering studies, development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.

- Subtask 2 – Modem Subject Matter Expertise
  The purpose of this subtask is to provide subject matter expert (SME) support in the conduct of modem-related engineering studies and sustaining efforts within the SN Project, including optical communication ground segment development activities.

The contractor will collaborate with systems engineers and subject matter experts from other contract teams and external entities, as coordinated with the task monitor, during execution of this task.

III. Requirements

The contractor shall provide systems engineering and modem SME support for evolution of the SN to include optical communication, and other enhancements, as coordinated with the task monitor and described in the work items listed in the table below.

1	General Optical Communication SE Support (Subtask 1)
1.1	The contractor shall conduct systems engineering appropriately per the SN System Engineering Management Plan (SEMP). The overall intent of this item is to

	a. provide a systems engineering resource for the optical communication ground segment development efforts within the context of the SN system of systems where and when needed, and b. provide the SN with the ability to ensure that systems engineering best practices are being applied consistently and appropriately.
1.2	The contractor shall provide cross-cutting technical/engineering guidance for SN optical communication ground segment development efforts. Identify and work systems-level technical issues across these efforts. Proactively look across ground segment elements from multiple perspectives (e.g., near-term implementation, extensibility and scalability, and operational sustainability) to ensure integrity and completeness at the systems level. Identify and perform trades for approaches and designs that consider commonality across the system of systems within the SN Ground Segment.
1.3	The contractor shall review and critique documents of interest to the optical communication ground segment development efforts. Consolidate comments, where appropriate, to ensure one set from systems engineering is provided to the document author.
1.4	The contractor shall conduct optical communication ground segment engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation approach, and cost and schedule estimates in a study report.
1.5	The contractor shall provide technical guidance of and participate in the development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.
1.6	The contractor shall conduct comprehensive analysis of Orion Artemis-2 Optical Communication (O2O) Ground Segment (GS) Level 4 and Level 5 requirements. Provide technical inputs/recommendations to the O2O GS development team to support the refinement and base-lining of these requirements sets.
1.7	The contractor shall support the development of interface control documents (ICD), internal and external to the optical communication ground segment, such as the Mission Control Center (MCC) / O2O GS ICD and the Table Mountain Facility (TMF) / O2O GS ICD.
1.8	The contractor shall establish and lead a new forum, with participation from O2O GS and Jet Propulsion Laboratory (JPL) TMF SMEs, to identify and address technical items of interest and issues pertaining to the O2O GS / TMF interface.
1.9	The contractor shall lead a forum, with participation from O2O GS, Laser Enhanced Mission Navigation and Operational Services (LEMNOS), JPL TMF, Massachusetts Institute of Technology (MIT) Lincoln Labs (LL), and Johnson Space Center (JSC) MCC SMEs, to identify and address technical items of interest and issues pertaining to future O2O ground operations.
2	**Modem SME Support (Subtask 2)**

2.1	The contractor shall conduct modem-related engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation approach, and cost and schedule estimates in a study report.
3	**SE and SME Collaboration with Other Participants**
3.1	The contractor shall collaborate with subject matter experts from external groups in support of execution of Subtask 1 and Subtask 2 requirements.
3.2	The contractor shall support systems engineering-related technical meetings. This support shall include documenting results of the meetings (meeting minutes) and maintaining an action item list, as required.
3.3	The contractor shall complete and adhere to Non Disclosure Agreements (NDAs) with participating contractors, as required, in order to fulfill these SE and SME roles as members of the team.

IV. Government Furnished Property/Facilities and Software

There is no Government-Furnished Property/Facility (GFP/GFF) associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The contractor shall propose any travel considered necessary to perform the work associated with this Task Order.

VI. Material Procurement

The contractor shall propose any materials considered necessary to perform the work associated with this Task Order.

VII. Deliverables

ID	Deliverable Description	Due Date
General		
G.1	**Task Progress Reports** – Progress report of all work accomplished during each week of task order performance and projected work activities to be performed during the next reporting period.	Weekly

G.2	**Monthly Cost Review Reports and Briefings –** Status reports and reviews on the technical, cost, schedule and operational performance, in accordance with the Work Breakdown Structure (WBS), to adequately describe the activities of this task order.	Monthly, generally within one week of delivery of the associated NASA 533M Report unless otherwise scheduled with the task monitor
Subtask 1		
1.1	**Document Comments** – Consolidated SE comments pertaining to documents of interest to the optical communication ground segment development efforts.	As specified when the document is delivered for review or otherwise, as needed
1.2	**Engineering Study Reports** – Comprehensive reports as described in requirement 1.4.	As required
1.3	**O2O GS Requirements Inputs** Technical inputs/recommendations to support the refinement and base-lining of O2O GS Level 4 and Level 5 requirements.	2 months prior to the O2O GS System Design Review (SDR) unless otherwise scheduled with the task monitor
1.4	**O2O GS Internal/External ICD and Integration and Test (I&T) Plan Inputs** – Technical inputs/recommendations to support the development and base-lining of the O2O GS internal and external ICDs and the O2O GS I&T Plan.	2 months prior to the O2O GS SDR unless otherwise scheduled with the task monitor
1.5	**O2O GS / JPL TMF Technical Interchange Meeting (TIM) Minutes** – Summaries of the TIMs described in requirement 1.8.	Within 2 business days of TIM completion
1.6	**O2O Ground Operations TIM Minutes** – Summaries of the TIMs described in requirement 1.9.	Within 2 business days

		of TIM completion
1.7	**Systems Engineering Reports** Reports summarizing major optical communication SE activities for the month and identifying any analyses, issues, concerns, and recommendations.	Monthly (within the first week of each month covering the previous month)
Subtask 2		
2.1	**Engineering Study Reports** Comprehensive reports as described in requirement 2.1.	As required

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 86
Modification: 1
Task Name: Optical Communication Systems Engineering

GSMO-2 SOW Reference: 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	03/16/20	09/26/20	Initial task order statement of work.
1	06/22/20	09/25/21	Add Subtask 3 for software development and extend PoP

II. Task Overview

This task order includes two subtasks:

- Subtask 1 – General Optical Communication Systems Engineering
  The purpose of this subtask is to provide systems engineering support to optical communication ground segment development activities within the Space Network (SN) Project. This support will include the technical guidance of and participation in the conduct of engineering studies, development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.

- Subtask 2 – Modem Subject Matter Expertise
  The purpose of this subtask is to provide subject matter expert (SME) support in the conduct of modem-related engineering studies and sustaining efforts within the SN Project, including optical communication ground segment development activities.

- Subtask 3 – Software Development Support
  The purpose of this subtask is to provide software development support for optical communication ground segment efforts in the SN Project, including the Low Cost Optical Terminal (LCOT). (See the addendum for LCOT background information.)

The contractor will collaborate with systems engineers and subject matter experts from other contract teams and external entities, as coordinated with the task monitor, during execution of this task.

III. Requirements

The contractor shall provide systems engineering, modem SME, and software development management support for the evolution of the SN to include optical communication, and other enhancements, as coordinated with the task monitor and described in the work items listed in the table below.

The Contractor shall supply personnel with Secret; Top Secret; and Top Secret/Sensitive Compartmented Information clearances as required by the Task Order.

1	**General Optical Communication SE Support (Subtask 1)**
1.1	The contractor shall conduct systems engineering appropriately per the SN System Engineering Management Plan (SEMP). The overall intent of this item is to a. provide a systems engineering resource for the optical communication ground segment development efforts within the context of the SN system of systems where and when needed, and b. provide the SN with the ability to ensure that systems engineering best practices are being applied consistently and appropriately.
1.2	The contractor shall provide cross-cutting technical/engineering guidance for SN optical communication ground segment development efforts. Identify and work systems-level technical issues across these efforts. Proactively look across ground segment elements from multiple perspectives (e.g., near-term implementation, extensibility and scalability, and operational sustainability) to ensure integrity and completeness at the systems level. Identify and perform trades for approaches and designs that consider commonality across the system of systems within the SN Ground Segment.
1.3	The contractor shall review and critique documents of interest to the optical communication ground segment development efforts. Consolidate comments, where appropriate, to ensure one set from systems engineering is provided to the document author.
1.4	The contractor shall conduct optical communication ground segment engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation approach, and cost and schedule estimates in a study report.
1.5	The contractor shall provide technical guidance of and participate in the development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.
1.6	The contractor shall conduct comprehensive analysis of Orion Artemis-2 Optical Communication (O2O) Ground Segment (GS) Level 4 and Level 5 requirements. Provide technical inputs/recommendations to the O2O GS development team to support the refinement and base-lining of these requirements sets.
1.7	The contractor shall support the development of interface control documents (ICD), internal and external to the optical communication ground segment, such as the Mission Control Center (MCC) / O2O GS ICD and the Table Mountain Facility (TMF) / O2O GS ICD.

1.8	The contractor shall establish and lead a new forum, with participation from O2O GS and Jet Propulsion Laboratory (JPL) TMF SMEs, to identify and address technical items of interest and issues pertaining to the O2O GS / TMF interface.
1.9	The contractor shall lead a forum, with participation from O2O GS, Laser Enhanced Mission Navigation and Operational Services (LEMNOS), JPL TMF, Massachusetts Institute of Technology (MIT) Lincoln Labs (LL), and Johnson Space Center (JSC) MCC SMEs, to identify and address technical items of interest and issues pertaining to future O2O ground operations.
2	**Modem SME Support (Subtask 2)**
2.1	The contractor shall conduct modem-related engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation approach, and cost and schedule estimates in a study report.
3	**Software Development Support (Subtask 3)**
3.1	Provide software development support per the contractor's NASA-reviewed/approved software development management plan. (This plan must be compliant with GSMO-2 contract requirements pertaining to software development and management.) The overall intent of this item is to provide the SN with the ability to ensure that software development management best practices are applied consistently and appropriately during LCOT implementation.
3.2	Support comprehensive configuration management, including version management of software and associated documentation.
3.3	Review and critique documents of interest to the LCOT software development efforts. Consolidate comments, where appropriate, to ensure one set from the software development group is provided to the document author.
3.4	Provide technical guidance of and participate in the development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of LCOT software components.

3.5	Support the definition of the LCOT conceptual software architecture, identifying all LCOT software subsystems/components and interfaces. Examples of functions that should be described in the architecture include the following:
	• Graphical User Interface (GUI)
	  ○ Control scripting
	  ○ Monitoring/visualization
	• Tracking
	  ○ Predicted satellite tracking
	  ○ Satellite/laser detection and acquisition
	  ○ Mount coarse tracking
	  ▪ Algorithm for closed loop mount tracking

	▪ Logging and time synchronization with Fine tracking software ▪ Coordinate frame automatic calibration ▪ Interface with Planewave API and software ○ Fine tracking • Adaptive Optics control interfaces • Hardware interfaces and device drivers • Data Storage / Playback • Attitude determination (i.e., using star tracker) ○ Initial target acquisition and propagation (propagate target vector to establish acquisition vector) ○ Time synchronization
3.6	Support development and maintenance of detailed software requirements for all LCOT subsystems/compontents, hardware interfaces, and device drivers, per the conceptual architecture. Support completion of an initial version of an LCOT Requirements Verification and Traceability Matrix (RVTM). For each requirement, identify the corresponding subsystem/component. a) Support execution of a detailed requirements review.
3.7	Support the design of the software for the LCOT subsystems/components, hardware interfaces, and device drivers, per the requirements. a) Support an update the RVTM to identify, for each requirement, the planned verification method. b) Support execution of a software design review.
3.8	Support implementation of the software for the LCOT subsystems/components, hardware interfaces, and device drivers, and optimization of the system. a) Support implementation of the software per the presented design. b) Support development of the build procedures for executable code. c) Test and debug LCOT software components, hardware interfaces, and device drivers. d) Support real-time framework implementation, integration, unit testing, and performance testing. e) Support completion of architecture optimization and refactoring. f) Support completion of an update the RVTM to identify, for each requirement, the results of testing/verification activities.
3.9	Support outdoor field testing for system integration, as coordinated with the task monitor, including nighttime field testing, and testing at the Goddard Geophysical and Astronomical Observatory (GGAO) and other sites.
3.10	Support testing to verify performance and hardware integration, as coordinated with the task monitor.
3.11	Collaborate with vendors to facilitate software development, testing, and integration as needed.
4	**SE and SME Collaboration with Other Participants**

4.1	The contractor shall collaborate with subject matter experts from external groups in support of execution of Subtask 1, Subtask 2, and Subtask 3 requirements.
4.2	The contractor shall support systems engineering-related technical meetings. This support shall include documenting results of the meetings (meeting minutes) and maintaining an action item list, as required.
4.3	The contractor shall complete and adhere to Non Disclosure Agreements (NDAs) with participating contractors, as required, in order to fulfill these SE and SME roles as members of the team.

IV. Government Furnished Property/Facilities and Software

There is no Government-Furnished Property/Facility (GFP/GFF) associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The contractor shall propose any travel considered necessary to perform the work associated with this Task Order.

VI. Material Procurement

The contractor shall propose any materials considered necessary to perform the work associated with this Task Order.

VII. Deliverables

ID	Deliverable Description	Due Date
General		
G.1	**Task Progress Reports** – Progress report of all work accomplished during each week of task order performance and projected work activities to be performed during the next reporting period.	Weekly
G.2	**Monthly Cost Review Reports and Briefings** – Status reports and reviews on the technical, cost, schedule and operational performance, in accordance with the Work Breakdown Structure (WBS), to adequately describe the activities of this task order.	Monthly, generally within one week of delivery of the associated

		NASA 533M Report unless otherwise scheduled with the task monitor
Subtask 1		
1.1	**Document Comments** Consolidated SE comments pertaining to documents of interest to the optical communication ground segment development efforts.	As specified when the document is delivered for review or otherwise, as needed
1.2	**Engineering Study Reports** – Comprehensive reports as described in requirement 1.4.	As required
1.3	**O2O GS Requirements Inputs** Technical inputs/recommendations to support the refinement and base-lining of O2O GS Level 4 and Level 5 requirements.	2 months prior to the O2O GS System Design Review (SDR) unless otherwise scheduled with the task monitor
1.4	**O2O GS Internal/External ICD and Integration and Test (I&T) Plan Inputs** – Technical inputs/recommendations to support the development and base-lining of the O2O GS internal and external ICDs and the O2O GS I&T Plan.	2 months prior to the O2O GS SDR unless otherwise scheduled with the task monitor
1.5	**O2O GS / JPL TMF Technical Interchange Meeting (TIM) Minutes** Summaries of the TIMs described in requirement 1.8.	Within 2 business days of TIM completion
1.6	**O2O Ground Operations TIM Minutes** Summaries of the TIMs described in requirement 1.9.	Within 2 business days of TIM completion
1.7	**Systems Engineering Reports** – Reports summarizing major optical communication SE activities for the month and identifying any analyses, issues, concerns, and recommendations.	Monthly (within the first week of each month covering

		the previous month)
Subtask 2		
2.1	**Engineering Study Reports** Comprehensive reports as described in requirement 2.1.	As required
Subtask 3		
3.1	**Document Comments** Consolidated comments pertaining to documents of interest to the LCOT software development efforts.	As specified when the document is delivered for review or otherwise, as needed
3.2	**LCOT Conceptual Software Architecture Description Inputs** – Inputs for a description of the LCOT conceptual software architecture, identifying all LCOT software subsystems/components and interfaces.	Initial inputs 2 weeks ARTO; update as coordinated with the government team
3.3	**LCOT Software Requirements Inputs** Inputs for a comprehensive listing of software requirements covering all LCOT subsystems/compontents, hardware interfaces, and device drivers.	1 month ARTO unless otherwise scheduled with the task monitor
3.4	**LCOT Software Requirements Review Package Inputs** – Inputs for presentation materials associated with execution of the requirements review.	2 days prior to the LCOT Software Requirements Review
3.5	**LCOT Software Design Document Inputs** Inputs for design documents, including detailed architecture/design diagrams, software component descriptions, and technical risk descriptions associated with LCOT subsystems/compontents, hardware interfaces, and device drivers.	3 months ARTO unless otherwise scheduled with the task monitor
3.6	**LCOT RVTM (Design Phase) Inputs** – Inputs for an updated RVTM with, for each requirement, identification of the planned verification method.	3 months ARTO unless otherwise scheduled with the task monitor

3.7	**LCOT Software Design Review Package Inputs** – Inputs for presentation materials associated with execution of the software design review.	2 days prior to the LCOT Software Design Review
3.8	**LCOT Source Code** – All final source, test, and unit code, developed and/or obtained during execution of this task by the contractor, associated with the LCOT subsystems/components, hardware interfaces, device drivers, and all other system elements.	Scheduled with the task monitor
3.9	**LCOT Software Build Procedures Inputs** – Inputs for sufficiently detailed procedures for building and testing all LCOT executable code.	Scheduled with the task monitor
3.10	**LCOT Test Results and Artifacts Inputs** – Inputs for a comprehensive set of descriptions of all testing performed during execution of this task, and associated artifacts.	Scheduled with the task monitor
3.11	**LCOT RVTM (Final) Inputs** – Inputs for a final RVTM with, for each requirement, identification of the results of testing/verification.	5.5 months ARTO unless otherwise scheduled with the task monitor

End of Task Order Statement of Work

Addendum: LCOT Background Information

NASA Goddard Space Flight Center (GSFC) is developing a Low Cost Optical Terminal (LCOT). Optical space communications provide benefits over radio frequency (RF) including lower weight, power, and higher bandwidth, while avoiding the significant regulatory burden of RF spectrum allocation. The GSFC LCOT will be initially deployed at the Goddard Geophysical and Astronomical Observatory (GGAO) in Beltsville, Maryland.

The LCOT system contains a number of elements including downlink and uplink tracking telescopes, controllable optical telescope mounts, course pointing cameras, fine steering mirrors (FSM), optical modems for uplink and downlink, and computers for control, monitoring, visualization, and data storage. The system will include adaptive optics.

A major component for LCOT is the ground system software. The software is needed for operator control to include commanding, monitoring, visualization, scheduling, and data storage/playback of both housekeeping and optical data. The software is also needed for interface to cameras, mounts, FSMs, modems, frame grabbers, and other system hardware. Finally, the software is needed to implement algorithms to provide precision pointing of the LCOT to allow two-way optical communication between spaced based

laser communication systems and the LCOT. The algorithms include attitude determination, initial target acquisition and target position propagation, and coarse and fine pointing control.

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 86
Modification: 3
Task Name: Optical Communication Systems Engineering

GSMO-2 SOW Reference: 3.1

I. Task Order History

Mod #	Start	End	Brief Description
0	03/16/20	09/26/20	Initial task order statement of work.
1	06/22/20	09/25/21	Add Subtask 3 for software development and extend PoP
2			Changing the task monitore
3	08/20/20	09/25/21	Add Subtask 4 for update receiver GUI software

II. Task Overview

This task order includes two subtasks:

- Subtask 1 – General Optical Communication Systems Engineering
  The purpose of this subtask is to provide systems engineering support to optical communication ground segment development activities within the Space Network (SN) Project. This support will include the technical guidance of and participation in the conduct of engineering studies, development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.

- Subtask 2 – Modem Subject Matter Expertise
  The purpose of this subtask is to provide subject matter expert (SME) support in the conduct of modem-related engineering studies and sustaining efforts within the SN Project, including optical communication ground segment development activities.

- Subtask 3 – Software Development Support
  The purpose of this subtask is to provide software development support for optical communication ground segment efforts in the SN Project, including the Low Cost Optical Terminal (LCOT). (See the addendum for LCOT background information.)

- Subtask 4 – Update Receiver Grafical User Interface (GUI) Software
  The purpose of this subtask is to provide software development support for upgrading simple receiver GUI for the Optical to Orion (O2O) optical communication ground segment effort in the SN Project.

The contractor will collaborate with systems engineers and subject matter experts from other contract teams and external entities, as coordinated with the task monitor, during execution of this task.

III. Requirements

The contractor shall provide systems engineering, modem SME, and software development management support for the evolution of the SN to include optical communication, and other enhancements, as coordinated with the task monitor and described in the work items listed in the table below.

The Contractor shall supply personnel with Secret; Top Secret; and Top Secret/Sensitive Compartmented Information clearances as required by the Task Order.

1		**General Optical Communication SE Support (Subtask 1)**
1.1		The contractor shall conduct systems engineering appropriately per the SN System Engineering Management Plan (SEMP). The overall intent of this item is to a. provide a systems engineering resource for the optical communication ground segment development efforts within the context of the SN system of systems where and when needed, and b. provide the SN with the ability to ensure that systems engineering best practices are being applied consistently and appropriately.
1.2		The contractor shall provide cross-cutting technical/engineering guidance for SN optical communication ground segment development efforts. Identify and work systems-level technical issues across these efforts. Proactively look across ground segment elements from multiple perspectives (e.g., near-term implementation, extensibility and scalability, and operational sustainability) to ensure integrity and completeness at the systems level. Identify and perform trades for approaches and designs that consider commonality across the system of systems within the SN Ground Segment.
1.3		The contractor shall review and critique documents of interest to the optical communication ground segment development efforts. Consolidate comments, where

		appropriate, to ensure one set from systems engineering is provided to the document author.
1.4		The contractor shall conduct optical communication ground segment engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation approach, and cost and schedule estimates in a study report.
1.5		The contractor shall provide technical guidance of and participate in the development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of optical communication ground segment components.
1.6		The contractor shall conduct comprehensive analysis of Orion Artemis-2 Optical Communication (O2O) Ground Segment (GS) Level 4 and Level 5 requirements. Provide technical inputs/recommendations to the O2O GS development team to support the refinement and base-lining of these requirements sets.
1.7		The contractor shall support the development of interface control documents (ICD), internal and external to the optical communication ground segment, such as the Mission Control Center (MCC) / O2O GS ICD and the Table Mountain Facility (TMF) / O2O GS ICD.
1.8		The contractor shall establish and lead a new forum, with participation from O2O GS and Jet Propulsion Laboratory (JPL) TMF SMEs, to identify and address technical items of interest and issues pertaining to the O2O GS / TMF interface.
1.9		The contractor shall lead a forum, with participation from O2O GS, Laser Enhanced Mission Navigation and Operational Services (LEMNOS), JPL TMF, Massachusetts Institute of Technology (MIT) Lincoln Labs (LL), and Johnson Space Center (JSC) MCC SMEs, to identify and address technical items of interest and issues pertaining to future O2O ground operations.
2		**Modem SME Support (Subtask 2)**
2.1		The contractor shall conduct modem-related engineering studies. For each study, document the trade space, problem and/or risk, analyses performed, recommendations, implementation

		approach, and cost and schedule estimates in a study report.
3		**Software Development Support (Subtask 3)**
3.1		Provide software development support per the contractor's NASA-reviewed/approved software development management plan. (This plan must be compliant with GSMO-2 contract requirements pertaining to software development and management.) The overall intent of this item is to provide the SN with the ability to ensure that software development management best practices are applied consistently and appropriately during LCOT implementation.
3.2		Support comprehensive configuration management, including version management of software and associated documentation.
3.3		Review and critique documents of interest to the LCOT software development efforts. Consolidate comments, where appropriate, to ensure one set from the software development group is provided to the document author.
3.4		Provide technical guidance of and participate in the development/refinement of concepts of operation, definition/refinement of requirements, design, implementation, integration, testing, verification, and validation of LCOT software components.

3.5		Support the definition of the LCOT conceptual software architecture, identifying all LCOT software subsystems/components and interfaces. Examples of functions that should be described in the architecture include the following:
		• Graphical User Interface (GUI)
		  o Control scripting
		  o Monitoring/visualization
		• Tracking
		  o Predicted satellite tracking
		  o Satellite/laser detection and acquisition
		  o Mount coarse tracking
		  ▪ Algorithm for closed loop mount tracking
		  ▪ Logging and time synchronization with Fine tracking software

		▪ Coordinate frame automatic calibration ▪ Interface with Planewave API and software o Fine tracking • Adaptive Optics control interfaces • Hardware interfaces and device drivers • Data Storage / Playback • Attitude determination (i.e., using star tracker) o Initial target acquisition and propagation (propagate target vector to establish acquisition vector) o Time synchronization
3.6		Support development and maintenance of detailed software requirements for all LCOT subsystems/compontents, hardware interfaces, and device drivers, per the conceptual architecture. Support completion of an initial version of an LCOT Requirements Verification and Traceability Matrix (RVTM). For each requirement, identify the corresponding subsystem/component. a) Support execution of a detailed requirements review.
3.7		Support the design of the software for the LCOT subsystems/components, hardware interfaces, and device drivers, per the requirements. a) Support an update the RVTM to identify, for each requirement, the planned verification method. b) Support execution of a software design review.
3.8		Support implementation of the software for the LCOT subsystems/components, hardware interfaces, and device drivers, and optimization of the system. a) Support implementation of the software per the presented design. b) Support development of the build procedures for executable code. c) Test and debug LCOT software components, hardware interfaces, and device drivers. d) Support real-time framework implementation, integration, unit testing, and performance testing.

		e) Support completion of architecture optimization and refactoring. f) Support completion of an update the RVTM to identify, for each requirement, the results of testing/verification activities.
3.9		Support outdoor field testing for system integration, as coordinated with the task monitor, including nighttime field testing, and testing at the Goddard Geophysical and Astronomical Observatory (GGAO) and other sites.
3.10		Support testing to verify performance and hardware integration, as coordinated with the task monitor.
3.11		Collaborate with vendors to facilitate software development, testing, and integration as needed.
4		**Upgrade Receiver GUI Software (Subtask 4)**
4.1		Support ugrading of the software for the O2O GS simple receiver GUI, hardware interfaces, and device drivers, and optimization of the system As follow: a) Change telemetry registers to be 64 bit registers instead of 8 bits. b) Display a settable and resettable time-based window of the errors, total counts, and error rates. c) Add a register which displays the version of the bitfile. d) Assist with regression testing.
5		**SE and SME Collaboration with Other Participants**
5.1		The contractor shall collaborate with subject matter experts from external groups in support of execution of Subtask 1, Subtask 2, and Subtask 3 requirements.
5.2		The contractor shall support systems engineering-related technical meetings. This support shall include documenting results of the meetings (meeting minutes) and maintaining an action item list, as required.
5.3		The contractor shall complete and adhere to Non Disclosure Agreements (NDAs) with participating contractors, as required, in order to fulfill these SE and SME roles as members of the team.

IV. Government Furnished Property/Facilities and Software

There is no Government-Furnished Property/Facility (GFP/GFF) associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

The contractor shall propose any travel considered necessary to perform the work associated with this Task Order.

VI. Material Procurement

The contractor shall propose any materials considered necessary to perform the work associated with this Task Order.

VII. Deliverables

ID	Deliverable Description	Due Date
General		
G.1	**Task Progress Reports** Progress report of all work accomplished during each week of task order performance and projected work activities to be performed during the next reporting period.	Weekly
G.2	**Monthly Cost Review Reports and Briefings –** Status reports and reviews on the technical, cost, schedule and operational performance, in accordance with the Work Breakdown Structure (WBS), to adequately describe the activities of this task order.	Monthly, generally within one week of delivery of the associated NASA 533M Report unless otherwise scheduled with the task monitor
Subtask 1		
1.1	**Document Comments –** Consolidated SE comments pertaining to documents of interest to the optical communication ground segment development efforts.	As specified when the document is

		delivered for review or otherwise, as needed
1.2	**Engineering Study Reports** – Comprehensive reports as described in requirement 1.4.	As required
1.3	**O2O GS Requirements Inputs** – Technical inputs/recommendations to support the refinement and base-lining of O2O GS Level 4 and Level 5 requirements.	2 months prior to the O2O GS System Design Review (SDR) unless otherwise scheduled with the task monitor
1.4	**O2O GS Internal/External ICD and Integration and Test (I&T) Plan Inputs** – Technical inputs/recommendations to support the development and base-lining of the O2O GS internal and external ICDs and the O2O GS I&T Plan.	2 months prior to the O2O GS SDR unless otherwise scheduled with the task monitor
1.5	**O2O GS / JPL TMF Technical Interchange Meeting (TIM) Minutes –** Summaries of the TIMs described in requirement 1.8.	Within 2 business days of TIM completion
1.6	**O2O Ground Operations TIM Minutes** – Summaries of the TIMs described in requirement 1.9.	Within 2 business days of TIM completion
1.7	**Systems Engineering Reports** – Reports summarizing major optical communication SE activities for the month and identifying any analyses, issues, concerns, and recommendations.	Monthly (within the first week of each month covering the previous month)
Subtask 2		
2.1	**Engineering Study Reports –** Comprehensive reports as described in requirement 2.1.	As required
Subtask 3		
3.1	**Document Comments** – Consolidated comments pertaining to documents of interest to the LCOT software development efforts.	As specified when the document is delivered for

		review or otherwise, as needed
3.2	**LCOT Conceptual Software Architecture Description Inputs** – Inputs for a description of the LCOT conceptual software architecture, identifying all LCOT software subsystems/components and interfaces.	Initial inputs 2 weeks ARTO; update as coordinated with the government team
3.3	**LCOT Software Requirements Inputs** – Inputs for a comprehensive listing of software requirements covering all LCOT subsystems/compontents, hardware interfaces, and device drivers.	1 month ARTO unless otherwise scheduled with the task monitor
3.4	**LCOT Software Requirements Review Package Inputs** – Inputs for presentation materials associated with execution of the requirements review.	2 days prior to the LCOT Software Requirements Review
3.5	**LCOT Software Design Document Inputs** – Inputs for design documents, including detailed architecture/design diagrams, software component descriptions, and technical risk descriptions associated with LCOT subsystems/compontents, hardware interfaces, and device drivers.	3 months ARTO unless otherwise scheduled with the task monitor
3.6	**LCOT RVTM (Design Phase) Inputs** – Inputs for an updated RVTM with, for each requirement, identification of the planned verification method.	3 months ARTO unless otherwise scheduled with the task monitor
3.7	**LCOT Software Design Review Package Inputs** – Inputs for presentation materials associated with execution of the software design review.	2 days prior to the LCOT Software Design Review
3.8	**LCOT Source Code** – All final source, test, and unit code, developed and/or obtained during execution of this task by the contractor, associated with the LCOT subsystems/components, hardware interfaces, device drivers, and all other system elements.	Scheduled with the task monitor
3.9	**LCOT Software Build Procedures Inputs** – Inputs for sufficiently detailed procedures for building and testing all LCOT executable code.	Scheduled with the task monitor

3.10	**LCOT Test Results and Artifacts Inputs** – Inputs for a comprehensive set of descriptions of all testing performed during execution of this task, and associated artifacts.	Scheduled with the task monitor
3.11	**LCOT RVTM (Final) Inputs** – Inputs for a final RVTM with, for each requirement, identification of the results of testing/verification.	5.5 months ARTO unless otherwise scheduled with the task monitor
Subtask 4		
4.1	**O2O GS Rciever GUI Source Code** – All final test, and unit code, developed and/or obtained during execution of this task by the contractor, associated with the receiver GUI	1 month ARTO unless otherwise scheduled with the task monitor
4.2	**O2O GS Rciever GUI Software Build Procedures Inputs** – Inputs for sufficiently detailed procedures for testing all developed executable code under this task.	1 month ARTO unless otherwise scheduled with the task monitor

End of Task Order Statement of Work

Addendum: LCOT Background Information

NASA Goddard Space Flight Center (GSFC) is developing a Low Cost Optical Terminal (LCOT). Optical space communications provide benefits over radio frequency (RF) including lower weight, power, and higher bandwidth, while avoiding the significant regulatory burden of RF spectrum allocation. The GSFC LCOT will be initially deployed at the Goddard Geophysical and Astronomical Observatory (GGAO) in Beltsville, Maryland.

The LCOT system contains a number of elements including downlink and uplink tracking telescopes, controllable optical telescope mounts, course pointing cameras, fine steering mirrors (FSM), optical modems for uplink and downlink, and computers for control, monitoring, visualization, and data storage. The system will include adaptive optics.

A major component for LCOT is the ground system software. The software is needed for operator control to include commanding, monitoring, visualization, scheduling, and data storage/playback of both housekeeping and optical data. The software is also needed for interface to cameras, mounts, FSMs, modems, frame grabbers, and other system

hardware. Finally, the software is needed to implement algorithms to provide precision pointing of the LCOT to allow two-way optical communication between spaced based laser communication systems and the LCOT. The algorithms include attitude determination, initial target acquisition and target position propagation, and coarse and fine pointing control.

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 87
Modification: 0
Task Name: ESTO Program Management Support

GSMO-2 SOW Reference: 2.1

I. Task Order History

Mod #	Start	End	Brief Description
0	07/13/2020	07/31/2021	Initial task order statement of work.

II. Task Overview

The Science Mission Directorate (SMD) Earth Science Division (ESD) is responsible for the next generation of Earth science requirements, planning, technology investment, science measurement analysis, and execution. It also includes the collection and dissemination of the data, and support for algorithm and modeling development.

The ESD scope includes activities related to program support for NASA's science efforts towards defining approaches and techniques related to the next generation Earth science technology development, prototypes, and studies of instruments, components, and information systems. Specifically, this includes support for the Earth Science Technology Office (ESTO) and relevant collaborations with other SMD divisions. Activities include technology investment portfolio management and gap analyses, technology and programmatic requirements definition, participation in solicitation development and evaluation, and presentation development for ESD instruments, relevant PSD (Planetary Science Division) instruments and data systems and services. It includes planning, management and coordination activities; database development, technical tools and server support; and resources support, to ensure success. It also includes communication and outreach internally, externally and with other science and technical communities, conferences, and meeting participation.

III. Requirements

1	**ESTO Program Management Support**
1.1	**Technology Development and Coordination**
1.1.1	The contractor shall provide support to the ESTO Program Managers in areas of strategic and program planning, requirements gathering, data and project analysis, producing documentation, project management, and collaboration and presentations within and outside ESTO.
1.1.2	The contractor shall provide systems expertise and guidance to the ESTO Program Managers for the definition, development and implementation of ESTO technology programs, including the Instrument Incubator, Advanced

	Component Technology, and Advanced Information Systems Technology Programs. The support shall require the compilation and maintenance of tools in support of ESTO technology initiatives.
1.1.3	The contractor shall support the management of solicitation documentation with version control.
1.1.4	The contractor shall support ESTO collaborations with NASA Science Mission Directorate Programs.
1.1.5	The contractor shall support in the formulation and management of Peer Reviews and Panels.
1.1.6	The contractor shall support in technology development management and preparation of presentation materials.
1.1.7	The contractor shall support the use of existing tools and, when needed, development of new tools for technology and proposal evaluation and project administration.
1.1.8	The contractor shall support the use of existing tools and, when needed, development of new tools for program management and coordination.
1.1.9	The contractor shall support the use of existing web-based system for scheduling and participation in project reviews.
1.1.10	The contractor shall support requirements development, testing, feedback, training, and use of the web-based system for project management.
1.1.11	The contractor shall support the operations, process management, and strategic planning of the ESTO programs and funded projects.
1.2	**Outreach and Documentation Services**
1.2.1	The contractor shall support the creation of articles, information posters, brochures, and annual reports highlighting the ESTO projects; and where applicable synergies with SMD projects.
1.2.2	The contractor shall provide support in compiling abstracts, papers, presentations, quad charts, etc., and formatting material for production and web site inclusion.
1.2.3	The contractor shall provide content management, coordination, compilation of presentation materials, and display of the NASA ESTO Outreach Booth and materials at the annual Earth Science Technology Forum (ESTF), American Geophysical Union (AGU), International Geoscience and Remote Sensing Symposium (IGARSS); American Meteorological Society (AMS) Annual Meeting, and other conferences, workshops, and meetings as participated in by ESTO.
1.2.4	The contractor shall support the creation of documentation, technical papers, white papers and library support related to the technology developments.
1.2.5	The contractor shall provide web site development, maintenance, and updating.
1.2.6	The contractor shall provide additional development for the newly added ESTO program lines and partnerships and provide backup services to the ESTO webmaster.
1.2.7	The contractor shall provide for awareness and use of evolving digital media communications, such as Twitter.

1.2.8	The contractor shall provide coordination with the SMD Chief Technologist on the scheduling, and management of Tech Talks at NASA HQ featuring ESTO projects, and where relevant SMD projects.
1.2.9	The contractor shall support the production of various videos that can be used in/at conferences, presentations and websites that highlights Earth science technology developments. The work includes (but is not limited to) script writing, storyboarding, narration, music, illustrations and animations.
1.2.10	The contractor shall conduct video interviews of ESTO PI's and staff members to be used for web videos, conferences and presentations to highlight and explain the work of ESTO and ESTO projects. This includes lighting, sound, video, editing, graphics, and rendering.
1.2.11	The contractor shall develop final multimedia web videos that are strategically aligned with ESTO's outreach campaigns that utilize the previously collected interviews, newly recorded footage, and new animations and graphics.
1.2.12	The contractor shall perform the development, update, maintenance and programming enhancements to the ESTO Technology Portfolio tool. The ESTO Technology Portfolio consists of over 2200 records and associated meta-data. This work includes maintenance, conducting an annual update, provide interface portal, perform design, coding, validation and testing, interface, and Web portal, and provide ongoing support and periodic maintenance as required.
1.3	**Information Systems Support**
1.3.1	The contractor shall ensure the integrity and security of the ESTO network, server operations, and server backup strategy.
1.3.2	The contractor shall provide system requirements to and maintain coordination with the Information Technology (IT) desktop support contractor.
1.3.3	The contractor shall provide for work products that include IT system announcements and IT Security documentation as required by NASA HQ and NASA GSFC.

IV. Government Furnished Property/Facilities and Software

Access to databases and resource materials. Government-furnished computers.

Work shall be performed both on-site at GSFC, on-site at NASA HQ and at the prime and any sub-contractor facilities. Computer equipment shall be provided by GSFC or the contractor as required.

V. Travel

(b) (4) [redacted]

(b) (4)

[redacted]

Commented [MOU1]: This is still a pretty accurate travel guesstimate

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VI. Material Procurement

The Contractor shall on occasion directly procure various services and products related to the Technical Services outlined above. These Other Direct Costs (ODCs) may include, but are not limited to: videography services, web and multimedia services, printing and duplication, exhibit design and production, graphic design, and other outreach-related products.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 88
Modification: 0
Task Name: GDC Mission and Systems Development

GSMO-2 SOW Reference: 2.1, 2.2

I. Task Order History

Mod #	Start	End	Brief Description
0	5/1/2020	12/26/2020	Initial task order statement of work.

II. Task Overview

The Geospace Dynamics Constellation (GDC) Mission is a Pre-Phase A study intended to study the coupling between the magnetosphere and the ionosphere/thermosphere (IT) system, and how that coupled system responds to external energy input. This task provides mission formulation support, systems engineering support, and architecture definition support for the GDC study team.

III. Requirements

1	GDC Mission and Systems Development
1.1	The contractor shall support Pre-phase A mission and architecture design activities.
1.2	The contractor shall assist or lead in the development and decomposition of requirements, supporting plans, documents and specifications.
1.3	The contractor shall assist or lead the definition, implementation and recommendations of trade studies and analysis.
1.4	The contractor shall assist in the preparation and implementation of design and milestone reviews, supporting materials and gateway products.
1.5	The contractor shall assist in the development of agreements between the project and supporting organizations.
1.6	The contractor shall assist in the development of cost estimates for elements of the mission.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

There is currently no travel envisioned at this time associated with this Task Order.

VI. Material Procurement

There are no materials identified at this time associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order. Deliverables, at a minimum will include the products in the following table

(b) (4)

[redacted]

End of Task Order Statement of Work

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)
TASK ORDER

Task No: 90
Modification: 0
Task Name: Planetary Environments Laboratory Support

GSMO-2 SOW Reference: **2 MISSION GROUND SYSTEM DEVELOPMENT**

I. Task Order History

Mod #	Start	End	Brief Description
0	08/01/2020	07/31/2021	Initial task order statement of work.

II. Task Overview

The Planetary Environments Laboratory (NASA Goddard Code 699) studies the chemistry of atmospheres and surfaces of planets and their moons. Personnel participate in all phases of planetary investigations, from defining and developing specialized instrumentation to analyzing, interpreting, distributing, and archiving data collected during flight missions. A vigorous program of planetary analog research that includes laboratory simulations of planetary environments, geochemical and isotopic analysis, computational modeling of planetary atmospheres, and field studies of planetary analog sites provides a basis for planetary mission studies.

This task provides for general instrument development and operations support for the Planetary Environments Lab. Projects supported by this task include the Sample Analysis at Mars (SAM). The Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument which is flying on the Mars Atmosphere and Volatile Evolution (MAVEN) mission. The LITMS, and the SPECIES instruments. Generic work to support the lab which is not specific to a particular project is also included in this SOW. The task is further divided into 3 subtasks: SAM Support, NGIMS support, and General Support which includes LITMS, SPECIES, and generic support. This task includes travel approved by the task monitor as needed.

Subtask 1: Covers all work associated with the Mars Organic Molecule Analyzer (MOMA) instrument.

The Mars Organic Molecule Analyzer (MOMA) instrument is a combined Gas Chromatograph/Mass Spectrometer (GC/MS) payload on a landed Mars rover developed by ESA and is part of the ExoMars program. MOMA is a collaboration between the US and the Max Planck Institute for Solar System Research (MPS) in Germany, with MPS as the lead institution. The US MOMA-MS flight hardware was delivered to ESA/TAS-I in June 2018, with continuing post-delivery support since delivery.

The mission was scheduled for a launch in July 2020, but a mission delay was announced

by ESA on 12 March 2020, due to technical and schedule risks. The new launch date is 30 September 2022.

This task describes software support activities to support the mission as it prepares for the new launch date, including mission support preparatory activities such as the completion and qualification of the testbed, mission planning support activities including training, and documentation ins support of the mission which will involve an element of overseas travel.

After future task extensions, the support from this task will go through 31 October 2022 (launch + 30 days).

Subtask 2: Covers all work associated with the Sample Analysis at Mars (SAM) instruments.

Subtask 3: Covers all work associated with the Neutral Gas and Ion Mass Spectrometer (NGIMS) which is flying on the Mars Atmosphere and Volatile Evolution (MAVEN) Mission.

The Neutral Gas and Ion Mass Spectrometer (NGIMS) is flying on the Mars Atmosphere and Volatile Evolution (MAVEN) Mission to characterize the Martian atmosphere. This mission will require EGSE S/W and FSW support.

Subtask 4: Covers all work associated with general support for the Planetary Environments Laboratory.

This subtask will provide software support to multiple projects such as LITMS and SPECIES.

III. Requirements

1	**Mars Organic Molecule Analyzer (MOMA) instrument**
1.1	**MOMA System Engineering**
1.1.1	The contractor shall update any system-level requirements and interface control documents.
1.1.2	The contractor shall support the MOMA systems engineering team in the verification of requirements.
1.1.3	The contractor shall support newly identified life testing of mission-critical elements.
1.1.4	The contractor shall support the upgrade, modification, or completion of all models, including Flight, testbed, ETU, breadboards, QSM, & EIS and SWIS.
1.1.5	The contractor shall support interface meetings with ESA, MPS, TAS-I, and other ExoMars team members.
1.1.6	The contractor shall develop and review plans and support MOMA instrument re-verification efforts.

1.1.7	The contractor shall provide Goddard systems engineering inputs for ESA level pre-launch reviews.
1.1.8	The contractor shall provide post deliver support.
1.2	**MOMA GSE S/W for Operations**
1.2.1	The contractor shall maintain MOMA GSE, including Core GSE, RSim, Xina, and DataView through I&T (phase D).
1.2.2	The contractor shall continue support for MOMA testbed including for the Mars chamber.
1.2.3	The contractor shall support the upgrade, modification of MOMA Command, and Telemetry database.
1.2.4	The contractor shall develop patch file capability to accommodate different MOMA models and configurations.
1.2.5	The contractor shall develop and maintain MOMA GSE limit checking capability.
1.2.6	The contractor shall modify and support flight software for all models and ensure compatibility with the flight model.
1.2.7	The contractor shall develop test procedures and verify MOMA flight software requirements.
1.2.8	The contractor shall maintain traceability from requirements to test procedures.
1.2.9	The contractor shall ensure MOMA FSW validation testing completion on the ETU and Flight models.
1.2.10	The contractor shall control and coordinate configuration and changes to FSW and flight tables.
1.2.11	The contractor shall verify completion of the FSW Acceptance and Provide test results as requested.
1.2.12	The contractor shall provide systems administration for all GSE computers.
1.2.13	The contractor shall provide configuration management and systems for all software developed for MOMA. Systems include SVN and GitHub.
1.3	**MOMA Software Simulator Development**
1.3.1	The contractor shall maintain MOMA simulator to support flight software validation and verification as needed.
1.3.2	The contractor shall maintain MOMA Software Interface Simulator. Support functional and operational simulation as required.
1.3.3	The contractor shall support integration of MOMA SWIS into TAS-I software simulator.
1.3.4	The contractor shall provide post-delivery support as needed.
1.3.5	The contractor shall support requirements verification.
1.4	**MOMA Data Mining and Science Data Processing**
1.4.1	The contractor shall provide the development of data mining python scripts to extract MOMA housekeeping and science data from telemetry files to include data from the Goddard Breadboard (GB2), the ETU, Flight, testbed, and QSM, and other instrument models.
1.4.2	The contractor shall archive of all MOMA science/instrument data.

1.4.3	The contractor shall provide the development of automated tools to upload all MOMA data to the XINA web-based science archive and data processing system.
1.4.4	The contractor shall provide the development of tools for MOMA web-based science data processing.
1.4.5	The contractor shall plan and support development of the MOMA Science Payload Operations Control Center (SPOCC).
1.4.6	The contractor shall support planning with European Space Agency (ESA), Max Plank Institute (MPS), and Thales Alenia Space, Italy (TAS-I), and ESA designated partners for MOMA integration, testing, and operations.
1.5	**MOMA Script Development and Operator Support**
1.5.1	The contractor shall develop operational scripts to support LDI, GCMS, and MS-MS instrument modes of operation.
1.5.2	The contractor shall support script reviews and testing as required to ensure post-delivery support and preparedness for operations for MOMA, for both ground and flight software.
1.5.3	The contractor shall develop scripts to support Aliveness, Electrical baseline testing, Functional Testing, Comprehensive Performance Testing, special one-off tests, and other tests as needed.
1.5.4	The contractor shall support operations of GB lab, ETU, Flight, Testbed, QSM, SWIS, and EIS models.
1.5.5	The contractor shall maintain operational journals and ensure all data is uploaded for archive.
1.5.6	The contractor shall provide support post-delivery to MPS and TAS-I and other ESA designated partners.
1.5.7	The contractor shall provide development plans for MOMA software. Manage software development according to plan.
1.5.8	The contractor shall maintain software bug reporting, tracking, and resolution tickets and provide project reporting of software issues.
1.5.9	The contractor shall provide weekly, monthly reporting to the project as required.
1.5.10	The contractor shall provide support to other Project Management requests as deemed necessary including support of Management reporting and communications needs.

2	**Sample Analysis at Mars (SAM) instruments**
2.1	**SAM Support**
2.1.1	The contractor shall provide instrument-specific EGSE S/W and FSW support during SAM mission operations.
2.1.2	The contractor shall be fully cognizant of and build upon the EGSE S/W and FSW development history and methodologies established since the launch of SAM on Nov 26, 2011.
2.2	**Uplink Activities**
2.2.1	The contractor shall communicate with SAM science team to determine instrument specific needs.

2.2.2	The contractor shall use intimate knowledge of SAM instrument operation and safety constraints to develop compatible SAM scripts and configuration files.
2.2.3	The contractor shall test SAM scripts on breadboard and/or testbed instrument set ups.
2.2.4	The contractor shall deliver uplink products to the JPL MSL Operations Center.
2.2.5	The contractor shall check downlink data to verify functionality of scripts.
2.2.6	The contractor shall maintain the Science Operations web tool for configuration file generation.
2.3	**Science Support Activities**
2.3.1	The contractor shall use file formats and programing API's to access other SAM instrument payload data.
2.3.2	The contractor shall maintain an archive of SAM and ancillary data.
2.3.3	The contractor shall write programs to distill this data into a form usable by SAM science team.
2.3.4	The contractor shall deliver data via web format to SAM science team.
2.3.5	The contractor shall format Data for delivery to the Planetary Data System for long term archive.
2.4	**Mission and SPOCC Support Activities**
2.4.1	The contractor shall provide technical support to SPOCC IT assets.
2.4.2	The contractor shall assist with process automation.
2.4.3	The contractor shall assist with testing and verification of new FSW builds and SAM configuration (EEPROM) changes.
2.4.4	The contractor shall assist with data analysis and troubleshooting for any mission anomalies.

3	**Neutral Gas and Ion Mass Spectrometer (NGIMS)**
3.1	**NGIMS Support**
3.1.1	The contractor shall continue to provide instrument-specific EGSE S/W and FSW support during NGIMS mission operations.
3.1.2	The contractor shall be fully cognizant of and build upon the EGSE S/W and FSW development history and methodologies established since the launch of MAVEN on Nov 18, 2013.
3.2	**Uplink Activities**
3.2.1	The contractor shall communicate with MAVEN NGIMS science team to determine instrument specific needs.
3.2.2	The contractor shall use intimate knowledge of NGIMS instrument operation and safety constraints to develop compatible NGIMS scripts and configuration files.
3.2.3	The contractor shall test NGIMS scripts on breadboard and/or testbed instrument set ups.
3.2.4	The contractor shall deliver uplink products to the Science Operations Center.
3.2.5	The contractor shall check downlink data to verify functionality of scripts.
3.2.6	The contractor shall maintain the Science Operations web tool for configuration file generation.

3.3	**Science Support Activities**
3.3.1	The contractor shall learn file formats and programing API's to access other MAVEN instrument payload data.
3.3.2	The contractor shall write programs to distill this data into a form usable by NGIMS science team.
3.3.3	The contractor shall deliver data via web format to MAVEN science team.
3.3.4	The contractor shall provide an archive of MAVEN NGIMS and ancillary data.
3.4	**Mission and SPOCC Support Activities**
3.4.1	The contractor shall provide technical support to SPOCC IT assets.
3.4.2	The contractor shall assist with process automation.
3.4.3	The contractor shall assist with testing and verification of new FSW builds and NGIMS configuration (EEPROM) changes.
3.4.4	The contractor shall assist with data analysis and troubleshooting for any mission anomalies.

4	**General support for the Planetary Environments Laboratory**
4.1	**LITMS Support**
4.1.1	The contractor shall develop new control commands and functionality.
4.1.2	The contractor shall make software changes to implement new commands and telemetry.
4.1.3	The contractor shall make GSE changes to implement new commands and telemetry.
4.1.4	The contractor shall design and implement script changes to implement new commands and functionality.
4.1.5	The contractor shall modify Dataviewer to accept new telemetry fields.
4.1.6	The contractor shall establish SVN directories for data archive.
4.1.7	The contractor shall support the science team with system integration, script editing and instrument operations.
4.2	**General Lab Support**
4.2.1	The contractor shall provide data acquisition and control software support for existing and future research projects.
4.2.2	The contractor shall assist with experiment automation in the labs.
4.2.3	The contractor shall provide inputs to future proposals in the areas of data processing and GSE support software.

IV. Government Furnished Property/Facilities and Software

There is no Government furnished Property/Facilities associated with this Task Order.

There is no Government-Furnished Computer Software (GFCS) associated with this Task Order.

V. Travel

(b) (4)

[redacted]

VI. Material Procurement

The Contractor shall propose material that they identify as necessary to perform the work associated with this Task Order.

VII. Deliverables

The Contractor shall provide monthly status reports and reviews on the technical, cost, schedule and operational performance in accordance with the WBS to adequately describe the activities of this Task Order.

The Contractor shall propose a list of deliverables that will be provided to the customer specific to this Task Order.

End of Task Order Statement of Work