

## **GSMO TASK ORDER**

Task No: 27  
 Modification: 5  
 Task Name: LDCM Ground Systems Infrastructure Support  
 Task Period of Performance: 3/01/2012 to 6/30/2013  
 Modification Period of Performance: 7/01/2013 to 9/30/2013  
 GSMO SOW Reference: 2.3.1, 2.3.2.9, 3.7.2

### **I. Task Order History**

**Description of current modification (Modification 0):** This is the initial task order statement of work for LDCM Ground Systems Infrastructure Support Task.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	3/01/2012	2/28/2013	Initial task order statement of work.
1	6/1/2012	2/28/2013	Launch and early orbit, and power distribution unit equipment purchase and installs
2	9/1/2012	2/28/2013	Increased on-call and on site support at launch site and Gilbert, AZ and additional equipment to support increased integration and testing activities
3	3/1/2013	5/31/2013	Extend task order period of performance for 3 months
4	6/1/2013	6/30/2013	Extend task order period of performance for 1 month
5	7/1/2013	9/30/2013	Extend task order period of performance for 3 months and increase resources for close-out of Landsat 8 transition tasks

### **II. Background**

As a joint initiative between the United States Geological Survey (USGS) and National Aeronautics and Space Administration (NASA), the Landsat Project and the data it collects support government, commercial, industrial, civilian, military, and educational communities throughout the United States and worldwide. The Landsat Program provides repetitive acquisition of high resolution multispectral data of the Earth's surface on a global basis. Landsat represents the world's longest continuously acquired collection of space-based moderate-resolution land remote sensing data. Nearly four decades of imagery provides a unique resource for those who work in agriculture, geology, forestry, regional planning, education, mapping, and global change research. Landsat images are also invaluable for emergency response and disaster relief.

The Landsat Data Continuity Mission (LDCM) is the future of Landsat satellites. The satellite is scheduled for launch in January, 2013. The LDCM Ground System includes all of the ground-based assets needed to operate the LDCM observatory. The primary components of the Ground System are the Mission Operations Element, Collection Activity Planning Element, Ground Network Element, and the Data Processing and Archive System.

### **III. Scope of Work**

The Contractor shall provide engineering services, sustaining engineering, IT Security, network design, administration and sustaining, facility, installation, and integration support for the LDCM Ground System, focusing on the Mission Operations Center (MOC) facilities.

## A. Requirements

- A.1. The contractor shall coordinate and perform the installation of the LDCM MOC Facilities, including facility preparation, power installation, data communications cabling, and MOC network infrastructure and services. The contractor shall support the MOC Element Vendors in their initial systems installations; including coordinating the schedule, configuration of the infrastructure to accept the systems, and providing technical and facility support as required. The contractor shall procure and install power distribution units (PDUs) to replace the current end-of-life PDUs which support the LSR.
- A.2. The contractor shall develop and implement a MOC IT infrastructure to support the MOC Element systems, connectivity, dataflows, and IT Security requirements. The contractor shall coordinate external interface requirements with NISN and Code 700, and support the design, implementation, and configuration of connectivity into the MOC environment. The contractor shall ensure that the MOC infrastructure supports critical mission tests including Ground Readiness Tests (GRTs), RF compatibility testing, and Mission Readiness Tests (MRTs), including timely resolution of test discrepancy reports (TDRs). The contractor shall support establishment of the MOC network interfaces to the LDCM launch site. The contractor shall procure, configure, and install computer systems and equipment to support launch and early orbit testing and operations readiness. The contractor shall procure, configure, and install additional equipment in support of increased Integration and Testing activities.
- A.3. The contractor shall provide Sustaining support of the LDCM MOC Network Infrastructure and Services, in order to maintain availability and reliability of services. The contractor shall manage and troubleshoot MOC Infrastructure Services; configure infrastructure to accommodate new features, capabilities, and requirements; provide MOC account management; interfaced with NISN for troubleshooting and new requirements; and perform daily IT Security log reviews. The contractor shall perform routine preventative maintenance for the MOC equipment and facilities, as recommended by the vendors and established standards. The contractor shall develop and implement improvements to MOC Infrastructure services to improve the reliability, efficiency, and IT Security compliance. Personnel should be experienced with Cisco, Checkpoint, Active Directory, RSA, Network Management Software, System and Network Log analysis, SNMP, Proxy Services, and Computer Hardware maintenance.
- A.4. The contractor shall provide technical and IT Security expertise to support the LDCM project in interpreting, defining, implementing, and complying with NASA and Federal IT Security Requirements. The contractor shall serve as the Alternate Computer Security Official (alt-CSO) for the LDCM MOC, representing LDCM to Code 400 and the Center IT Security personnel. The contractor shall define and maintain the LDCM MOC IT Security implementation and documentation, facilitate center and agency reporting requirements, and perform annual IT Security Assessments and assessments for new configurations. The contractor shall lead the coordination effort with the LDCM MOC Element Vendors to maintain network compatibility and adherence with MOC IT Security requirements. Personnel should have demonstrated experience working under

NASA and Federal IT Security requirements, including System Security Plans, Documentation, Vulnerability Scanning, and IT Security Risk Assessments.

- A.5. The contractor shall provide routine monitoring and maintain the certification for the Electrostatic Discharge (ESD) Protected Area (EPA) containing the Spacecraft Simulator. Personnel should be familiar with Electrostatic Discharge (ESD) precautions for working around ESD sensitive equipment.
- A.6. The contractor shall develop, install, and sustain the LDCM Project Reference Database (PRD), which provides a central repository of MOC Application and System Configuration Items. The contractor shall maintain configuration management of the PRD; develop and maintain Translators to convert between Spacecraft and Application databases; and provide and maintain a development environment for MOC PRD users.
- A.7. The contractor shall manage vendor service agreements for MOC Hardware, Operating Systems, and COTS Applications, as required to meet support requirements and service levels. Management includes the procurement, tracking, and renewal.
- A.8. The contractor shall support the planning for transition of Ground Systems Infrastructure Support tasks identified as necessary to sustain smooth operations of the LDCM MOC, to a USGS-funded task order at the end of Initial Operational Checkout (IOC).
- A.9. There are no Capability Maturity Model Integration (CMMI) software development requirements in this task order.
- A.10. The contractor shall provide the support included in this SOW for the LDCM MOC Facilities, including: MOC, MOC Equipment Room (MER), Launch Support Room (LSR), Spacecraft Analysis and Launch Support Area (SALSA), and Backup MOC (bMOC), located at Goddard Space Flight Center (GSFC). Facilities also include the MOC equipment deployed at Orbital's Factory in Gilbert, AZ, and Vandenberg Air Force Base (VAFB) in Lompoc, CA. The contractor shall provide on-site and on-call IT support for MOC and Spacecraft Integration & Testing activities; including on-site support at the Orbital Gilbert, AZ facility and VAFB in Lompoc, CA.
- A.11. The contractor shall provide Information Technology and Facilities support to complete outstanding Landsat 8 Ground Systems tasks to complete the transition to USGS. The contractor shall complete modifications to MOC Interface at Orbital to effectively sustain long-term operations.

## **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 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**

There are no specific Government furnished facilities, equipment, or software required with this Task Order

#### **V. Material Procurement**

The Contractor shall procure materials that are identified as necessary to perform the work associated with this Task Order. The Task Monitor shall concur with the materials list prior to procurement for any changes.

#### **VI. Travel Support**

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>Travel Description</b>	<b>Approximate Time Frame</b>
Provide O&M support for MOC systems installed at Orbital's Factory in Gilbert, AZ	3/2012– 9/2013
Relocate and Install MOC Equipment from Orbital's Factory to VAFB	8/2012 – 10/2012
Provide O&M support for MOC systems installed at VAFB Launch Site in Lompoc, CA	8/2012 – 2/2013
Decommission MOC equipment installed at VAFB, return to GSFC for re-utilization	1/2013 – 2/2013 (post-launch)

#### **VII. Deliverables**

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

<b>ID</b>	<b>Deliverable Description</b>	<b>Due Date</b>
1		

End of Task Order Statement of Work

## **GSMO TASK ORDER**

Task No: **28**  
 Modification: **3**  
 Task Name: Fermi Spacecraft Sustaining Engineering and Anomaly Support  
 Task Period of Performance: March 1, 2012 to February 29, 2016  
 Modification Period of Performance: March 1, 2015 to February 29, 2016  
 GSMO SOW Reference: 3.1, 3.7

### **I. Task Order History**

**Description of current modification (Modification 1):** This modification to the initial task order statement of work for the Fermi Spacecraft Sustaining Engineering and Anomaly Support task is to extend the period of performance.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	03/01/2012	02/28/2013	Initial task order statement of work.
1	03/01/2013	02/28/2014	Extend the task period of performance
2	03/01/2014	02/28/2015	Extend the task period of performance
3	03/01/2015	02/29/2016	Extend the task period of performance

### **II. Background**

The Fermi Gamma-ray Space Telescope (FGST) Project requires sustaining engineering and anomaly support for the spacecraft bus and all of the spacecraft subsystems. In the event of a time critical situation that endangers the safety of the Fermi Observatory, the contractor shall make all reasonable efforts to provide immediate and appropriate engineering support to ensure the health and safety of the Observatory and support returning it to fully functional status. The Sustaining Engineer(s) will work with members of the Flight Operations Team (FOT), the instrument engineering teams, the Principal Investigator (PI), and others as required. The Sustaining Engineer(s) will advise and make recommendations to the FGST Mission Director (MD).

### **III. Scope of Work**

The Contractor shall provide expert FGST system engineering for the spacecraft bus and all of the spacecraft subsystems in the analysis and resolution identification of problems encountered.

#### **A. Requirements**

A.1. The contractor shall support anomaly resolution as determined by the MD. 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. The contractor shall participate in the formulation of a near-term course of action necessary to ensure the health and safety of the Observatory. The contractor shall also participate in the determination of root cause as related to the spacecraft bus. When required, as determined by the MD, the contractor shall submit an anomaly report containing spacecraft anomaly conditions, insights on root cause related to the spacecraft, and corrective or preventive actions for each anomaly.

A.2. The contractor shall closely coordinate efforts through all phases of Anomaly Resolution with the MD and the FOT. The contractor shall maintain daily contact with the FOT during an ongoing anomaly investigation to discuss the status of the investigation.

A.3. The contractor shall plan to support one spacecraft anomaly of similar size and complexity as the Fermi "cascading processor reboots" anomaly, which occurred in March 2009.

A.4. 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.

A.5. 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. The contractor may also utilize ITPS or ITPS trending reports generated by the FOT to look at long term component performance

A.6. The contractor will review the FOT Quarterly Report and the associated ITPS trending reports and provide a Quarterly Report that either confirms the information presented by the FOT or includes appropriate additional information and/or elaborates on information provided in the FOT Quarterly Report.

## **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 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**

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

## **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.

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

Travel Description	Approximate Time Frame
None at this time	

## VII. Deliverables

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

ID	Deliverable Description	Due Date
1	Quarterly Status Report	2 weeks after the Quarterly Review with the project

End of Task Order Statement of Work

**GSMO TASK ORDER**  
**Statement of Work (SOW)**  
**For**  
**Magnetospheric Multi-scale (MMS) Mission**  
**Ground System (GS)/Mission Operations Center (MOC) and Flight**  
**Operations Development Support**

Task No: 29  
 Modification: 6  
 Task Name: MMS GS/MOC and Flight Ops Development Support  
 Task Period of Performance: 03/01/2012 - 11/30/2015  
 Modification Period of Performance: 12/01/2014 - 11/30/2015  
 GSMO SOW Reference: 2.1, 2.3, 2.4, 3.1, 3.2

**I. Task Order History**

**Description of current modification (Modification 6):** This statement of work describes the products and services to be provided by the contractor on the MMS GS/MOC and Flight Operations Development support task through February 2015.

Mod #	Start	End	Brief Description
0	03/01/2012	02/28/2013	Initial task order statement of work.
1	04/01/2012	02/28/2013	Add desktop IT support requirement
2	06/01/2012	02/28/2013	Add MOC hardware/software procurement-related tasks for MOC Release-2 and FlatSat electrical power support
3	03/01/2013	02/28/2014	Extends TO29 covering one additional year of the MMS mission pre-launch development phase.
4	03/01/2014	02/28/2015	Extends TO29 covering one additional year of the MMS mission pre-launch development activities through Launch and Commissioning Operations.
5	05/22/2014		Administrative Modification
6	12/01/2014	11/30/2015	Updates the task due to the change in launch date from November 2014 to March 2015 and extends the POP end date through November 2015 to cover the Commissioning Phase.

**II. Background**

The Magnetospheric Multi-scale (MMS) mission is a Solar Terrestrial Probe mission comprising four identically instrumented observatories that will use Earth's magnetosphere as a laboratory to study the microphysics of three

fundamental plasma processes; magnetic reconnection, energetic particle acceleration, and turbulence. These processes occur in all astrophysical plasma systems but can be studied *in situ* only in our solar system and most efficiently only in Earth's magnetosphere, where they control the dynamics of the geospace environment and play an important role in the processes known as "space weather".

All four observatories will be operated from a single Mission Operations Center (MOC) located at GSFC. The MOC will be staffed and operated by a dedicated Flight Operations Team (FOT). The Flight Dynamics team will be collocated with the FOT in the MOC. The Science Operations Center (SOC), located at the Laboratory for Atmospheric and Space Physics (LASP) in Boulder, CO, will provide the interface with the instrument teams and is responsible for Instrument Suite (IS) operations.

This SOW specifies Contractor support to provide MOC and Mission Operations development activities during the implementation phase following the conclusion of the MMS Ground System Critical Design Review (CDR) in February 2012.

**Assumptions:**

- The Advanced Spacecraft Integration and System Test (ASIST) telemetry and command system baselined to support the spacecraft Integration and Test (I&T) activities will also be used to support mission operations; development and technical support for the ASIST and Front End Data System (FEDS) will be provided by Design America Inc., under a separate contract.
- The Flight Dynamics functions are developed, implemented and operated under a separate Flight Dynamics Support Services (FDSS) contract.
- MOC will provide the interface between the SOC and the observatories; the SOC performs all Instrument Suite (IS) health and safety monitoring, science planning and data processing, and resolves all inter-instrument conflicts.
  
- The Mission Training Simulator (MTS) is the primary resource for simulating the MMS constellation of four spacecraft for mission simulations and rehearsals. Development and technical support for MTS will be provided under a separate GSMO task order #42.
- The FlatSat suite of hardware and ancillary equipment will be moved to Building 14, room E229 (on Goddard Space Flight Center), and the level of effort required for that move will be shared between this task order and the Integration and Test task order (TO014).

- Development and technical support for tACT will be provided under a separate GSMO task order #95.
- The Ground System Freeze is December 12, 2014. MMS Launch Ready Date is March 12, 2015.

### **III. Scope of Work**

The Contractor shall provide support for developing the MMS Ground System Mission Operations and the Flight Operations through launch and commissioning and into mission Phase 1a. The specific task details are listed in the following requirement section.

#### **A. Requirements**

##### **A-1 Management Approach**

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.

Management responsibility will at a minimum include the following areas:

##### **a. Staff Allocation, Expertise, and Level of Effort**

The Contractor shall ensure the availability and competence of the work force necessary to execute the management and technical activities of this Task Order. The Contractor shall manage staff allocation to the required tasks specified.

##### **b. Configuration Management**

The Contractor shall support the Configuration Management (CM) policies and procedures established by the MMS Project Office, GSFC Code 461.

##### **c. Operations Facilities**

The Contractor shall perform the work specified in this SOW at GSFC. Travel to support Technical Interface Meetings and Working Groups may be required.

##### **d. Information Technology Security**

The Contractor shall perform the work specified in this SOW in compliance with the security procedures established by the MMS Project Office.

##### **A-2. Technical**

The Contractor shall provide pre-launch technical support to the Ground System Manager for the MMS program. These tasks include the following sub-activities:

**a. Systems Engineering**

- 1) Provide technical support for maintaining MOC requirements, interface control documents, design specifications, and other related development documents as applicable.
- 2) Mature the MMS mission operations concepts and scenarios as they evolve through the design and implementation phase.
- 3) Support the Project Office Configuration Control Board (CCB) process and provide Configuration Change Request (CCR) technical review and impact assessments as needed.
- 4) Maintain the Configuration Management Plan for the MMS Ground System.
- 5) Provide technical review of Project documents as applicable to the ground system and/or flight operations.
- 6) Support Ground System and mission operations test planning and coordination; (i.e., element interface testing, acceptance testing, ground system mission readiness testing, and mission operations tests and simulations).
- 7) Support the technical review and maintenance of Interface Control Documents (ICDs) for external interfaces to the MMS MOC, including interface with the SOC, Flight Dynamics Operations Area (FDOA), and with the Tracking, Telemetry, and Command (TT&C) networks including the Deep Space Network (DSN), Universal Space Network (USN), and Space Network (SN).
- 8) Provide technical review and comments to GSFC Code 450 on the MMS Network Requirements Document (NRD) and the Project Service Level Agreement (PSLA).
- 9) Provide technical review and comments to the Jet Propulsion Laboratory (JPL) on the DSN-MMS Operations Interface Control Document (OICD) as needed.
- 10) Support operations working group meetings and Technical Interface Meetings (TIMs) as necessary.
- 11) Provide support to the GSM with the Flight Operations Review (FOR)/Operations Readiness Review (ORR) close out any Requests For Action (RFAs).
- 12) Provide systems engineering input and oversight to the MOC implementation activities, including external interface testing, and system release acceptance testing.
- 13) Provide systems engineering support and oversight to the move of FlatSat into the MOC facility, Building 14, Room E229.
- 14) Complete testing and ensure operation readiness of the MOC backup Telemetry and Command (T&C) system in Building 32

**b. MOC Development, Integration, and Test**

- 1) Maintain level-3 requirements levied on the MMS MOC.

- 2) Maintain level-4 requirements for all MMS MOC subsystems.
  - 3) Maintain documentation detailing the design of the MOC subsystems including:
    - a. Automation
    - b. Mission Planning System (MPS)
    - c. Data Archive and Distribution System (DADS)
    - d. Network Scheduling
    - e. Integrated Trending and Plotting System (ITPS)
    - f. Advanced Spacecraft Integration and System Test (ASIST) telemetry and command system
    - g. Facility including power, network and equipment configuration including the FlatSat spacecraft simulator.
  - 4) Maintain MOC and related ICDs.
  - 5) Comply with configuration management procedures, processes, and policies as per the MMS Configuration Management Plan.
  - 6) Maintain a Software Development Plan that details the approach to satisfying the baseline set of MMS MOC requirements per NASA Procedural Requirement (NPR) 7150.2.
  - 7) Maintain MOC subsystems; MPS, DADS, ITPS, and automation and tools software and hardware; and ensure its operational readiness for Launch and Commissioning.
  - 8)
  - 9)
  - 10) Maintain MOC facility including LSR and FDOA countdown clocks and overhead displays.
    - a.
      - 11) Provide system administration of MOC including LSR and FDOA hardware and software systems.
      - 12) Provide property management including inventory and tracking of all MOC hardware and software installed on MOC systems
      - 13) Provide desktop IT support for the FOT and the ground system development team.
- c. Flight Operations Planning and Development**
- 1) Support the NASA GSM in developing a baseline operations approach for all aspects of mission operations including Real-time Health & Status monitoring, spacecraft commanding, management of on-board recorders, engineering and science data capture and distribution, mission planning, network scheduling, trending and engineering analysis, ground system monitor and control, training and certification, configuration management, and autonomous operations.

- 2) Maintain close working relationships with the Project Systems Engineering Team, spacecraft subsystem Product Development Leads (PDLs), Instrument Teams, FD Team, and I&T Test Conductors as required to capture the operational requirements and constraints of the MMS spacecraft.
- 3) Coordinate with the MMS Test Conductor team the development of the MMS Project Database (PDB) telemetry and command definitions.
- 4) Develop and 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.
- 5) Support maintenance of operations agreements (OAs) between the FOT and the following organizations:
  - a. SOC Operations Team
  - b. SSMO Scheduling Office
  - c. Flight Software Sustaining Engineering (FSSE) Team
  - d. Flight Dynamics Operations Area
  - e. Science and Planetary Operations Control Center (SPOCC)
- 6) Maintain spacecraft Flight Operations Plan (FOP).
- 7) Provide technical review and comment on Project documentation as required.
- 8) Plan and coordinate MMS spacecraft test opportunities with the I&T Manager designed for ground system and operations procedure validation and operations team training purposes.
- 9) Coordinate with Mission Systems Engineer, Spacecraft I&T, FlatSat, MRT and other Project personnel to plan Mission Simulation exercises.
- 10) Maintain FOT/MOC Skills Checklists per the baselined version of the Operations Training and Certification Plan.
- 11) Perform user acceptance testing of the MOC subsystems and support MOC external interface testing and GSRT testing as needed
- 12) Operate the tACT tool to support MRT and L&EO activities.

**d. Security Planning, Implementation, and Administration**

- 1) Maintain required NASA Information Technology Security documentation.
- 2) Coordinate with GSFC Code 700 development, update, and maintenance of the MMS MOC Subsystem Acceptance and Implementation Variances (SAIV) document; also known as IT Security Plan.
- 3) Perform IT security risk assessments and perform risk reporting.
- 4) Identify and support the implementation of security controls as per NASA IT Security requirements.
- 5) Ensure that systems are kept up to date with latest security patches in accordance with GSFC Code 400/700 direction.
- 6) Define procedures for managing user accounts, backing up data, and configuring systems.

- 7) Maintain user accounts in support of flight operations development and testing.

**e. Mission Readiness and Test (MRT) Support**

- 1) Coordinate with the SOC for the last Ground System Readiness Test (GSRT) and generate the GSRT report.
- 2) Coordinate with I&T Manager and other Project personnel, planned test opportunities with the observatories.
- 3) Help maintain and operate the MTS tool (developed under a separate task order) to ensure simulation integrity and fidelity suitable for mission rehearsals and flight operations training.
- 4) Maintain operational understanding of the MMS Mission Training Simulator (MTS) sufficient to perform MTS operations in support of MRT, MOC testing, and Operations Team training exercises.

**f. Spacecraft Integration and Test (I&T) Support**

- 1) Support the development of subsystem-specific telemetry and command database definitions using the ASIST Record Definition Language (RDL).
- 2) Learn and devise monitor and control Local Operating Procedures (LOPs) for MMS-specific Ground Support Equipment (GSE).
- 3) Develop Systems Test and Operations Language (STOL) procedures and display pages to support flight hardware and software testing and flight operations.
- 4) Provide test conductor support for observatory-level activities including launch site testing.
- 5) Provide S/C TC and FlatSat assistance as needed to support MOC and FOT testing activities.

**B. Management Reporting**

The Contractor shall provide weekly status reporting to the MMS Ground System Manager (GSM)/TM and shall address technical, cost, and schedule performance versus plans for each of the major subtasks identified, showing milestones as appropriate. The Contractor shall report to the GSM, any identified risks (technical, cost, or schedule), consistent with the MMS Project Office continuous risk management plan.

**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**

**a. Office Space**

All personnel supporting this task order shall utilize government-furnished office space. This shall include office furnishings, telephone, laptop and desktop computer hardware and software resources, and Center Network Environment (CNE) access.

**b. MOC Computer Systems and Peripherals**

All hardware and associated Ground Support Equipment (GSE) for the FlatSat spacecraft simulator installation in the MOC shall be GFE.

**c. MOC Software**

Software from the suite of GSFC Mission Services Evolution Center (GMSEC) tools and applications shall be available to the Contractor.

**V. Material Procurement**

The contractor shall procure additional hardware and software as needed to maintain the functionalities of MOC, FDOA, LSR, FlatSat room, and backup MOC T&C system. This shall include mobile devices necessary to complete the ETE notification functionality of the ANS.

**VI. Travel Support**

The Contractor shall plan travel destinations to include the Science Operations Center located at the Laboratory for Atmospheric and Space Physics (LASP) in Boulder, Colorado. For the purposes of this SOW, the contractor shall plan one trip to this destination during this period of performance.

**VII. Deliverables**

The Contractor shall provide the following deliverables in support of the Task Order. Each deliverable and delivery due date are listed below. Unless specified otherwise, all deliverables will be provided in electronic "soft copy" form and will comply with Project-established documentation and CM standards.

**a. Software Deliverables**

The Contractor shall deliver formal releases of the MOC subsystems during this period of performance as per the following table:

<b>DELIVERABLE</b>	<b>Due Date</b>

DELIVERABLE	Due Date
Release-5: Alert Notification System including source code and build procedures	December 2014
Mission Planning System source code and build procedures	December 2014
Integrated Trending and Plotting System source code and build procedures	December 2014

**b. Documentation Deliverables**

The Contractor shall deliver and CCB boarded the following documentation during this period of performance:

DELIVERABLE	SCHEDULE	MILESTONE
MOC Detailed Design Specification final as-built revision Revision	February 2015	Launch minus 30 days
MMS Project to SSMO Operations Transition Plan (Baseline)	February 2014	Launch minus 30 days
MOC Weekly Report (emailed to GSM)	Every Week	COB Wednesday

End of Task Order Statement of Work

## **GSMO TASK ORDER**

Task No: 030  
 Modification: 05  
 Task Name: Geotail Mission Operations  
 Task Period of Performance: 03/01/2015 to 02/29/2016  
 Modification Period of Performance: {03/01/2015 to 02/29/2016  
 GSMO SOW Reference: 3, 3.3

### **I. Task Order History**

**Description of current modification (Modification 0):** This is the initial task order statement of work for Geotail mission operations task.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	03/01/2012	02/28/2013	Initial task order statement of work.
1	05/01/2012	02/28/13	De-Scoping of the task
2	11/01/2012	02/28/13	LZP Re-engineering effort added
3	03/01/2013	02/28/14	One year Extension
4	03/01/2014	02/28/15	Second year extension
5	03/01/2015	02/29/16	Third year extension

### **II. Background**

The Geotail spacecraft was launched on July 24, 1992. The Geotail is operated by the Institute of Space and Astronautical Science (ISAS) of Japan. NASA/GSFC is responsible for Geotail science data distribution. In addition, Deep Space Network (DSN) Scheduling Services, Hardware Maintenance, System Administration and Software Maintenance support will be performed in this Task Order.

This Statement of Work (SOW) defines the work required to provide Geotail Science data processing and DSN Scheduling services, located at the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland.

An overview of the Geotail mission objectives and requirements for all ground system elements is contained in the following document:

A) Requirements for Polar, Wind and Geotail Spacecraft Operations and Ground System Data Handling, June 24, 2002.

- The GSFC's Space Science Mission Operations (SSMO) Project (GSFC Code 444) is responsible for Geotail Level-Zero Processing (LZP) mission operations and mission support services.
- The responsibilities specific to the management and technical requirements of the Flight Operations Team (FOT) are described in general terms in Section III of this SOW. Additional details are provided in the document listed in A) above.

The work defined herein describes the Government's minimum objectives; however, to meet the Geotail mission objectives, some capabilities beyond the scope of this SOW may be required. The Government will provide the Wide Area Network (WAN) services and

Ground Network (GN) services necessary to perform the activities required by this SOW through other contracts. The Government, GSFC Code 632, will provide Level-0 and Level-1 data processing services for Geotail. This task shall also provide funding for Geotail DSN scheduling services. For details regarding actual DSN scheduling services provided for Geotail, see Task order 3.

### **III. Scope of Work**

This task shall have financial roll-up responsibilities and overall coordination responsibilities for all GSMO elements supporting Geotail. The Contractor shall perform mission support services in support of the Geotail spacecraft. The contractor shall perform Geotail science data processing as well as DSN Scheduling duties. To successfully operate these assets, the Contractor shall operate and maintain the elements of the Geotail LZP ground system. Specific work activities of this support responsibility are defined in Section A of this Task Order.

The contractor shall support feasibility and technical studies related to Geotail Ops concepts and science data acquisition as required.

The work to be performed shall be carried out with the approval of the SSMO Mission Director. For normal operations, the SSMO Mission Director or his/her designate shall provide final approval of all procedures used to support Geotail activities. During special operations, the SSMO Mission Director shall provide final approval for all planning, execution and post-event analysis.

Since this task is not responsible for software development, the Capability Maturity Model Integration (CMMI) requirement does not apply.

#### **A. Requirements**

The Contractor shall perform mission operations of the Geotail spacecraft consistent with other sections of this SOW. Mission operations include science data processing operations, DSN Scheduling Services, Hardware Maintenance, System Administration and Software Maintenance support.

##### **A.1. Flight Operations:**

The Geotail spacecraft flight operations are currently done by the Institute Space and Astronautical Science (ISAS) of Japan and therefore it is not part of this SOW. However, for the Geotail mission the Contractor shall perform Level-zero processing consistent with other sections of this SOW. The contractor shall interface with DSN for requesting Data Capture and Delivery (DCD) data, as required by the Geotail data operations group, Code 632.

##### **A.2. Planning and Scheduling:**

The contractor shall secure adequate communications services through the Deep Space Network (DSN) for the delivery of Geotail spacecraft telemetry to the ground. The contractor shall provide a conflict-free schedule of activities for all spacecraft contacts.

##### **A.3. Anomaly Detection, Isolation, Analysis, Recovery and Reporting**

The Contractor shall monitor, collect telemetry data and process the Level zero data for Geotail.

The Contractor shall report all anomalies or incidents as detailed in the Wind/Geotail Escalation Procedures. This report shall be made to the SSMO Mission Director within one business day; unless the incident is mission threatening in which case the parties shall be notified immediately. A summary of the incident shall be received via e-mail within one business day.

For each anomaly or incident the Contractor shall generate an Anomaly Closeout Report or a Root Cause or Corrective Action (RCCA) report depending on the incident. This report shall describe how the incident or 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 report shall be provided to the SSMO Mission Director within 10 business days of resolution of the anomaly.

**Support for Resolution of Ground-based Anomalies:** With the oversight of the SSMO Mission Director, the Contractor shall 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.

The Contractor shall maintain a database of all ground-based flight operations anomalies.

A.4. Level Zero Processing:

The contractor shall provide Level Zero Processing (LZP) and data distribution support for the Geotail spacecraft.

A.5. Flight Operations Mission Library

The contractor shall maintain a library of current operating documents and reports for the Geotail mission. This library shall serve as a repository of the Geotail mission history, LZP operations procedures and activity plans, and a repository for manufacturer provided documentation.

A.6. Support Services:

Mission Operation Center (MOC) Facilities:

The building and environmental control for the Mission Operations Center (MOC) will be provided by the Government as will all networks, hardware and system software necessary to support Geotail mission operations activities and interfaces.

The hardware required to support Geotail in the MOC includes, but is not limited to:

1. Geotail Level-Zero Processor (LZP) Systems
2. Raw Data Archive (RDA)

A.7. Hardware, Software, Database and Document Configuration and Maintenance

Hardware, software, database and document configuration management (CM) shall be controlled via the mechanisms referenced in A10. The Contractor shall follow all procedures and guidelines specified in the MMOC Configuration Management Plan in proposing, analyzing, implementing and recording changes to systems associated with the Geotail mission.

Change Requests which affect elements outside the Geotail MOC, or as specified in the MMOC Configuration Management Plan, shall be submitted by the Contractor to the SSMO Mission Director.

The contractor shall perform all system administration functions for all computer systems used in direct support of this task.

A.8. Organizational Interfaces:

The Contractor shall manage the external interfaces. In coordination with the external elements, the contractor shall evaluate the need and impact of changes in the interfaces required to support Geotail mission operations. The Contractor shall coordinate any changes through the SSMO Mission Director.

1. Routine Operations

The Contractor shall support and maintain the interfaces required for routine operations and coordination of Geotail mission activities.

2. Cooperative Mission Activities

The Contractor shall support communication and coordination, as required, between the Geotail mission and other U.S. and non-U.S. missions.

3. International Partners

The Contractor shall support operational interfaces with International Partners in support of Geotail mission operations.

A.9. Staff Allocation, Expertise , and Level of Effort:

The Contractor shall ensure availability and competence of the work force necessary to execute the management and technical activities specified in this SOW. This shall be accomplished through recruitment, training, certification, and the analysis of comparable work environments and associated compensation. The Contractor shall manage staff allocation to the required tasks described in this SOW.

A.10. Configuration Management:

The Contractor shall maintain and execute a MOC Configuration Management Plan for operational products.

The Contractor shall operate and maintain a Government approved configuration management system. This system shall be used to manage change requests for ground hardware and software as well as technical and procedural documentation necessary for the operation and maintenance of the Geotail ground-based mission operations systems.

The Contractor shall accurately track changes to mission operations requirements, products, systems, software, and the on-orbit spacecraft configuration. The SSMO Mission Director or his/her designate shall approve all configuration changes before the changes are implemented. The Contractor shall also track and maintain changes to interfaces with network and other institutional facilities as changes occur.

A.11. Operations Facilities:

The Contractor shall establish the FOT within the Mission Operations Center (MOC) currently located in Building 3/14 at the GSFC. The Contractor shall provide all office supplies and consumables used in the daily execution of this contract.

A.12. Training and Certification of Personnel

The contractor shall maintain and execute a formal training and certification program. The objective of the program shall be to assure mission success by cultivating a diverse, competent staff of FOT professionals. The 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 contractor shall reports metrics on training and certification on a monthly basis.

A.13. Risk Management and Best Practices

The Contractor shall identify and evaluate risks to Geotail operations support. For those risks that are within control of mission operations, the contractor shall recommend to the SSMO Mission Director any changes to systems or procedures that could reduce or eliminate the risk.

The Contractor shall have a process for applying lessons learned and best practices from other NASA missions to the Geotail mission. The Contractor shall have a process for minimizing the number and impact of operational errors. The Contractor shall report all operational errors to the SSMO Mission Director as they occur and in the weekly status report.

A.14. Information Technology Security

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 a NASA network that requires compliance with GSFC and NASA security requirements. The Contractor shall make arrangements and coordinate

security checks and scanning of operational systems as required by GSFC and the Agency.

The Contractor shall apply IT security standards as defined by NPG 2810.1 for systems classified as a Mission (MSN) for all IT systems. In addition, the Contractor shall comply with all Federal Rules and Regulations and Agency directives.

A.15. Performance Metrics:

The following metrics are intended as example indicators of the Geotail mission accomplishments and performance relative to mission requirements and objectives.

1. Spacecraft contacts successfully supported is a key element of measurement, reflecting the frequency and nature of Geotail spacecraft contacts that are routinely and successfully supported on a daily basis. A spacecraft contact shall be deemed "unsuccessful" if all planned activities are not completed, command capability is not maintained for the duration of all staffed contacts, and/or if additional resources are required in order to complete all planned activities.
2. The contractor shall report on a weekly basis the percentage of science data capture.
3. Science data scheduled but not acquired is a measure of the problems encountered, and of the operational practice of identifying and documenting failures in daily acquisition management. The minimum data delivery requirement is 80%, with an operational goal of 90%.
4. Interface coordination activities are a measure of the effectiveness of coordinating and communicating with the various operational elements of the PWG system required to carry out daily operational activities. LZP data product delivery will be assessed per the requirements specified in section III.A.15.3 above.
5. State of documentation (procedures, operating instruction, etc.) is a measure of the attention to detail and the thoroughness applied to maintaining documentation files regarding the state of the systems and operational procedures employed in flight operations. Documentation control will be assessed based on GSFC ISO standards.
6. Adherence to existing and developed configuration control mechanisms will be an indication of the procedural discipline enforced by the Contractor and their commitment to sound engineering and operational practices.
7. The smooth operation of the Geotail system relies on a well-trained and motivated FOT. On a monthly basis, the Contractor shall report on the status of staffing levels, training and certification activities and identify any known areas of future attrition.

The performance metrics defined in general terms here shall be reported through regular weekly meetings, reports, and briefings presented by the Contractor and reviewed by the SSMO Mission Director and SSMO Project Management Staff.

## **B. Management Reporting**

The Contractor shall create and maintain a Mission Management Plan. This document shall describe the manner in which the Contractor shall manage the work described in this statement of work.

The Contractor shall provide Monthly status reports and reviews on the technical, cost, schedule and operational performance to adequately describe the activities of the FOT to the SSMO Project. Reports of anomaly detection, isolation and resolution shall be provided. Planning, status and definitive reports shall be provided for all special operations.

The Contractor shall provide an annual performance review of the Geotail mission support services based on current requirements and actual services provided.

All reports shall be made available in both soft and hardcopy when required.

## **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 the facilities and the facility services for the Geotail support functions performed on site at the GSFC. Office and workstation furniture required to manage and operate the Geotail spacecraft and its ground support elements will be provided. The Contractor may have access to office space located in the GSFC Building 3/14 near the Mission Operations Center to support the Geotail mission operations and FOT management requirements.

The Contractor shall be accountable for all Geotail Government Furnished Equipment (GFE). A summary of GFE hardware and associated software will be provided.

## **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**

No travel is required.

## VII. Deliverables

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

**Mission Management Plan:** This plan shall be updated as necessary for any changes in the operations of Geotail or on the ground system processing. The Mission Management Plan shall include sections describing, mission management and reporting, staffing, training and certification, risk management and best practices, IT security, configuration management, ground systems sustaining engineering and maintenance of mission and technical records or reference a Contractor-provided plan for these areas.

**Weekly Spacecraft Performance Report:** The Contractor shall generate Weekly Spacecraft Performance Reports. The report shall include, as a minimum, a summary of the operational statistics, major upcoming Geotail and related DSN scheduling activities. The report shall discuss the results of the trending analysis and highlight any areas of potential concern.

This deliverable is no longer required by the task monitor.

This is not a deliverable to TM and no longer needed.

**Risk Mitigation Plans:** As required

**Root Cause and Corrective Action:** For each incident that requires an RCCA, the contractor shall describe what caused the incident, the impact of the incident and what corrective actions are required. The RCCA shall be provided to the SSMO Mission Director within 10 business days of the incident.

**Monthly Financial Report:** The contractor shall generate a monthly financial status report for the mission

**Escalation Plan:** The task will continue to use the Wind/Geotail Escalation Plan.

ID	Deliverable Description	Due Date
1	Mission Management Plan	As required
2	Weekly Spacecraft Performance Report	COB Wed
3	Risk Mitigation Plans	As required
4	Root Cause and Corrective Action	As required
5	Re-Engineered LZP System(removed from task)	Feb 28, 2013

End of Task Order Statement of Work

## **GSMO TASK ORDER**

Task No: 031  
 Modification: 3  
 Task Name: WIND Mission Operations  
 Task Period of Performance: 03/01/2015 to 02/28/2016  
 Modification Period of Performance: 03/01/2015 to 02/29/2016  
 GSMO SOW Reference: 3, 3.3

### **I. Task Order History**

**Description of current modification (Modification 0):** This is the initial task order statement of work for Wind mission operations task.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	03/01/2012	02/28/2013	Initial task order statement of work.
1	03/01/2013	02/28/2014	First Year extension
2	03/01/2014	02/28/2015	Second Year extension
3	03/01/2015	02/29/2016	Third Year Extension

### **II. Background**

The Wind spacecraft was launched on Nov 1, 1994 and it is operated by NASA at GSFC. This Statement of Work (SOW) defines the work required to provide mission operations for the Wind spacecraft and its instruments, mission support services, attitude determination, science data processing, DSN Scheduling services, Hardware Maintenance, System Administration, and Software Maintenance for the ground-based mission operations systems, located at the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland.

An overview of the Wind mission objectives and requirements for all ground system elements and flight operations, are contained in the following documents:

- A) GGS Wind/Polar Mission Rules, January 31, 1996
- B) Requirements for Polar, Wind and Geotail Spacecraft Operations and Ground System Data Handling, June 24, 2002.
- The GSFC's Space Science Mission Operations (SSMO) Project (GSFC Code 444) is responsible for Wind mission operations and mission support services. The government's active participation in flight operations management will incrementally increase with operational situation severity.
- The responsibilities specific to the management and technical requirements of the Flight Operations Team (FOT) are described in general terms in Sections III of this SOW. Additional details are provided in the documents listed in A and B above.

The work defined herein describes the Government's minimum objectives; however, to meet the Wind mission objectives, some capabilities beyond the scope of this SOW may be required. The Government will provide the Wide Area Network (WAN) services and Ground Network (GN) services necessary to perform the activities required by this SOW through other contracts. Through other Task Orders, the Government will provide Flight Dynamics

(Orbit and Maneuver) and DSN scheduling support necessary to perform the activities required by this SOW. The Government, GSFC Code 632, will provide Level-0 and Level-1 data processing services for Wind. This task shall also provide funding for Wind DSN scheduling services. For details regarding actual DSN scheduling services provided, see Task order 3.

### **III. Scope of Work**

This task shall have financial roll-up responsibilities and overall coordination responsibilities for all GSMO elements supporting Wind. The Contractor shall perform mission operations and mission support services in support of the on-orbit Wind spacecraft and its instruments throughout the period of performance. The contractor shall perform Wind science data processing. To successfully operate these assets, the Contractor shall operate and maintain the elements of the Wind Multi-Mission Operations Center (MMOC) ground system. Specific work activities of this support responsibility are defined in section A of this Task Order.

The Contractor shall support feasibility and technical studies related to Wind operations concepts and science data acquisition as required.

The work to be performed shall be carried out with the approval by the SSMO Wind Mission Director. For normal operations, the SSMO Mission Director or his/her designate shall provide final approval of all procedures used to operate and maintain the spacecraft, their instruments and space/ground support activities. During special operations, the SSMO Mission Director shall provide final approval for all planning, execution and post-event analysis. During contingency operations, the SSMO Mission Director shall lead efforts in analysis, planning, rehearsal, execution and post-activity analysis. If any travel is required by the mission personnel, this will be covered by project funds.

Since this task is not responsible for software development, the Capability Maturity Model Integration (CMMI) requirement does not apply.

### **A. Requirements**

The Contractor shall perform mission operations of the on-orbit Wind spacecraft consistent with other sections of this SOW. Mission operations include WIND Flight Operations, science data processing operations, DSN Scheduling Services, Hardware Maintenance, System Administration, Software Maintenance support and flight dynamics attitude determination.

- A.1. Flight Operations:  
The Contractor shall perform flight operations of the on-orbit Wind spacecraft consistent with other sections of this SOW. Flight operations includes all activities, including automation, 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. Planning, rehearsal, execution and post-event analysis shall also be performed for special events such as orbital/attitude maneuvers and infrequent activities (e.g. spacecraft engineering tests and instrument calibration activities). In particular, the contractor shall plan and prepared for an attitude maneuver to correct for the known attitude misalignments. The contractor shall interface with DSN for requesting data via the Data Capture and Delivery (DCD) system, as required by the Wind data operations group, Code 632. Finally, the Contractor shall be responsible for the

planning, rehearsal, execution and evaluation of contingency operations through its FOT and the SSMO provided Anomaly Support Team (AST) described below.

A.2. Planning and Scheduling:

The contractor shall secure adequate communications services through the Deep Space Network (DSN) for the delivery of Wind spacecraft and Instrument telemetry to the ground and the commanding and tracking to the Wind spacecraft.

The contractor shall also provide a conflict-free schedule of activities for all Wind spacecraft contacts, spacecraft activities, and instrument operations that are consistent with the overall Wind science Operation Plan.

A.3. Real-Time and Support Operations:

The Contractor shall support real-time operations of the Wind spacecraft from the Deep Space Network. 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 and/or attitude maintenance maneuvers, system configuration, housekeeping telemetry processing, command load verification and uplink, onboard table and memory load/dump operations, and management of the Digital Tape Recorders (DTRs) to capture and downlink a minimum of 80% of all science and spacecraft engineering data with a goal of at least 90% data recovery. These data recovery statistics apply to any given one month period. 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, maneuver planning, and spacecraft clock maintenance.

A.4. Anomaly Detection, Isolation, Analysis, Recovery and Reporting

The Contractor shall monitor and maintain the health of the Wind spacecraft, collect telemetry data and process all health and status telemetry data to assess the performance of each spacecraft subsystem and instrument.

In response to real-time spacecraft anomalies the contractor shall execute the pre-approved response (such as flight operations procedure, spacecraft commands, or script). In response to real-time 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 in real-time. The contractor shall support SSMO anomaly review boards as needed to assess on-orbit problems and formulate a response using the appropriate expertise.

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 Wind missions operations system. The Contractor shall be responsible for support of anomaly resolution activities as defined in this section. The contractor shall report all anomalies per escalation procedures and SSMO guidance, and utilize the Spacecraft Orbital Anomaly Reporting System (SOARS) to manage anomalies through closure.

The Contractor shall report all anomalies or incidents that occur to the spacecraft, the instruments, the Mission Operations Center, or other areas that impact the operation or safety of personnel and equipment. This report shall be made to the SSMO Mission Director within one business day; unless the incident is mission threatening in which case the parties shall be notified immediately. A summary of the incident shall be received via e-mail within one business day.

A Level-1 anomaly is defined as any isolated accident, failure, or event that is likely to compromise the ability of an instrument or spacecraft to successfully complete its mission. Each Level 1 anomaly requires a Root Cause and Corrective Action (RCCA) to be generated.

Specific examples of reportable anomalies during routine operations include:

1. Loss of science or engineering data flow (i.e., communication failure, instrument failure, unexpected entry into a safe mode, etc.).
2. Loss of redundancy onboard the spacecraft where an additional failure would result in the loss of the mission.
3. Any event that jeopardizes the ability of the spacecraft to complete the target mission life (i.e., loss of expendables, degraded solar array performance, etc.).

For each anomaly or incident the Contractor shall generate an Anomaly Closeout Report or a Root Cause or Corrective Action (RCCA) report depending on the incident. This report shall describe how the incident or 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 report shall be provided to the SSMO Mission Director within 10 business days of resolution of the anomaly.

The Contractor shall maintain a database of all spacecraft and ground-based flight operations anomalies.

**Support for Resolution of On-Orbit Anomalies:** The Government is responsible for maintaining and managing an Anomaly Support Team (AST). In addition, the Government shall be responsible for any augmentation of technical staff to support anomaly analysis, except where such augmentation requires expertise from sources external to the Government. The AST shall have 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 AST is also responsible for development of a corrective action recommendation to be given to the SSMO Mission Director. The Contractor shall

participate in the analysis of such anomalies in support of the AST, when requested by and under the oversight of the SSMO Mission Director. As required by the AST, the contractor shall obtain additional expertise for anomaly resolution from sources external to the Government. The Contractor shall also implement corrective actions as authorized by the SSMO Mission Director.

**Support for Resolution of Ground-based Anomalies:** With the oversight of the SSMO Mission Director, the Contractor shall 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.

A.5. Spacecraft Subsystems and Associated Operations

The Contractor shall plan, rehearse, perform and assess real-time, special and contingency operations that involve or impact the Wind spacecraft subsystem. The Contractor shall support operational engineering and performance analysis of, at a minimum, the Power Subsystem, Thermal Subsystem, Command and Data Handling (C&DH) Subsystem, Attitude Control and Determination (ACAD) Subsystem, Mechanisms Subsystem, Communications Subsystem, and the Reaction Control Subsystem (RCS). The Contractor shall interface with all instrument teams in support of operational engineering and performance analysis of the Wind instruments.

A.6. Performance Analysis and Trending:

The Contractor shall collect and store the housekeeping and health and safety data from the Wind spacecraft. The Contractor shall interface with the PWG Data Processor to acquire all necessary Wind engineering data. The Contractor shall also process, trend and analyze these data on a short-term, long-term and periodic basis depending on the specific parameters and objectives. 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 Wind flight hardware. The contractor shall also provide proposed recommendations/solutions for any such unacceptable performance degradations.

In addition, ad hoc reports shall be generated as needed to support anomaly investigations, maneuver planning, and any special reports requested by SSMO Mission Director.

A.7. Spacecraft & Instrument Off-line Engineering Support:

The Contractor shall provide off-line engineering support for the Wind spacecraft and their 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 for investigation of any instrument anomalies.

The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.

The Contractor shall maintain and update documentation, plans and procedures as required in support of mission operations and mission support activities.

The Contractor shall maintain a repository of the spacecraft manufacturer provided documentation.

The Contractor shall maintain and update flight team training plans and provide the necessary training as classroom training and training exercises.

The Contractor shall maintain analysis tools as required for off-line engineering support of normal and special flight operations activities and contingency analysis activities.

A.8. Level Zero Processing:

The contractor shall provide Level Zero Processing (LZP) and data distribution support for the Wind spacecraft.

A.9. Flight Operations Mission Library

The contractor shall maintain a library of current operating documents and reports for the Wind mission. This library shall serve as:

1. Repository of the Wind mission history
2. Reference library for flight operations testing
3. On-console reference library for flight operations activities
4. Repository of flight operations procedures, activity plans, and command authorization meeting presentations
5. Repository for manufacturer provided documentation.

A.10. Support Services:

MOC Facilities:

The building and environmental control for the Multi-Mission Operations Center (MMOC) will be provided by the Government as well as all networks, hardware and system software necessary to support Wind mission operations activities and interfaces.

The hardware required to support Wind in the MMOC includes, but is not limited to:

1. Legacy system (Transportable Payload Operations Control Center (workstation and front end)
2. ITOS – Integration Test and Operation System
3. MUS – Multi User Space Link Extension
4. GMSEC – Goddard Mission Services Evolution Center
5. Wind Level-Zero Processor (LZP) Systems
6. Wind Command Request System (CSR – also known as SPOF)
7. Wind Re-engineered Command Management System (RCMS)
8. Wind Integrated Trending and Plotting System (ITPS)
9. Raw Data Archive (RDA)

A.11. Hardware, Software, Database and Document Configuration and Maintenance

Hardware, software, database and document configuration management (CM) shall be controlled via the mechanisms referenced in III.A.14. The Contractor shall follow all procedures and guidelines specified in the MMOC Configuration Management Plan in proposing, analyzing, implementing and recording changes to systems associated with the Wind mission.

Change Requests which affect elements outside the Wind MMOC, or as specified in the MMOC Configuration Management Plan, shall be submitted by the Contractor to the SSMO Mission Director.

The contractor shall perform all system administration functions for all computer systems used in direct support of this task.

A.12. Organizational Interfaces:

The Contractor shall manage the external interfaces. In coordination with the external elements, the contractor shall evaluate the need and impact of changes in the interfaces required to support Wind mission operations. The contractor shall be responsible for integrating all GSMO Wind mission activities including Wind FDF related work. The Contractor shall coordinate any changes through the SSMO Wind Mission Director.

1. Routine Operations

The Contractor shall support and maintain the interfaces required for routine operations and coordination of Wind mission activities.

2. Cooperative Mission Activities

The Contractor shall support communication and coordination, as required, between the Wind mission and other U.S. and non-U.S. missions.

3. International Partners

The Contractor shall support operational interfaces with International Partners in support of Wind mission operations.

A.13. Staff Allocation, Expertise , and Level of Effort:

The Contractor shall ensure availability and competence of the work force necessary to execute the management and technical activities specified in this SOW. This shall be accomplished through recruitment, training, certification, and the analysis of comparable work environments and associated compensation. The Contractor shall manage staff allocation to the required tasks described in this SOW.

A.14. Configuration Management:

The Contractor shall maintain and execute a MMOC Configuration Management Plan for operational products.

The Contractor shall operate and maintain a Government approved configuration management system. This system shall be used to manage change requests for ground hardware and software as well as technical and procedural documentation necessary for the operation and maintenance of the Wind ground-based mission operations systems.

The Contractor shall accurately track changes to mission operations requirements, products, systems, software, and the on-orbit spacecraft configuration. The SSMO Mission Director or his/her designate shall approve all configuration changes before the changes are implemented. The Contractor shall also track and maintain changes to interfaces with network and other institutional facilities as changes occur.

A.15. Operations Facilities:

The Contractor shall establish the FOT within the Multi-Mission Operations Center (MMOC) currently located in Building 3/14 at the GSFC. The Contractor shall provide all office supplies and consumables used in the daily execution of this contract.

A.16. Training and Certification of Personnel

The contractor shall maintain and execute a formal training and certification program. The objective of the program shall be to assure mission success by cultivating a diverse, competent staff of FOT professionals. The 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 contractor shall reports metrics on training and certification on a monthly basis.

A.17. Risk Management and Best Practices

The Contractor shall identify and evaluate risks to Wind mission operations support. For those risks that are within control of mission operations, the contractor shall recommend to the SSMO Mission Director any changes to systems or procedures that could reduce or eliminate the risk.

The Contractor shall have a process for applying lessons learned and best practices from other NASA missions to the Wind mission. The Contractor shall have a process for minimizing the number and impact of operational errors. The Contractor shall report all operational errors to the SSMO Mission Director as they occur and in the weekly status report.

A.18. Information Technology Security

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 a NASA network that requires compliance with GSFC and NASA

security requirements. The Contractor shall make arrangements and coordinate security checks and scanning of operational systems as required by GSFC and the Agency.

The Contractor shall apply IT security standards as defined by NPG 2810.1 for systems classified as a Mission (MSN) for all IT systems. In addition, the Contractor shall comply with all Federal Rules and Regulations and Agency directives.

A.19. Performance Metrics:

The following metrics are intended as example indicators of the Wind mission accomplishments and performance relative to mission requirements and objectives.

1. Spacecraft contacts successfully supported is a key element of measurement, reflecting the frequency and nature of Wind spacecraft contacts that are routinely and successfully supported on a daily basis. A spacecraft contact shall be deemed "unsuccessful" if all planned activities are not completed, command capability is not maintained for the duration of all staffed contacts, and/or if additional resources are required in order to complete all planned activities.
2. Successful vs unsuccessful execution of command and control sequences reflects performance of the FOT with regard to accuracy and timeliness of the process to formulate and execute instructions to the on-orbit asset. Stored command loads management will be assessed on the basis of ensuring an on-board command load does not terminate. Commanding for special events (including maneuvers, instrument reconfigurations, spacecraft component reconfigurations, and anomaly responses) will be assessed on the ability to be executed within the planned execution windows.
3. Science data scheduled and acquired is a measure of the effectiveness of the Digital Tape Recorder (DTR) management to meet data acquisition requirements, and the effectiveness of delivering data acquired by the instrument to the designated receiving facilities. DTR management will be assessed on the ability to ensure a minimum of 80% of the science data is delivered to the designated receiving facilities, with an operational goal of 90% delivery.
4. Science data scheduled but not acquired is a measure of the problems encountered, and of the operational practice of identifying and documenting failures in daily acquisition management. The minimum data delivery requirement is 80%, with an operational goal of 90%.
5. Anomalies detected, analyzed, reported and resolved is a measure of the operational response to ad hoc situations and unexpected occurrences, and the performance of the Contractor in responding to these demands.
6. Interface coordination activities are a measure of the effectiveness of coordinating and communicating with the various operational elements of the PWG system required to carry out daily operational activities. LZP

data product delivery will be assessed per the requirements specified in item A.19.4 above. Receipt of FDF products will be assessed based on delivery timeline requirements. Instrument command request processing and special events coordination shall be reported and assessed as required.

7. State of documentation (procedures, operating instruction, etc.) is a measure of the attention to detail and the thoroughness applied to maintaining documentation files regarding the state of the systems and operational procedures employed in flight operations. Documentation control will be assessed based on GSFC ISO standards.
8. Adherence to existing and developed configuration control mechanisms will be an indication of the procedural discipline enforced by the Contractor and their commitment to sound engineering and operational practices.
9. The smooth operation of the Wind system relies on a well-trained and motivated FOT. On a monthly basis, the Contractor shall report on the status of staffing levels, training and certification activities and identify any known areas of future attrition. MMOC cross-training shall be designed to incorporate training across multiple missions (i.e., ACE) and designated functions within the MMOC to optimize efficiency.

The performance metrics defined in general terms here shall be reported through regular weekly meetings, reports, and briefings presented by the Contractor and reviewed by the SSMO Mission Director and SSMO Project Management Staff.

A.20. RCMS Reengineering Project Plan

The contractor shall perform an analysis to determine feasible and cost effective options to make the RCMS system compliant with NPG 2810.1 Information Technology (IT) security standards. The report shall be delivered in a whitepaper format and provide viable options and the option recommended. For the recommended option, the report shall also include an implementation milestone schedule and the recommended hardware and software to be procured.

## **B. Management Reporting**

The Contractor shall create and maintain a Mission Management Plan. This document shall describe the manner in which the Contractor shall manage the work described in this Task Order.

The Contractor shall provide Monthly status reports and reviews on the technical, cost, schedule and operational performance to adequately describe the activities of the FOT to the SSMO Project.

Reports of anomaly detection, isolation and resolution shall also be provided. Planning, status and definitive reports shall be provided for all special operations.

The Contractor shall provide an annual performance review of the Wind mission support services based on current requirements and actual services provided. The contractor shall present to the government an operations concept for next year considering Wind mission's current status, expected budget and risk tolerance.

The contractor shall develop and deliver a project plan for the reengineering effort to virtualize the LZP system.

The contractor shall develop and deliver a project plan and prepare for an attitude maneuver to be executed in FY12. A Project plan shall be delivered, before executing the maneuver.

All reports shall be made available in both soft and hardcopy when required.

### **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 the facilities and the facility services for the Wind support functions performed on site at the GSFC. Office and workstation furniture required to manage and operate the Wind spacecraft and its ground support elements will be provided. The Contractor may have access to office space located in the GSFC Building 3/14 near the Multi-Mission Operations Center to support the Wind mission operations and FOT management requirements.

The Contractor shall be accountable for all Wind Government Furnished Equipment (GFE). A summary of GFE hardware and associated software will be provided.

## **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**

No travel is required.

## **VII. Deliverables**

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

**Mission Management Plan:** This plan shall be updated as necessary for any changes in the operations of Wind or on the ground system processing. The Mission Management Plan shall include sections describing, mission management and reporting, staffing, training and certification, risk management and best practices, IT security, configuration management, ground systems sustaining engineering and maintenance of mission and technical records or reference a Contractor-provided plan for these areas.

**Weekly Spacecraft Performance Report:** The Contractor shall generate Weekly 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, and all of Wind 's instruments. The report shall discuss the results of the trending analysis and highlight any areas of potential concern.

**Semi-Annual Spacecraft Performance Report:** The Contractor shall generate a Semi-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 semi-annual report shall be placed on spacecraft trends. Semi-annual reports shall be prepared and delivered by the end of the month following the end of the reporting period.

**Monthly Status Report:** On a monthly basis, the Contractor shall provide 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 payload activities including non-nominal events, development activities for each of the MMOC subsystems, issues from the month, Non-nominal events due to FOT errors, payload science data collection statistics, anomaly metrics, staffing status, training/certification metrics, special initiatives, planned activities and cost/budget status. The SSMO Mission Director may require additional items to be addressed on a periodic basis. A softcopy of this report shall be provided to the SSMO Mission Director.

**Anomaly Closeout Reports:** For each anomaly (or incident), the Contractor shall generate an Anomaly Closeout 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 Closeout Report shall be provided to the SSMO Mission Director within 10 business days of the resolution of the anomaly.

**Annual Performance Review:** The contractor shall present to the SSMO 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.

**End-of-Mission Plan:** Working with NASA personnel, the Contractor shall prepare/maintain an End-of-Mission Plan (EOMP) plan of actions for the Wind spacecraft as needed. This plan shall be delivered to the SSMO Mission Director upon modification.

**Monthly Financial Report:** Monthly

**Risk Mitigation Plans:** As required

**Root Cause and Corrective Action:** For each incident that requires an RCCA, the contractor shall describe what caused the incident, what was the impact of the incident and what corrective actions are required. The RCCA shall be provided to the SSMO Mission Director within 10 business days of the incident.

**Escalation Plan:** Updates as required

**LZP virtualization Project Plan:** This plan shall include schedules, milestones, and staffing level and a list of the necessary S/W and H/W to implement LZP virtualization.

**RCMS Reengineering Project Plan:** This plan shall include viable options, and the recommended option with schedules, milestones and staffing level.

<b>ID</b>	<b>Deliverable Description</b>	<b>Due Date</b>
1	Mission Management Plan	As required
2	Weekly Spacecraft Performance Report	COB Wed
3	Semi-Annual Spacecraft Performance Report	Semiannual
4	Monthly Status Report	Monthly
5	Anomaly Closeout Report	Within 10 business days of resolution
6	Annual Performance Review	Annually
7	End of Mission Plan	As required
8	Risk Mitigation Plans	As required
9	Root Cause and Corrective Action	As required
10	Monthly Financial Report	Monthly
11	Escalation Plan	As required
12	RCMS Reengineering Project Plan	May 30, 2014

End of Task Order Statement of Work

## **GSMO TASK ORDER**

Task No: **32**  
 Modification: **11**  
 Task Name: **GPM Mission Operations Support & TRMM**  
 Operations Close Out  
 Task Period of Performance: **March 1, 2013 to February 29, 2016**  
 Modification Period of Performance: **July 1, 2014 to February 29, 2016**  
 GSMO SOW Reference: **GSMO SOW Sections 3.3, 3.4, 3.6, 3.7**

### **I. Task Order History**

**Description of current modification (Modification 11):** This Modification 11 to the Global Precipitation Measurement (GPM) Ground System Development and Operations Task adds operations support for the ending Tropical Rainfall Measuring Mission (TRMM) which had been under TO #10 previously. In addition, this modification allows for travel in August to the Manned Spaceflight International Working Group (IWG) in Colorado Springs, CO. to support on-going coordination with ISS operations.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	3/1/2012	2/28/2013	Initial task order statement of work.
1			Administrative Mod. Changed TO Monitor
2	5/23/2012	2/28/2013	Adds Emergency MOC facility infrastructure work and modifies EMOC delivery dates.
3	1/1/2013	12/31/2013	Adds additional Operations Product milestones and deliverables, and pre-launch staffing preparations to support mission operations.
4	5/15/2013	12/31/2013	Adds a subtask for mission simulation and end-to-end management, and systems engineering activities, milestones and deliverables.
5	6/24/2013	12/31/2013	Adds the specific material procurements to support mission and launch critical operations and readiness.
6	12/1/2013	8/31/2014	Adds systems engineering support and travel to subtask 2 in preparation for shipment of the spacecraft to the launch site and post-launch activities, additional system administration support for pre-launch preparations of the MOC, I&T and launch site ground systems, and extends the task through launch and early orbit operations into the normal operations phase.
7	5/20/2014	8/31/2014	Adds operations team and IT security support through August 31, 2014, and removes subtask 2 from the task.
8	05/20/2014	08/31/2014	Change TM: Tony Foster to James Pawloski. Change Project RA: Ronnice Wedge to Sharon Purser Change Branch Head: Candace Carlisle to Eric Moyer
9	09/01/2014	02/28/2015	Extend operations to February 2015.
10	03/01/2014	02/29/2016	Extend operations to February 2016. Remove Ground System Hardware Support to GSMO TO #9 Remove Ground System Software Support to GSMO TO #8
11	07/01/2014	02/29/2016	Added TRMM Operations Support post-passivation (formerly TO #10) and GPM travel to the ISS IWG in August.

## II. Background

The contractor provides support to the GSFC Earth Science Mission Operations (ESMO) Project, GSFC Code 428, through the performance of requirements described in Section III of this task order. The contractor performs task requirements in various locations throughout the Goddard Space Flight Center campus, as described in detail in Section III of this task order.

The contractor will interface with a diverse set of organizations and groups during the performance of these activities, including GSFC civil servants and support contractors developing the GPM Core Spacecraft, representatives from the Ball Aerospace and Technology Corporation (BATC) developing the GPM Microwave Imager (GMI), representatives from the Japanese Space Exploration Agency (JAXA), representatives from the Precipitation Processing System (PPS), Flight Dynamics Facility (FDF), Attitude Control Systems Engineering Branch, Facilities Management Division (FMD), Software Engineering Division (SED), Mission Services Program Office, and representatives from the National Institute for Standards and Technology (NIST) for Space Systems security, as required.

The GSFC's Earth Science Mission Operations (ESMO) Project (GSFC Code 428) is responsible for mission operations and mission support services for the Tropical Rainfall Measuring Mission (TRMM). TRMM was passivated on April 15, 2015 and operations has ceased. However, additional support is required to complete documentation, archival and MOC clean out. This task will support that work in lieu of TO #10.

## III. Scope of Work

The contractor shall provide support to the ESMO Mission Director (MD) and Ground System Manager (GSM) to complete all required activities associated with the GPM Ground System implementation and Mission Operations effort, including maintenance and update of existing Ground system requirements, design, and programmatic documentation, ground system and Mission Operations Center (MOC) test planning, procedure development, execution, and reporting, training, and Information Technology (IT) security planning. The contractor shall develop, test, and maintain software for selected MOC subsystems, and install and configure furniture, equipment, and systems into the GPM MOC and Backup MOC, GPM MOC Development and Test Area, and FlatSat area. Specific work items, including documentation deliverables, are described below within Section III.A, Requirements.

### A. Requirements

#### 1 Spacecraft Operations

##### 1.1 Coordination with other entities

###### 1.1.1 Coordination with PPS:

A.1.1 The Contractor shall coordinate all activities related to the Dual Precipitation Radar (DPR) science data acquisition and instrument activities.

###### 1.1.2 Coordination of Non-nominal and/or Special Instrument Activities

A.1.2 The Contractor shall inform the Mission Director regarding any instrument team (DPR or GMI) request to perform special or non-nominal activities.

A.1.3 The Contractor shall support instrument teams in testing and checking of new or

modified procedures.

- A.1.4 Testing (via FlatSat or other necessary methods) shall be performed to the extent possible prior to the uplink of any new commands/procedures.
- A.1.5 Any activity requiring the concurrence of the instrument teams and/or Project Scientists shall be coordinated with the Mission Director.

#### **1.1.3 Coordination with External Users and/or Science Teams:**

- A.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.

### **1.2 Planning and Scheduling**

- A.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.
- A.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.

### **1.3 Real-time and Support Operations**

- A.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.

## **2 Spacecraft Engineering**

### **2.1 Staffing**

- A.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.
- A.2.2 The off-line engineering staff shall be the technical leadership of the Flight Operations Team (FOT) and shall be responsible for ensuring all aspects of spacecraft performance and safety.

### **2.2 Anomaly Detection, Isolation, Analysis, Recovery and Reporting**

- A.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.

## 2.2.4 Event Reports

- A.2.4 In response to any deviation to normal spacecraft operations, the Contractor shall 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).
- A.2.5 The ER shall 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
- A.2.6 The 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. ERs that are deemed to be Operator Errors will be identified as such and tracked by the contractor.

## 2.2.5 Spacecraft Anomalies

- A.2.7 In response to any spacecraft anomaly the Contractor shall execute government approved standard operating procedures and/or spacecraft commands.
- A.2.8 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 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.
- A.2.9 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.
- A.2.10 The Contractor shall be responsible for support of anomaly resolution activities as defined in this section.
- A.2.11 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.
- A.2.12 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.
- A.2.13 A summary of the anomaly shall be received 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.

- A.2.14 The Mission Director, or designee, is responsible for generation of all formal NASA Anomaly Reports. The Contractor shall work all anomalies to resolution, and document closure within the Anomaly Reporting system.
- A.2.15 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.
- A.2.16 The Anomaly Closeout Report shall be provided to the Mission Director within 10 business days of resolution of the anomaly.
- A.2.17 The Contractor shall maintain a database of all spacecraft and ground-based flight operations anomalies.
- A.2.18 The Contractor shall report on the status of all open anomaly investigations at all monthly status reviews or as requested by the Mission Director.
- A.2.19 As required, the Contractor shall 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.

### **2.2.6 Support for Resolution of On-Orbit Anomalies**

- A.2.20 The Contractor shall participate in Anomaly Support Team (AST) meetings as requested by the Mission Director.
- A.2.21 The Contractor shall implement corrective actions as authorized by the Mission Director.

### **2.2.7 Support for Resolution of Ground-Based Anomalies**

- A.2.22 ~~\_\_\_\_\_~~ The Contractor shall 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.

### **2.3 Performance Analysis and Trending**

- A.2.23 The Contractor shall collect and store the housekeeping data (which includes all health and safety data) and from the GPM Core spacecraft.
- A.2.24 The Contractor shall also process, trend and analyze these data on a short-term, long-term and periodic basis depending on the specific parameters and objectives.
- A.2.25 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.

A.2.26 In addition, special reports shall be generated as needed to support anomaly investigations, maneuver planning, and any special reports requested by the Mission Director.

#### **2.4 Spacecraft & Instrument Off-Line Engineering Support**

A.2.27 The Contractor shall provide off-line engineering support for the spacecraft and its instruments for all special engineering activities and contingency operations.

A.2.28 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.

A.2.29 This includes support to investigation of any instrument anomalies.

A.2.30 The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.

A.2.31 The Contractor shall maintain and update documentation, plans and procedures as required supporting mission operations and mission support activities.

A.2.32 The Contractor shall maintain and update flight team training plans and provide the necessary training as classroom training, training exercises, and simulations.

A.2.33 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.

#### **2.5 End of Mission Activities**

A.2.34 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.

#### **2.6 Support Ground System Upgrades and Technology Refresh Activities**

A.2.35 The contractor shall participate and provide support to all activities related to ground system changes or technology refresh activities.

A.2.36 The Contractor shall assess the potential level of impacts and risk to normal mission operations activities for all ground system changes.

A.2.37 The Contractors shall raise any issues of concerns and risk to the Mission Director as results of changes to the ground system.

#### **2.7 Instrument and Science Support**

A.2.38 The Contractor shall support all on-line instruments and sciences activities related to calibrations, anomaly resolution, reconfiguration and planning of instrument sciences activities

#### **2.8 Configuration Management Process**

A.2.39 The Contractor will follow configuration management processes for all FOT products including documentation of new or updated products, peer review and internal sign off.

A.2.40 The products will be presented to the Configuration Manager at the in-house Configuration Control Board meeting prior to being finalized.

#### **2.9 Automation Support**

A.2.41 The contractor shall conduct all automation development and ground system implementation activities.

**2.10 Proficiency Simulations**

A.2.42 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.

**2.11 Flight Operations Mission Library**

A.2.43 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

A.2.44 The contractor shall maintain an archive of all flight operations procedures, activity plans, timelines, and Command Authorization Meeting (CAM) presentations.

**2.12 Operations Oriented Documentation and products****2.12.8 End of Mission Plan**

A.2.45 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.

**2.12.9 Flight Operations Plan**

A.2.46 The contractor shall maintain the existing plan, which describes in detail the operational activities to be performed to activate, commission, and operate the GPM Core Observatory, per the schedule identified in Section VII of this document.

**2.12.10 Constraints and Restrictions database**

A.2.47 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.

**2.12.11 Training and Certification plan**

A.2.48 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, per the schedule identified in Section VII of this document. The contractor shall track training and certification for all flight operations team members within the guidelines of the Training and Certification Plan.

**2.12.12 Mission Operations Procedures**

A.2.49 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.

A.2.50 The contractor shall also maintain Configuration Managed STOL procedures and LOPs to recover from known operations contingencies which may occur during normal mission operations.

- A.2.51 Each operations procedure shall 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.
- A.2.52 The contractor shall organize and document these procedures using the established LOP and Mission Operations Change Request (MOCR) processes.
- A.2.53 The contractor shall test modifications to these procedures using appropriate flight hardware resources, including the GPM Flatsat.
- A.2.54 The contractor shall produce status reports which summarize the operational products in revision.
- A.2.55 STOL Procedures and LOPs will be delivered as needed to the ESMO Project.

#### **2.12.13 Core Spacecraft (S/C) user manual**

- A.2.56 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.

#### **2.12.14 Operations Agreements**

- A.2.57 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.
- A.2.58 The government serves as the lead author for each operations agreement indicated, the contractor shall assist the ESMO MD by attendance at 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.

#### **2.12.15 Automation Test Plan**

- A.2.59 The contractor shall maintain the draft GPM Automation Transition Plan, including the details of the phases and steps necessary to achieve automated, 8x5 operations. This document shall be updated as new or upgraded components are delivered into the MOC or EMOC.

### **3 General support**

- A.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 below at the frequency indicated for this Task Amendment:

#### **3.2 GMI instrument**

- A.3.2 The contractor shall participate in infrequent discussions with the GMI instrument developer (BATC) to discuss GMI instrument design details and operating concepts.

#### **3.3 JAXA**

- A.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 Ground System Interface Meetings (GSIMs) and peer reviews as requested by the ESMO MD.

### **3.4 ESMO**

- A.3.4 The contractor shall attend weekly operations meetings, as well as special activities at the request of the ESMO Project.
- A.3.5 The contractor shall participate in occasional discussions with systems and subsystem engineering teams.
- A.3.6 The contractor shall attend weekly status meetings, and shall manage and track action items resulting from the meetings.

## **4 GPM EMOC Maintenance**

- A.4.1 The contractor shall maintain the GPM Emergency Mission Operations Center (EMOC) housed in GSFC Building 3, Room S025, and the GPM Launch Support Room housed in GSFC Building 32 Room N202.

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.

- A.4.2 The contractor shall periodically perform proficiency tests of the EMOC to assure the systems are ready to support emergency operations.

## **5 TRMM Post-Passivation Operations Support**

- A.5.1 The Contractor shall coordinate configuration tracking for all mission operations changes with the TRMM Mission Director, including equipment retirement and disposal.
- A.5.2 The TRMM Mission Operations Center (MOC) is currently located in Building 32, with a backup Mission Operations Center (BMOC) facility located in Building 14 at GSFC and another facility at Capitol College. Both facilities decommissioning will be governed by the MOCR process and facilitated by the FOT.
- A.5.3 The Contractor shall develop and maintain, on an annual basis, all End of Mission materials, including the TRMM Interim End of Mission Plan, End of Mission Scripts (including all maneuvers and passivation activities), End of Mission Rehearsal documentation, and End of Mission Review materials.
- A.5.4 The Contractor shall compile a Final Spacecraft Operations Report deliverable at Passivation + 3 months.
- A.5.5 The Contractor shall coordinate with the Mission Director, TRMM instrument teams, Flight Dynamics Team, Flight Software Maintenance Team, Applied Engineering Technology Directorate (AETD) and other entities to compile the above report.
- A.5.6 The Contractor shall compile a complete Operations Archive to include, but not limited to: Operations Reports, Event Reports, Anomaly Reports, Operations Documentation, Spacecraft Documentation and Operations Products.
- A.5.7 The Contractor shall support the Mission Director as required for meetings, reports, coordination and planning, anomaly and problem resolution.

## **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 to adequately describe the activities of the task to the Task Monitor.

The Contractor shall provide monthly financial report to the Mission Director and the ESMO Project unique to GPM. Reporting will be using the 533M form level of information to allow long-term budget planning.

### 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

Office space/ADPE equipment for Ground Systems Development: The government shall provide office space, desktop personal computers, and telephone resources for [REDACTED]. For all other required staff, the contractor shall provide all office space, desktop personal computers, and telephone resources.

## 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.

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

<b>Travel Description</b>	<b>Approximate Time Frame</b>
5-day trip to White Sands, NM to interface with Space Network support to assure appropriate operations interface agreements are stable and reliable	April 2015
5-day trip to Tokyo, Japan for ground system interface meetings	June 2015
JAXA/NASA Ground System Interface Meeting (GSIM) #26 (TRMM FOT)	June 2015
5-day trip to Tokyo, Japan for ground system interface meetings	November 2015
3-day trip to Colorado, Springs (or other domestic location) for ISS Working Group	August 2015

## VII. Deliverables

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

1	<p><b>Weekly Operations FOT Priorities List</b> 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.</p>	2:00pm Monday, Weekly, unless otherwise deferred due to holiday or extenuating circumstances.
2	<p><b>Weekly Spacecraft Performance Report</b> 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.</p>	Tuesday, COB following week ending past Sunday
3	<p><b>Monthly Status Report</b> 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.</p>	Normally scheduled the first week of the following month
4	<p><b>Annual Operations Status Review</b> 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.</p>	Scheduled in the first quarter of the year following

5	<p><b>Command Authorization Meetings</b> 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.</p>	Prior to scheduled activity, nominally the day preceding the activity
6	<p><b>Anomaly Reports</b> 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.</p>	10 business days following resolution of the anomaly
6	<p><b>Event Reports</b> In response to any deviation to normal spacecraft operations, the Contractor shall immediately issue an Event Report (ER) to document the deviation.</p>	Within 1 orbit of incident, within operational constraints
7	<p><b>End-of-Mission Plan</b> The Contractor shall review and update the End-of-Life Plan on a yearly basis or as requested by the Mission Director.</p>	Annually, as requested

8	<p><b>Training and Certification Plan</b>  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.</p>	As required and Monthly metrics report
9	<p><b>Anomaly Response Plan</b>  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.</p>	As needed, annual review minimum.
10	<p><b>Mission Risk Management and Best Practices</b>  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.</p>	As needed, annual review minimum.
11	<p><b>Operations Procedures</b>  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.</p>	As required and Monthly metrics report

12	<p><b>Test Reports</b> 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.</p>	10 business days following test completion
13	<p><b>Financial Reports</b> The Contractor shall provide monthly 533M reports, 533Q reports and any other financial reports required to perform task planning and administrative budget planning.</p>	<p><b>533M:</b> Monthly not later than 10 working days following the close of the contractors' monthly accounting period <b>533Q:</b> Quarterly not later than the 15th day of the month preceding the quarter being reported <b>Other:</b> as required</p>
14	<p><b>Flight Operations Plan</b> 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.</p>	As needed, annual review minimum.
15	<p><b>Operations Agreements</b> The contractor shall update and review all Operations Agreements as required to address changes in the operations of the spacecraft.</p>	Updates as required
16	<p><b>Project Database</b> The contractor shall update and review all changes to the Project Database as required to address changes in the operations of the spacecraft.</p>	Updates as required
16	<p><b>TRMM Final Spacecraft Operations Report</b> The Contractor shall compile a Final Spacecraft Operations Report to include a detailed summary of the mission from launch to passivation. It shall include subsystem and instrument activities, events, anomalies and performance as well as control center activities and events.</p>	TRMM Passivation + 3 months.
17	<p><b>TRMM Flight Operations Archive</b> The Contractor shall compile a complete Operations Archive to include, but not limited to: Operations Reports, Event Reports, Anomaly Reports, Operations Documentation, Spacecraft Documentation and Operations Products.</p>	TRMM Passivation + 3 months.

**End of Task Order Statement of Work**

## GSMO Task 33, Mod: 3 – ACE Operations Support

### **GSMO TASK ORDER**

**Task Order Number:** 33  
**Mod Number:** 3  
**Task Title:** ACE Operations Support  
**Period of Performance:** 3/1/2012 through 02/29/2016  
**Modification Period of Performance:** 3/1/2015 through 02/29/2016  
**GSMO SOW Reference:** 3.0 (Operations)

#### **I. Task Order History**

This is the task order statement of work for **Advanced Composition Explorer (ACE) Operations Support**.

<b>Mod #</b>	<b>Start</b>	<b>End</b>	<b>Brief Description</b>
0	03/01/2012	02/28/2013	Initial task order Statement of Work (SOW)
1	03/01/2013	02/28/2014	One year extension
2	03/01/2014	02/28/2015	One year extension
3	03/01/2015	02/29/2016	One year extension

#### **II. Background**

The ACE Spacecraft (S/C) was launched on August 25, 1997. The S/C is owned and operated by NASA. The Flight Operations Team (FOT) is responsible for the daily operational support of the ACE S/C at the Goddard Space Flight Center (GSFC) Greenbelt, Maryland. The ACE Science Center (ASC) at the California Institute of Technology (Caltech), Pasadena, California is responsible for the collection and distribution of ACE Science data retrieved from the Deep Space Network (DSN) Data Capture & Delivery (DCD) system, operated by the Jet Propulsion Lab (JPL) at Pasadena, California.

This Task Order (TO) Statement of Work (SOW) defines the tasks required to provide mission operations and support services for the ACE S/C, its Instruments, and the ground-based mission operations systems located at GSFC.

An overview of the ACE mission objectives and requirements for all ground system elements and flight operations, are contained in the following documents:

- A) ACE Flight Operations Plan (FOP) Document, June, 1997
- B) ACE Detailed Mission Requirements (DMR), July 13, 1995
- The GSFC's Space Science Mission Operations (SSMO) Project (GSFC Code 444) is responsible for the ACE S/C, mission operations and mission support services. The government's active participation in flight operations management will incrementally increase with operational situation severity.

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

- The responsibilities specific to the management and technical requirements of the FOT are described in general terms in Sections III of this TO. Additional details are provided in the documents listed in A and B above.

The work described in the TO require capabilities beyond the scope of this Statement of Work (SOW) in order to provide complete functionality required to meet the ACE mission objectives. The Government will provide the Wide Area Network (WAN) services and DSN services necessary to perform the activities required by this TO through other contracts. Through other TO's under the GSMO contract, the Government will provide DSN Scheduling services necessary to perform the activities required by this TO SOW.

### **III. Scope of Work**

The Contractor shall perform mission operations of the on-orbit ACE S/C consistent with other sections of this TO.

The Contractor shall perform mission operations and mission support services in support of the on-orbit ACE S/C and the instrument teams. The Multi-Mission Operations Center (MMOC) shall be minimally staffed Monday to Friday to comply with GSFC core business hours. Weekends, Holidays, GSFC closures shall not be staffed provided nominal 'automated' support is accomplished or as otherwise directed. To successfully operate these assets, the Contractor shall operate and maintain the elements of the ACE MOC ground system. Specific work activities of this support responsibility are defined in Section A of this TO.

The Contractor shall support feasibility and technical studies related to operations concepts and science data acquisition as required. This task will have coordination responsibility for all elements supporting ACE. This task will also be responsible for providing roll up costs on a regular basis.

The work to be performed shall be carried out under direction of the SSMO Mission Director (MD) or other Government representatives identified by the SSMO Project. For normal operations, the SSMO MD or his/her designate will provide final approval of all procedures used to operate and maintain the S/C, the instruments, and space/ground support activities. During special operations, the SSMO MD or his/her designate will provide final approval for all planning, execution, and post-event analysis. During contingency operations, the SSMO MD or his/her designate will lead efforts in analysis, planning, execution and post-activity analysis. Project funds will cover any required travel for ACE Mission Operations as approved by the MD.

Note: This task is not responsible for software development, the Capability Maturity Model Integration (CMMI) requirement does not apply.

### **A. Requirements**

#### **1. Flight Operations**

Flight operations includes all activities necessary, which includes automation, to maintain S/C 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. Planning, execution and post-event analysis will also be performed for special events (e.g. S/C engineering tests, instrument calibration activities, maneuvers, etc.). The contractor shall

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

interface with DSN for requesting DCD data, if necessary to maintain S/C health & safety continuity. The Contractor shall support system enhancements and upgrades for development/implementation testing. Finally, the Contractor shall be responsible for the planning, execution and evaluation of contingency operations through its FOT and the SSMO provided Anomaly Support Team (AST) described in subsection III.A.1.c below.

### **a. Planning and Scheduling**

The Contractor shall secure adequate communications services through the Deep Space Network (DSN) for the delivery of ACE S/C and instrument telemetry to the ground and the commanding and tracking of the S/C.

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.

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.

### **b. Real-time and Support Operations**

The Contractor shall support real-time operations of the ACE S/C using the GSFC Ground System, the supporting infrastructure, and DSN and SN services. Real-time operations consist of those activities that are necessary to support direct communication with the S/C and include: telemetry, tracking and command activities, health and safety monitoring, orbital and/or attitude maintenance maneuvers, system configuration, housekeeping telemetry processing, command load verification and uplink, onboard table and memory load/dump operations, and management of the Solid State Recorders (SSRs) to capture and downlink a minimum of 90% of all science data with a goal of at least 95% data recovery. The data recovery statistics applies to any given one-month period. Support operations are those offline activities that are necessary to support the safe and nominal operation of the S/C and include: planning and scheduling, stored command load generation, maneuver planning, S/C clock maintenance, etc. The FOT shall perform weekly attitude maneuvers utilizing current or recommended ground system hardware and software application as developed and implemented.

### **c. Anomaly Detection, Isolation, Analysis, Recovery and Reporting**

The Contractor shall monitor and maintain the health of the ACE S/C, collect telemetry data and process health and status telemetry data to assess the performance of each S/C subsystem. The Contractor shall support the instrument teams as required.

In response to real-time S/C anomalies the contractor shall execute the pre-approved response as specified in the ACE Escalation Procedures document (e.g. Flight operations procedures, S/C commands, or scripts). In response to real-time S/C anomalies that do not have a pre-approved response (and the S/C is not in imminent danger of loss of mission), the contractor shall defer sending corrective action S/C commands in real-time. The SSMO MD shall conduct anomaly review boards as needed to assess on-orbit problems and formulate a response using the appropriate expertise.

An anomaly is defined as the occurrence of any event that causes the S/C, 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 ACE

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

mission operations system. The Contractor shall be responsible for support of anomaly resolution activities as defined in this section. The contractor shall report all anomalies per escalation procedures and SSMO guidance, and utilize the Spacecraft Orbital Anomaly Reporting System (SOARS) to manage anomalies through closure.

The Contractor shall report all Level I anomalies that occur to the S/C, the instruments, the Mission Operations Center, or other areas that impact the operation or safety of personnel and equipment. This report shall be made to the SSMO Mission Director within one business day; unless the anomaly is mission threatening in which case the parties shall be notified immediately. A summary of all Level-1 anomalies shall be received via e-mail within one business day. The definition of a Level 1 anomaly for the operational phase of a mission is as follows:

- Loss of science or engineering data flow in excess of 24 hours (i.e., communication failure, instrument failure, unexpected entry into a safe mode, etc.).
- Loss of redundancy onboard the S/C where an additional failure would result in the loss of the mission.
- Any event that jeopardizes the ability of the S/C to complete the target mission life (i.e., loss of expendables, degraded solar array performance, etc.).

For each Level-1 anomaly the Contractor shall generate an Anomaly Closeout Report (i.e. Root Cause and Corrective Action). 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 Closeout Report shall be provided to the SSMO Mission Director within 10 business days of resolution of the anomaly.

The Contractor shall maintain a common database as directed by the Project (e.g. Spacecraft On-orbit Anomaly System [SOARS]) of all S/C and ground-based flight operations anomalies.

**Support for Resolution of On-Orbit Anomalies:** The Government is responsible for maintaining and managing an Anomaly Support Team (AST). In addition, the Government shall be responsible for any augmentation of technical staff to support anomaly analysis. The AST shall have 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 AST is also responsible for development of a corrective action recommendation to be given to the SSMO MD. The Contractor shall participate in the analysis of such anomalies in support of the AST, when requested by [REDACTED] the SSMO MD. The Contractor shall also implement corrective actions as authorized by the SSMO Mission Director.

**Support for Resolution of Ground-based Anomalies:** [REDACTED] the Contractor shall have responsibility for analysis and resolution of anomalies that are determined to be the result of performance or failure of a MMOC ground-based system or subsystem, or a result of procedural error. These shall be reported on a weekly basis to the Mission Director or as noted otherwise in this Task Order

### **d. Spacecraft Subsystems and Associated Operations**

The Contractor shall plan, perform and assess real-time, special and contingency operations that involve or impact any ACE S/C subsystem. The Contractor shall support operational engineering and performance analysis of, at a minimum, the Power Subsystem, Thermal Subsystem, Command and Data Handling (C&DH) Subsystem, Attitude Subsystem, RF Communications

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

Subsystem, and the Propulsion Subsystem. Contractor shall interface with all instrument teams in support of operational engineering and performance analysis of the ACE instruments.

### **e. Performance Analysis and Trending**

The Contractor shall collect and store the housekeeping and health and safety data from the ACE S/C. The Contractor shall interface with the ACE Data Processor to acquire all necessary ACE engineering data. The Contractor shall also process, trend and analyze these data on a short-term, long-term and periodic basis depending on the specific parameters and objectives. The Contractor shall identify any parameters that demonstrate unacceptable performance degradation with time and trends that could lead to future performance loss or degradation of ACE flight hardware in the Weekly Report. The Contractor shall also provide proposed recommendations/solutions for any such unacceptable performance degradations to the MD.

In addition, ad hoc reports shall be generated as needed to support anomaly investigations, maneuver planning, and any special reports requested by SSMO MD.

### **f. Spacecraft & Instrument Off-Line Engineering Support**

The Contractor shall provide off-line engineering support for the ACE S/C and its instruments for all special engineering activities and contingency operations. Off-line, in-depth analysis shall be performed in order to validate S/C subsystem and instrument performance as well as to investigate any anomalies or trends that may occur. This includes support for investigation of any instrument anomalies.

The contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations.

The Contractor shall maintain and update documentation, plans and procedures as required to support mission operations and mission support activities.

The Contractor shall maintain a repository of the S/C manufacturer provided documentation.

The Contractor shall maintain and update flight team training plans and provide the necessary training as classroom training and training exercises.

The Contractor shall maintain analysis tools as required for off-line engineering support of normal and special flight operations activities and contingency analysis activities.

### **g. Level Zero Processing**

The Contractor is not required to produce level zero deliverables to the ASC.

### **h. Flight Operations Mission Library**

The contractor shall maintain a library of current operating documents and reports for the ACE mission. This library, currently located in Building 3, Rm. S-24 (or as otherwise re-located with MD approval), shall serve for

- Repository of the ACE mission history files
- Reference library for flight operations training
- On-console reference library for flight operations activities

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

- Repository of flight operations procedures, pass plans, engineering reports, special reports and daily reports
- Repository for manufacturer provided documentation

### **i. Training and Certification of Personnel**

The Contractor shall 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 Contractor shall report metrics on training and certification on a monthly basis.

### **j. Support Services – MOC Facilities**

The building and environmental control for the primary MMOC will be provided by the Government as will all networks, hardware and system software necessary to support ACE mission operations activities and interfaces.

### **k. Hardware, Software, Database and Document Configuration and Maintenance**

Hardware, software, database and document configuration management (CM) will be controlled via the mechanisms referenced in Section III.A.1.N. The Contractor shall follow all procedures and guidelines specified in the MMOC CM Plan in proposing, analyzing, implementing and recording changes to systems associated with the MMOC. The Contractor will be responsible for administration of desktop computers.

Mission Operations Change Requests (MOCRs), which affect elements outside the ACE MMOC, or as specified in the MMOC CM Plan, shall be submitted by the Contractor to the SSMO Mission Director.

The Contractor shall perform all system administration functions for all computer systems used in direct support of this task.

### **l. Organizational Interfaces**

The Contractor shall manage the external interfaces. In coordination with the external elements, the Contractor shall evaluate the need and impact of changes in the interfaces required to support ACE mission operations. The Contractor shall coordinate any changes through the SSMO Mission Director.

#### **1. Routine Operations**

The Contractor shall support and maintain the interfaces required for routine operations and coordination of ACE mission activities.

#### **2. Cooperative Mission Activities**

The Contractor shall support communication and coordination, as required, between the ACE mission and other U.S. and non-U.S. missions as approved/directed by ACE MD.

#### **3. International Partners**

The Contractor shall support operational interfaces with International Partners in support of ACE mission operations as approved/directed by ACE MD.

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

### **m. Staff Allocation, Expertise, and Level of Effort**

The Contractor shall ensure availability and competence of the work force necessary to execute the management and technical activities specified in this TO. This shall be accomplished through recruitment, training, certification, and the analysis of comparable technical work environments and associated compensation. The Contractor shall manage staff allocation to the required tasks described in this TO.

### **n. Configuration Management**

The Contractor shall maintain and execute a MOC Configuration Management (CM) Plan for operational products.

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 S/C and the ACE ground-based mission operations systems.

The Contractor shall accurately track and document changes to mission operations requirements, products, systems, software, and the on-orbit S/C configuration (e.g. Stored loads and/or Command Changes, Instrument Commands which may affect S/C Health & Safety). The SSMO Mission Director or his/her designate shall approve all configuration changes before the changes are implemented. The Contractor shall also track and maintain changes to interfaces with network and other institutional facilities.

### **o. Operations Facilities**

The Contractor shall establish the FOT within the MMOC currently located within GSFC Building 14, W222/W216. The MMOC shall be minimally staffed Monday to Friday to comply with GSFC core business hours. Weekends, Holidays, GSFC closures shall not be staffed provided nominal 'automation' is accomplished or as otherwise directed. The Contractor shall provide all office supplies and consumables used in the daily execution of this contract.

### **p. Risk Management and Best Practices**

The Contractor shall identify and evaluate risks to ACE mission operations. For those risks that are within the control of mission operations, the Contractor shall recommend to the SSMO MD any changes to systems or procedures that could reduce or eliminate the risk.

The Contractor shall have a process for applying lessons learned and best practices from other NASA missions to the ACE Mission. The Contractor shall have a process for minimizing the number and impact of operational errors. The Contractor shall report all operational errors to the SSMO MD within 24 hrs as they occur and in the weekly/monthly status report.

### **q. Risk Management and Best Practices**

The Contractor shall identify and evaluate risks to ACE mission operations. For those risks that are within the control of mission operations, the Contractor shall recommend to the SSMO MD any changes to systems or procedures that could reduce or eliminate the risk.

The Contractor shall have a process for applying lessons learned and best practices from other NASA missions to the ACE Mission. The Contractor shall have a process for minimizing the

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

number and impact of operational errors. The Contractor shall report all operational errors to the SSMO MD within 24 hrs as they occur and in the weekly/monthly status report.

### **r. Information Technology Security**

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 a NASA network that requires compliance with GSFC and NASA security requirements. The Contractor shall make arrangements and coordinate security checks and scanning of operational systems as required by GSFC and the Agency.

The Contractor shall apply IT security standards as defined by NPG 2810.1 for systems classified as a Mission (MSN) for all IT systems. In addition, the Contractor shall comply with all Federal Rules and Regulations and Agency directives.

### **s. Performance Metrics**

The following metrics are intended as example indicators of the ACE mission accomplishments and performance relative to mission requirements and objectives.

- A. S/C contacts successfully supported are a key element of measurement, reflecting the frequency and nature of ACE S/C contacts that are routinely and successfully supported on a daily basis. A spacecraft contact shall be deemed “unsuccessful” if all planned activities are not completed, command capability is not maintained for the duration of all staffed contacts, and/or if additional resources are required in order to complete all planned activities
- B. Successful vs. unsuccessful preparation and execution of command and control sequences reflects performance of the FOT with regard to accuracy and timeliness of the process to formulate and execute instructions to the on-orbit asset. Stored command loads management will be assessed on the basis of ensuring on-board loads are executed as planned. Commanding for special events (including maneuvers, instrument reconfigurations, spacecraft component reconfigurations, and anomaly responses) will be assessed on the ability to be executed within the planned execution windows.
- C. Science data acquired at the supporting DSN ground site is a measure of the effectiveness of the Solid State Recorder (SSR) management to meet data acquisition requirements, and the effectiveness of delivering data acquired by the instrument to the designated receiving facilities. SSR management will be assessed on the ability to ensure a minimum of 90% of the science data is delivered to the designated receiving facilities, with an operational goal of 95% delivery.
- D. Science data scheduled for real time support but not acquired is a measure of the problems encountered, and of the operational practice of identifying and documenting failures in daily acquisition management. The minimum data delivery requirement is 90%, with an operational goal of 95%.
- E. Anomalies detected, analyzed, reported and resolved is a measure of the operational response to ad hoc situations and unexpected occurrences, and the performance of the Contractor in responding to these demands.

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

- F. Interface coordination activities are a measure of the effectiveness of coordinating and communicating with the various operational elements of the ACE system required to carry out daily operational activities. Receipt of FDF products will be assessed based on delivery timeline requirements. Instrument command request processing and special events coordination shall be reported and assessed as required.
- G. State of documentation (procedures, operating instruction, etc.) is a measure of the attention to detail and the thoroughness applied to maintaining documentation files regarding the state of the systems and operational procedures employed in flight operations. . Documentation control will be assessed based on GSFC ISO standards.
- H. Adherence to existing and developed configuration control mechanisms will be an indication of the procedural discipline enforced by the Contractor and their commitment to sound engineering and operational practices.
- I. The smooth operation of the ACE system relies on a well-trained and motivated FOT. On a monthly basis, the Contractor shall report on the status of Staffing Levels, Planned and Prioritized Activities, Training and Certification activities, Identify any known areas of future attrition or team functionality or structure.

The performance metrics defined in general terms here shall be reported through regular monthly meetings, reports, and briefings presented by the Contractor and reviewed by the SSMO MD and SSMO Project Management Staff.

### **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 to adequately describe the activities of the task to the Task Monitor.

**a. Weekly Spacecraft Performance Report:** The Contractor shall generate Weekly Performance Reports due by COB Tuesday. The report shall include, as a minimum, a summary of the overall status and performance of the S/C and its instruments for the week, operational statistics, major upcoming activities, and status, performance, and plans for the S/C and all its instruments. The report shall discuss the results of the trending analysis and highlight any areas of potential concern. The report shall identify activities, which affect MMOC support (e.g. s/w deliveries, power outages, planned maintenance, etc.) A softcopy of this report will be provided to the SSMO MD.

**b. Monthly Status Report:** On a monthly basis, the Contractor shall provide 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 payload activities including non-nominal events, development activities for each of the MMOC subsystems, issues from the month, Non-nominal events due to FOT errors, payload science data collection statistics, anomaly metrics, staffing status, training/certification metrics, special initiatives, planned activities, and cost/budget status (e.g. DSN scheduling, h/w & s/w maintenance, facility maintenance...) for ACE Operations Support. The SSMO MD may require additional items to be addressed on a periodic basis. A softcopy of this report will be provided to the SSMO MD

## **GSMO Task 33, Mod: 3 – ACE Operations Support**

### **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 the facilities and the facility services for those ACE mission support functions performed on site at the GSFC MOC. Office and workstation furniture required to manage and operate the ACE S/C and its ground support elements will be provided.

**The Contractor shall be accountable for all ACE GFE. A summary of GFE hardware and associated software shall be provided.**

### **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.

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

<b>Travel Description</b>	<b>Approximate Time Frame</b>
<b>None currently planned</b>	<b>TBD</b>

### **VII. Deliverables**

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

<b>ID</b>	<b>Deliverable Description</b>	<b>Due Date</b>
<b>1</b>	<b>Anomaly Notification Reports:</b> Contractor shall generate Anomaly Update Reports Closeout Report which shall include Date, Project, Location (S/C Type Orbit), Date/Time of Anomaly, Description of Anomaly, Impact on Project/Science, and Corrective/Mitigation Action.	Initial report within 24hrs to SSMO MD with subsequent updates as required
<b>2</b>	<b>Anomaly Closeout Reports:</b> For each Anomaly/Incident the Contractor shall generate an Anomaly Closeout Report. This	

### GSMO Task 33, Mod: 3 – ACE Operations Support

	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 Closeout report shall be provided to the SSMO MD 10 business days of the resolution of the anomaly
3	<b>Ad Hoc Presentations/Reports:</b> E.G. The Contractor shall provide: -. ACE Science Working Team (SWT) Updates, Operational Change Recommendations, H/W changes. ETC.	As required
4	<b>Root Cause and Corrective Action (RCCA):</b> For each incident that requires an RCCA, the Contractor shall describe what caused the incident, what was the impact of the incident and what corrective actions are required.	The RCCA shall be provided to the SSMO MD within 10 business days of the incident
5	<b>Risk Mitigation Plan/Matrix:</b> The Contractor shall Identify/Review risks associated with the operation of ACE Mission Operations. This includes updating the ACE Risk Matrix.	Yearly and/or As required
6	<b>Escalation Plan/Directives:</b> The Contractor shall review and update Escalation Plan/Directives with SSMO MD.	Yearly and/or As required
7	<b>End-of-Mission Plan:</b> Working with the SSMO MD and supporting NASA personnel, the Contractor shall prepare an End-of-Mission Plan for the ACE S/C.	To the SSMO Mission Director by TBD <b>NOT REQUIRED</b>
8	<b>Monthly Financial report</b>	Monthly
9	<b>Summary of GFE Hardware, Software, &amp; Licenses</b>	Semi-Annually
10	<b>Mission Management Plan:</b> The Plan shall include sections describing, mission management and reporting, staffing, training and certification, risk management and best practices, IT security, configuration management, ground systems sustaining engineering and maintenance of mission and technical records or reference a Contractor-provided plan for these areas.	As Required
11	<b>Semi-Annual S/C Performance Review:</b> The Contractor shall generate a Annual Performance Report that contains the same content as the monthly report except that engineering evaluation of S/C performance shall be more detailed. This report will cover the six month performance period and be reviewed with the MD.	Semi-Annually

**End of Task Order Statement of Work**