STATEMENT OF WORK (SOW)

Attachment A

GROUND SYSTEMS AND MISSION OPERATIONS (GSMO-2)

TBD, 2015

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INTRODUCTION

The purpose of this contract is to acquire engineering services for the Goddard Space Flight Center (GSFC) for ground systems and mission operations support in all phases of a mission life cycle. The scope encompasses concept studies, design, development, integration, test, verification, operations, and sustainment of mission operations systems and subsystems, and operations processes and procedures.

The Government issued task orders will specify the specific work to be performed, including the requirements to be met, the standard(s) of performance, required deliverables or output, government furnished property or information, and applicable documents within this broader contract scope.

The contractor shall adhere to the sections under the following documents, and their updates, applicable to the requirements on this Statement of Work (SOW):

NPR 7120.5, NASA Space Flight Program and Project Management Requirements
NPR 7123.1, NASA Systems Engineering Processes and Requirements
GPR 8070.4 Administration and application of Goddard Rules for Design, Development, Verification and Operation of Flight Systems

NPR 2810.1, Security of Information Technology
GPR 1600.1, Goddard Security Requirements

NASA-STD-8719.14, Process for Limiting Orbital Debris
NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris
GPR 8715.7, GSFC Orbital Debris and End of Mission Program Requirements

GPR 1410.2, Configuration Management
GPR 1440.8, Records Management
400-PG1440.7.2, Retention of Program and Project Technical Records by the Code 400 Directorate Library

GPR 8621.4, GSFC Mishap Preparedness and Contingency Plan
400-PG-8621.1.1, Anomaly Notification System for Flight Programs and Projects

GPR 8070.4, Administration and Application of Goddard Rules for Design, Development, Verification and Operation of Flight Systems

1 MANAGEMENT

The Contractor shall perform all the necessary program management functions in order to plan, implement, execute, track, and report progress of work tasked, and manage risks. The Contractor shall support all Center mandated audits, such as IT Security, Physical Security, Health and Safety, International Organization for Standardization (ISO), and Property.

The Government will provide the facilities and associated support for those functions performed on-site. The Government will provide desktop computing services for administrative functions on-site. On-site property will be Installation (IAGP) Government Property, and will be the Government's responsibility to manage. The Government may issue task orders to direct the Contractor to perform management functions in support of the Government. The Contractor shall manage all property at Contractor locations.

The Contractor shall interface with entities performing work outside the scope of this SOW, such as the Local and Wide Area Network (LAN and WAN), the Flight Dynamics Facility (FDF), and the Near Earth Network (NEN) services, Deep Space Network (DSN) services, and Space Network (SN) services.

The Contractor shall provide the appropriate skill mix, material, and resources necessary to perform work tasked.

The Contractor shall monitor and status performance summarized at the Contract level, including objective measures of technical, schedule, and cost performance.

The Contractor shall provide contract Configuration Management (CM) which includes the development of an approved CM plan which specifies the change control process. Additional CM requirements will be identified in individual task orders. The designated Government representative shall concur on configuration changes before the changes are implemented.

The Contractor shall supply personnel with Secret clearances as required by individual task orders.

The Contractor shall provide Task Order processing and status performance on a monthly basis.

2 MISSION OPERATIONS DEVELOPMENT

The Contractor shall support the development phase of the mission life-cycle, by providing systems engineering, performing studies, and performing design, development, integration, and test of systems, subsystems, and procedures and processes to achieve mission objectives.

2.1 Systems Engineering

The Contractor shall provide systems engineering services for mission operations development activities. The Contractor shall provide engineering services related to spacecraft operations, spacecraft subsystems operations and performance analysis, mission planning, payload operations planning, space-to-ground communications, ground-to-ground communications, modeling of spacecraft operations, modeling of communications and ground station operations, spacecraft command systems, and ground processing of telemetry. The Contractor shall provide over-arching systems engineering for the integration of ground system development and implementation with operations processes and procedures to facilitate effective and efficient operations of the flight segment. The Contractor shall provide systems engineering for mission operations to include conducting studies, developing systems, integrating and testing systems, and providing information technology support.

2.2 Engineering Studies

The Contractor shall perform engineering analysis and studies as tasked for operations concept development and definition, system and subsystem trade studies to identify and evaluate alternative approaches, and system definition in support of missions operations.

2.3 Facility Engineering

The Contractor shall provide support for the preparation, design, and integration of facilities in support of mission operations activity. The support includes identification of communications, power, and heating ventilation and air conditioning requirements. The support also includes the configuration of consoles, computer equipment and peripherals, clocks, visual displays, and other systems required for effective and efficient mission operations.

2.4 Ground System Development

The Contractor shall define operations concepts, define system and subsystem requirements, design, develop, and implement systems and subsystems to perform mission operations. These functions may include command and control, telemetry monitoring and event response, planning and scheduling, housekeeping and science data processing, integrated flight dynamics functions, automation, spacecraft trend analysis, miscellaneous engineering analysis tools,

Information Technology support, and development of simulators and Ground Support Equipment (GSE).

2.4.1 Telemetry, Command, and Control

The Contractor shall provide support to develop or procure systems to ingest and process spacecraft telemetry, and evaluate telemetry against specific constraints and limits identified in the Project Database. The system shall enable spacecraft command and control functions, including the issuance of individual commands, the execution of procedures, the loading of spacecraft tables, and dump and verification of spacecraft and instrument microprocessor memory images.

2.4.2 Mission Planning

The Contractor shall provide support services to develop or procure systems to perform integrated mission planning to ensure efficient and effective mission execution to meet mission objectives. Mission planning tools shall support efforts to identify and resolve resource contentions, and may generate integrated mission timelines, spacecraft execution timelines, and spacecraft load products such as an Absolute Time Sequence (ATS) of spacecraft commands.

2.4.3 Network Scheduling

The Contractor shall develop tools to support the scheduling of all space-to-ground link opportunities, including the Near Earth Network (NEN), the Space Network (SN), and the Deep Space Network (DSN). The Contractor shall support the development and implementation of standards for scheduling such as those supported by the Consultative Committee for Space Data Systems (CCSDS) Space Link Extension (SLE) Service Management.

2.4.4 Trending

The Contractor shall develop systems to ingest and analyze telemetry data to identify spacecraft system and subsystem performance over time.

2.4.5 Flight Dynamics

The Contractor shall develop systems to provide flight dynamics functions integrated in the Mission Operations Center(s). Support includes such items as orbit determination, ephemeris generation, assessment of on-board orbit determination system performance, maneuver planning and execution support, attitude determination, verification of onboard attitude, generation of attitude control parameters, and generation of mission planning products.

2.4.6 Level Zero Processing

The Contractor shall develop systems to provide level zero processing of spacecraft and payload data. Level zero processing includes the time ordering of data, and the identification and removal of duplicate data.

2.4.7 Analysis Tools

The Contractor shall develop various analysis tools to aid and support mission operations efforts.

2.4.8 Automation

The Contractor shall develop integrated systems to automate the execution of mission operations actions such as spacecraft commanding, health and safety monitoring, alert notification, data analysis, product generation, and data delivery.

2.4.9 Information Technology Support

The Contractor shall provide information technology support for the development effort, including system or software installation, setup, configuration or de-installation; IP management; account management; system backup; and data cleaning for computer systems. Task activities may include the preparation, review, and updating of IT security procedures and processes to ensure consistency with NASA and GSFC guidelines, the reporting of security compromises, and the identification and repair of security problems.

2.4.10 Simulators

The Contractor shall develop tools to simulate the performance of operations elements and interfaces to facilitate system development, testing, and training.

2.4.11 Ground Support Equipment (GSE)

The Contractor shall support the development and integration of equipment to support the integration and testing of spacecraft and payload systems and subsystems.

2.5 Operations Products

The Contractor shall design, develop, and implement the procedures to operate mission spacecraft and associated payload. The Contractor shall develop and maintain mission data base(s) that define the spacecraft and instrument telemetry points, their associated limits, calibration parameters, and the spacecraft command definitions including the identification of critical commands.

The Contractor shall define, develop, and maintain the procedures, processes, and plans to effectively and efficiently conduct mission operations including the development of plans such as the Flight Operations Plan, Launch and Early Orbit

Support Plan, Configuration Management Plan, Risk Management Plan, Training and Certification Plan, and End of Mission Plan.

The Contractor shall identify, design, and develop the displays to communicate spacecraft configuration, and performance during operational support activities. The displays shall provide situational awareness of spacecraft, payload, support element, and environmental activity.

2.6 Integration and Test

The Contractor shall provide support of integration and test activities of mission services systems. These activities may include component- and system-level acceptance testing, the coordination of interface testing with other components of a mission, end-to-end testing, and mission readiness testing and operations readiness testing. The Contractor shall develop test plans, design and execute tests to verify system requirements, and collect. analyze, and report test results.

3 MISSION OPERATIONS

The Contractor shall perform mission operations. This support includes routine flight operations, anomaly response, integrated flight dynamics operations, and mission data collection and distribution. The Contractor shall perform system engineering and sustaining engineering services as tasked to support spacecraft and payload engineering requirements, and sustain the ground system. The Government shall provide the baseline operational equipment, systems, and facilities needed for mission operations.

The Contractor shall provide, with the Government's approval, mission specific flight operation certification plans.

The Contractor shall utilize the NASA's anomaly reporting system to report, manage, and maintain a database of flight segment and ground segment anomalies.

3.1 System Engineering

The Contractor shall provide the overarching engineering to ensure the complement of elements, systems, and subsystems interact effectively to achieve mission objectives. The Contractor shall coordinate interfaces, internal and external, to ensure compatibility and interoperability.

The Contractor shall develop and maintain mission documents under Government approved Configuration Management (CM) plans, and manage mission libraries. The Contractor shall provide anomaly response and investigation.

3.2 Launch and Early Orbit Support

The Contractor shall support Launch and Early Orbit operations, including the coordination of launch site operations, data flow, and interfaces with all support elements. The Contractor shall conduct mission tests, and training simulations to ensure operations readiness. The Contractor shall develop, maintain, and execute an integrated mission timeline of events detailing the pre-launch, launch, initial acquisition, on-orbit checkout and verification, and payload commissioning.

3.3 Flight Operations

The Contractor shall develop, maintain, and configuration control processes, procedures, and analysis tools to operate the spacecraft and associated payload to meet mission requirements, including mission decommissioning. These include real time commanding, generation of command loads and tables, telemetry monitoring (real-time and playback) to evaluate configuration and health and safety status of the spacecraft and instrument(s), spacecraft and instrument data storage management, and perform mission planning to establish a conflict free timeline of activities. It is expected that the Flight Operations Team(s) for missions in the routine phase will coordinate activities with external interfaces as appropriate.

The contractor shall analyze the spacecraft subsystems, and selected instruments to understand current trends and anticipate future performance.

In response to spacecraft anomalies the Contractor shall execute only the pre-approved response, such as flight operations procedures, spacecraft commands, or scripts. 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 coordinate operations with Government approval.

3.4 Network Scheduling

The Contractor shall interface with the space-to-ground link network providers (NEN, SN, and DSN) to obtain necessary and sufficient tracking, telemetry, and command services to satisfy mission requirements.

3.5 Flight Dynamics Support

The Contractor shall support Flight Dynamics functions that are integrated into the Mission Operations Center (MOC). These services may include orbit determination, maneuver planning and execution, planning product generation, attitude determination and control, and associated analyses.

The Contractor shall perform orbit determination, or verification of on-board navigation as required by the mission. It includes ground and on-board orbit determination and ephemeris generation.

The Contractor shall provide orbit and attitude maneuver planning and execution to satisfy mission objectives.

The Contractor shall provide for the support, generation and quality assurance of mission planning data, scheduling aids, tracking data network acquisition data, and related spacecraft products.

The Contractor shall provide real time and non-real time attitude determination, attitude control command generation, attitude sensor calibration and alignment, and attitude sensor viewing coverage and performance.

3.6 Mission Data Collection and Distribution

The Contractor shall operate and maintain mission data collection and distribution systems that collect data, remove duplicate information, put it in time order and distribute to various consumers including the MOCs, the Science Operations Centers, and archive facilities. In addition to GSFC, these systems, or elements of these systems, are located coincident with several ground station facilities including, but not limited to, White Sands Complex (WSC) near Las Cruces, New Mexico, Wallops Flight Facility at Wallops Island, Virginia, facilities near Fairbanks, Alaska, Gilmore Creek, Alaska, and in Spitzbergen, Norway. Systems located away from GSFC shall be remotely operated and monitored. Maintenance updates and enhancements must be fielded. Reliability, quality assurance, data retention, and timeliness requirements shall be specific to each mission.

3.7 Sustaining Engineering

The Contractor shall provide the engineering to maintain the performance of the operations elements, and to manage obsolescence.

3.7.1 Flight Segment

The Contractor shall be able to provide/obtain spacecraft and payload vendor sustaining engineering support, special analysis, and anomaly investigation support.

3.7.2 Ground System Software

The Contractor shall perform software maintenance of mission systems, as tasked. Software maintenance activities may include: managing vendor maintenance agreements and software licenses for Commercial Off the Shelf (COTS) products, corrective maintenance of operational custom software systems, modifications to existing operational custom software systems,

supporting test and integration of new or modified software, documenting software changes and problems, maintenance of operational parameter databases, and configuration control of software system configurations.

3.7.3 Ground System Hardware

The Contractor shall perform hardware maintenance of mission systems, as tasked. The hardware maintenance function includes activities required to maintain the ground systems in a mission support capability. Hardware maintenance activities may include: re-installation and modification of existing equipment, preventive and corrective maintenance including procurement and certification of the replacement equipment as needed to maintain original hardware configuration functionality, and documentation of equipment architecture and cabling configurations.

Critical operational mission systems hardware frequently requires high availability, and low mean time to repair. Some key components may include custom hardware.

3.7.4 System Administration and IT Security

The Contractor shall perform system administration of mission systems and facilities. The system administration function provides the support required for maintaining the ground system software, firmware, hardware, COTS, and subscriber provided applications in the authorized system configuration. The Contractor shall maintain network software configurations on hosts and Local Area Network (LAN) routers, in accordance with the applicable IT security procedures.

3.7.5 Database Administration

The Contractor shall maintain project database software and database content, as tasked. Databases may include project administrative information, such as lists of names or discrepancy reports; operations documentation, such as system configurations, software configurations; or operational information, such as spacecraft command lists, or data processing parameters.

4 SECTION 508 ELECTRONIC AND INFORMATION TECHNOLOGY (EIT) STANDARDS

In order to comply with the Section 508 Standards for Electronic and Information Technology, the contractor shall perform all work required under this contract in compliance with the following technical standards delineated in Code of Federal Regulations (CFR) Title 36:

1194.21 Software Applications and Operating Systems

1194.22 Web-based Intranet and Internet Information and Applications

(End of SOW)

Acronym List

ATS	Absolute Time Sequence
CCSDS	Consultative Committee for Space Data Systems
CFR	Code of Federal Regulations
CM	Configuration Management
COTS	Commercial Off-the-Shelf
DSN	Deep Space Network
EEO	Equal Employment Opportunity
EIT	Electronic and Information Technology
FDF	Flight Dynamics Facility
GPR	Goddard Procedural Requirements
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GSMO	Ground Systems and Mission Operations
IAGP	Institutional Accountable Government Property
ISO	International Standards Organization
IT	Information Technology
LAN	Local Area Network
MOC	Mission Operations Center
NASA	National Aeronautics and Space Administration
NEN	Near Earth Network
NPR	NASA Procedural Requirements
PG	Procedures and Guidelines
SLE	Space Link Extension
SN	Space Network
SOW	Statement of Work
STD	Standard
WAN	Wide Area Network
WBS	Work Breakdown Structure
WSC	White Sands Complex

End of Acronym List