ATTACHMENT A

STATEMENT OF WORK

FOR

SOFTWARE ENGINEERING SERVICES (SES) II

DATE
11/19/14

The Software Engineering Division (SED) provides quality software products, services and expertise to ensure the success of NASA missions and stakeholders. Products, services and expertise include: flight, ground and science data systems and technologies; mission environments, software engineering, software systems engineering, software/data systems project management, mission operations and mission validation capabilities (see SED's website for complete organization details at http://aetd.gsfc.nasa.gov/code580/).

1.0 Software Engineering Services (SES) II Contract

SED is responsible for the engineering of software and information systems through all phases (formulation through on-orbit operations/decommissioning) of NASA programs and projects. These systems include: flight, ground, and science data software for spacecraft monitoring, control, on-orbit performance management and operations; spacecraft data processing and analysis; information management; and science data analysis and management. The SED focuses on the development of reusable flight and ground architectures and frameworks to reduce mission cost, decrease development time, minimize customer risk, and increase the scientific value of information products. The SED provides expertise in software systems engineering, secure environments, and the software product development lifecycle to ensure the delivery of reliable software and information systems solutions.

To improve the quality of the software engineering processes and hence the products produced by them, NASA Headquarters Office of the Chief Engineer (OCE) has mandated specific procedural requirements and provides procedural guidance for software engineering that affect this contract. Any organization developing, maintaining, or acquiring software for NASA must adhere to NASA Procedural Requirements (NPR) 7150.2 and the flow-down of those requirements to Goddard Space Flight Center (GSFC) Procedural Requirements (GPR) 7150.1-4 and companion procedural guidance with process assets, as applicable for mission success. These procedural requirements and guidance are benchmarked against the Capability Maturity Model Integration (CMMI) for Development and Acquisition or equivalent leading practices. These procedural requirements and guidance are directly applicable to the SED for the in-house products we provide to GSFC flight missions as well as the programmatic oversight for out-of-house missions managed by GSFC.

The contractor shall comply with mandated specific procedural requirements for software engineering:

- ANSI/ISO/ASQ Q9001-2000 Quality Management System (QMS) requirements as documented on-line in the GSFC QMS system (http://gsfcmanagementsystem.gsfc.nasa.gov/fundamentals.cfm). -or- The Aerospace Standard (AS) 9100. Additional quality requirements may also be specified in individual task orders.
- Goddard Procedural Requirements 8070.4 (GPR 8070.4)
- NASA Procedural Requirements 7150.2a (NPR 7150.2a)
- Goddard Procedural Requirements 7150.1-4 (GPR 7150.1-4)

In order to comply with the Section 508 Standards for Electronic and Information Technology, the Contractor shall perform all software application development, including the development of code, in compliance with the technical standards delineated in 36 Code of Federal Regulations

(CFR) Part 1194.21 Software Applications and Operating Systems. Also, the Contractor shall perform all web development in compliance with the technical standards delineated in 36 CFR Part 1194.22 Web-based Intranet and Internet Information and Applications.

The Statement of Work (SOW) and Core Requirements and Indefinite Delivery, Indefinite Quantity (IDIQ) Task Orders shall describe the work to be performed by the Contractor in terms of NASA-required outcomes and/or results. The Contractor shall be responsible and accountable for achieving the required results.

1.1 The Statement Of Work Structure

The Core SOW is defined in Sections 2.0 and 3.0. The Indefinite Delivery, Indefinite Quantity (IDIQ) requirements are outlined in the Statement of Work Section 4.0. Core requirement functions, such as systems administration, configuration management, quality assurance, etc. are required to support IDIQ Task Orders.

The majority of the work comprised within the SED consists of the development, acquisition and maintenance of software supporting Missions led by the Flight Projects and Science Explorations Directorates. The nature of the SED development efforts consist of a diverse mix of commercial and Government assets, evolving/dynamic geographic and technical customer requirements, and legacy systems, etc. lends itself to an IDIQ approach.

Other activities, i.e., Computing Environments and Collaborative Technologies, Research and Development for advanced data processing concepts, requirements development, hardware and software development, etc. are best suited to an IDIQ approach. The work and activities described in the SOW are generally performed within a resource-constrained environment. SED and its partners/Contractors are challenged to deliver high quality products and services on cost/schedule within these constrained environments.

CORE STATEMENT OF WORK REQUIREMENTS (SECTIONS 2 AND 3)

2. Computer Security and System Administration (SA)

The computer security and SA support under this element refers to support across multiple Divisions within the Applied Engineering and Technology Directorate (AETD), Division specific support under this Core contract is stated. Division specific system administrative support supporting specific Projects and/or Division specific functions are located in the IDIQ section of the SOW.

The current AETD Information Technology (IT) environment contains the following services:

- Splunk server, for consolidating log files
- Windows Service Update Services (WSUS)
- System Center Configuration Manager (SCCM)
- Spacewalk Free & Open Source Systems Management Server
- Red Hat Satellite server
- Wiki services (i.e. confluence)
- MacOS Patching Server
- Kali Penetration Testing Server

- Foundstone scanner
- Symantec Endpoint Protection Server

2.1 Computer Security

The Contractor shall provide IT technical support to the AETD facilities and associated desktops as described below. The Contractor team shall work in concert with Division level IT managers and Division System Administration (SA) teams (not necessarily under this contract vehicle) supporting a wide array of efforts to ensure NASA, Center and Directorate level polices and best practices are adhered to, given the constraints of their requirements. AETD IT facilities support a variety of activities associated with NASA projects, from Mission conception to spacecraft/instrument operations. These activities include the development of high performance and cost effective solutions to the most challenging problems on flight missions ranging from suborbital projects—including balloons, sounding rockets, and airplanes—to interplanetary probes and flagship observatories. In addition, we acquire and distribute science data worldwide. Systems located in these facilities frequently contain sensitive International Traffic in Arms Regulation (ITAR) and Sensitive But Unclassified (SBU) data that shall be handled according to NASA regulations.

2.1.1 AETD/Code 500 Information System Security Officers (ISSO)

The Contractor shall employ individuals that shall serve as AETD/Code 500 Information System Security Officers (ISSO). Tasks for the ISSOs encompass all IT security-related initiatives such as leading the development, maintenance, and operations of system security plans for systems located within the Divisions, supporting the development of Directorate level policies and best practices checklists related to current and persistent IT security issues for Directorate System Administrator's (SA) use, and keeping abreast of current IT security related issues and mitigation processes.

The Contractor personnel in the ISSO roles shall hold a Top-Secret clearance to participate in Center level cyber security meetings. The Contractor personnel in the ISSO roles shall also hold (or have a plan to hold within 6 months of being assigned to the position) a Certified Information Systems Security Professionals (CISSP) certification.

The ISSOs shall support the AETD IT as follows:

- Interact and consult with Division level system administration teams to convey the understanding of how IT is used across the Directorate in support of institutional and Mission requirements.
- Support the development of AETD procedures and lead trade studies to identify problems and recommend Directorate-wide solutions to the Computer Security Officials/IT managers in the technical areas of IT security as it relates to the IT environment within the Directorates.
- Prepare and maintain security documentation for AETD IT Security Plan including: Risk Assessment, Security Plan, Contingency Plan, Data Flow Analysis, Network Diagram, Security Assessment and Authorization testing and Continuous Monitoring.
- Maintain membership in IT working groups such as, Data Center Consolidation, System Administrators Working Group, Active Directory Working Group, the

Agency Security Configuration Standards (ASCS) Group, at the direction of the Directorate IT Manager.

- Develop and maintain automated processes and procedures to streamline the continuous monitoring of AETD IT resources to ensure compliance with AETD, GSFC, Agency, and Federal mandates, policies and guidelines.
- Prepare IT security policies and procedures to ensure consistency with NASA and GSFC guidelines. Security related IT best practices are shared with working level System Administrators.
- Monitor and report statistics on lower organizational levels (Division/Branch) System Administrators adherence to Directorate level policies and procedures in a consistent manner. Report shall be presented to the Directorate and Division level IT managers via electronic delivery (e-mail), on a monthly basis.
- Provide vulnerability scanning reports for all AETD devices to the Division level SA teams on a monthly basis, one week following the Center scan and in accordance with an approved Code 700 format. Provide SAs with proper procedures to correct all vulnerabilities. Support Division level SA teams by researching solutions working within Center resources, if the vulnerability is discovered across multiple Divisions.
- Resolve of all IT Security Incidents in AETD and work with the Government Directorate and Division Computer Security Official (CSO) to bring issues to conclusion.
- Complete all necessary incident reports and vulnerability scans within 10 calendar days of an incident with the support of the Division SA team.
- Process all IT related waivers for AETD Divisions: Review waivers for compliance with GSFC/NASA policies and IT security Standard Operating Procedures (SOPs). Support the Division level SA teams in researching other possible secure solutions.
- Develops scripts and other support applications, supporting high-level reporting and system patching.

The Contractor team shall have working knowledge of system and security administration for Windows, Macintosh, Linux, and UNIX systems for desktops, workstations and servers. It is required that the Contractor be familiar with web technologies including deployment, hosting, and management. The Contractor team shall also have experience administering systems running typical Engineering software applications (i.e. ProEngineer, MathCAD, etc) and maintaining firewalls. The Contractor shall have working knowledge of the GSFC IT security environment and be up-to-date on current IT security related issues and mitigation.

2.1.2 Division Lead System Administrator (SA) and Alternate Computer Security Official (ACSO) for the Mechanical Systems Division (Code 540), Instrument Systems and Technology Division (Code 550), Electrical Engineering Division (Code 560), Software Engineering Division (Code 580), and the Mission Engineering and Systems Analysis Division (Code 590)

The Division Lead SA serves as the Team Lead for the Division team(s) of System Administrators (potentially on different contract vehicles) in support of a large enterprise environment supporting infrastructure and Project specific customers, primarily reporting the Government Division IT Manager (referred to as the Division IT manager) of the Division

assigned to. The Division Lead SA shall have the ability to solve problems quickly and completely; the ability to identify tasks which should be automated and then write tools to automate them; possess a working knowledge across all of the Windows/Linux/Mac/Unix based operating systems: understand the concepts of paging and swapping, inter-process communication, devices and device drivers; and shall be able to perform system analysis and tuning. The Division Lead SA is also considered to be part of the Division SA team, closing the more complex support tickets.

The Division Lead SA shall also possess a solid understanding of networking/distributed computing environments, understanding the principals of routing, web application programming, and the design of consistent network-wide file systems. The Lead SA shall have experience in the installation and administration of Windows Active Directory (AD), be knowledgeable in Group Policy objects, Microsoft IIS, and Windows Server Update Service (WSUS), Storage Area Network (SAN) environments, databases and Virtual Servers.

Each AETD Division Government Computer Security Official (CSO) shall determine the policies to ensure sound IT security procedures for their respective Division; the ACSOs have the responsibility to ensure that the system administrators carry out these policies and procedures. The ACSOs shall complete assignments of various projects and policies dictated by NASA, the GSFC and the AETD Directorate.

The ACSOs shall perform all tasks of the Division CSO when the CSO is not available. When serving as CSO in the absence of the CSO, the ACSOs shall provide critical communications between the Division they support and the AETD ISSOs, on all matters related to IT security. The ACSO shall copy the Division CSO on all communications and provide documentation to the Division CSO on all tasks performed.

A monthly vulnerability scan is performed by GSFC security officials, working under the direction of the Center's Chief Security Officer, assessing the security of AETD assets connected to the GSFC network. The ACSOs shall provide Division specific reports on a monthly basis, posted to the security wiki, highlighting issues with Divisions assets to the Division IT manager and system administration team and shall ensure all vulnerabilities are corrected or waiver provided/approved prior to the date that the system is scheduled to be blocked on the local network.

The lead SA/ACSOs shall support the Division IT as follows:

- Develop proposal and papers for the integration of new products/techniques into the existing Division IT environment, act as a vendor liaison, and make presentations to IT managers at the Division and Directorate level before changing the current IT configuration.
- Resolution of all Division level IT Security Incidents working with the Division IT manager and system administration team, Directorate ISSOs, and Center security teams. Provide SA team with proper procedures to correct all identified vulnerabilities or research a solution to be implemented by the SA team. Complete all necessary incident reports and vulnerability scans within 10 calendar days of an incident.

- Perform monthly tests of system backups for each Division, ensuring that full system backups are completed and stored in a physically different onsite location, at least monthly. Provide a monthly report, to the Division IT Manager, via e-mail, on the status of all Division backups and test restores.
- Process all IT related waivers for their Division. Review waivers for compliance with GSFC/NASA policies and IT security SOPs, or research other possible secure solutions.
- Maintain a backup of encryption/decryption keys to recover encrypted data for users who forget their password.
- Scan all Division computers to ensure compliance with NASA/GSFC data and IT security requirements, as part of the process for establishing IP addresses, Certification, new-builds, and post-security incidents.
- Provide input and reviews of security documentation for IT Security Plan including: Risk Assessments, Security Plans, Contingency Plans, Data Flow Analyses, Network Diagrams, Security Assessments and Authorization testing.
- Maintain an understanding of Active Directory, Dell's KACE, Symantec Endpoint Protection, Symantec PGP and how these tools/capabilities are installed and implemented at NASA.
- Document and distribute Security Bulletins, when the primary CSO is not available, to alert Division users of special IT issues/vulnerabilities when they arise.

2.2 Consolidated AETD System Administration (SA)

The Contractor shall provide a consolidated portion of the IT technical support to the Divisions within the AETD for non-Agency Consolidated End-user Services (ACES) administered systems. The Contractor shall provide Virtual Machine (VM) management/expertise, AETD shared server resources, engineering software license management, helpdesk support, and documentation support to the AETD Divisions. The Contractor shall manage systems in accordance with the AETD Laboratory Systems Multi-Program IT & Project Unique IT (CD-013-M-GSF-5001) security plan. The Contractor shall provide support for 3rd party applications to AETD employees with ACES-managed systems, as needed. The Contractor shall provide IT architecture engineering, configuration management, and system administration.

2.2.1 Shared Server Support for AETD Divisions

The Contractor shall configure and maintain the AETD SA service ticket system, Storage Area Network (SAN) device, Spacewalk Free & Open Source Systems Management Server, Red Hat Satellite server, MacOS Patching Server, AETD Print Server, AETD License Servers and other AETD shared servers. The Contractor shall deploy updates to AETD computers, as approved by the AETD configuration control board.

The Contractor shall provide assistance in the definition of the hardware configuration for the AETD Divisions IT infrastructure. The Contractor shall provide for maintenance of a Configuration Management plan for the AETD shared IT resources. This plan will include: disk space management, server configuration and management, back-up procedures, software licensing configuration and operations plan.

2.2.2 VMware / Server Support for the AETD Divisions

The Contractor shall:

- Deploy the virtual machines/systems and manage the physical infrastructure needed to maintain the virtual machines and systems.
- Install, configure, update and resolve any issues with the VMware software and operating environment.
- Manage the server resources in order to maximize performance and reliability for all VMs on the server.
- Resolve all issues involving the physical infrastructure (server, storage, network, power, etc.).
- Manage the AETD vCenter environment and ensure that all AETD VMs are reporting.
- Ensure completion of daily virtual machine backups for disaster recovery purposes.

2.2.3 SA Documentation Support for the AETD Divisions

The Contractor shall:

- Develop and maintain procedures and guidelines for continuity, consistency, and awareness of system administrator services.
- Develop and maintain documentation to inform AETD users of IT access procedures, such as, Virtual Private Network (VPN) and Elevated Privileges (EP).
- Maintain the AETD Users IT Policies and Procedures Document.
- Maintain the AETD System Administration Policies and Procedures Document.

2.2.4 Helpdesk Support for the AETD Divisions

The Contractor shall:

- Provide phone support to all AETD users between the hours of 8:00am-5:00pm on weekdays excluding holidays.
- Utilize the Helpdesk Expert Automation Tool (HEAT) support/help ticket system to track and report on IT-related problems and/or service requests. When necessary the Division IT Manager will establish the priority of individual service requests.
- Resolve work stoppage tickets within 8 business hours of the trouble ticket submittal or phone message by either fixing the issue or providing an equivalent loaner computer from the Division pool of loaner machines.
- Resolve software installation/update tickets within an average of 2 business days.
- Resolve all other support tickets within an average of 5 business days.
- Tickets open for more than 5 business days, shall require a documented agreement with the ticket owner/originator to extend the completion date of the ticket.
- Provide monthly reports on customer satisfaction survey results to the Directorate IT Manager, via an excel spreadsheet, on the 15th of each month.
- Provide monthly reports showing the average time to close tickets:
    - Work stoppage tickets;
    - Software installation/update tickets, and
    - All other types of tickets.

2.2.5 AETD Engineering Software License Management

The Contractor shall:

- Develop and maintain procedures/guidelines for tracking the use of existing engineering software tools (i.e. ProE, MatLab, LabView, MSC, etc).
- Develop and maintain documentation/reports for AETD IT managers of tool usage, reporting monthly on tool over/under utilization.
- Add, delete, and update license files on the AETD license servers. Work with engineering tool Point of Contacts (POC), to integrate their tools into the AETD environment.
- Develop and maintain a real-time web enabled Dashboard that provides accessibility to license/tool usage by Division employee and project supporting, cost reports, and trends based on tool usage, for the Division IT managers.
- Maintain the list of AETD 'owned' tools, including; the tool POC, vendor, license renewal dates, license server, cost for use, and users of the tools.
- Organize user forum meetings for tool POCs and IT managers to discuss current licenses available, use trends and inclusion of new tools/licenses on a bi-annual basis.

3 Flight Software Sustaining Engineering (FSSE) - Maintenance and On-orbit Sustaining Engineering

The Contractor shall ensure the health, safety and success of the spacecraft and/or science operations of each on-orbit spacecraft the SED supports. This support includes pre-launch Flight Software (FSW) training and flight software maintenance preparations through post-launch/on-orbit multi-mission flight software sustaining engineering. The Contractor shall be required to analyze on-orbit anomalies, recommend and provide flight software solutions, provide consultation to the Flight Operations Team (FOT), prepare flight software patches, investigate and prototype agreed upon new technology initiatives, and provide a current archive of all flight software versions, associated tools, testbed software and databases for each supported mission. The Contractor shall also be assigned sustaining engineering responsibilities for several new missions during the contract period.

The Contractor shall be required to follow, maintain, and support the continuous improvement of the Multi-Mission Flight Software Sustaining Engineering (MMFSSE) infrastructure, including all existing MMFSSE processes, procedures, standards, guidelines, templates, tools, and policies.

The FSSE team collectively supports a wide array of on-orbit missions, including:

Pre-launch FSSE support continues for James Webb Space telescope (JWST) Integrated Science Instrument Module (ISIM); Magnetospheric Multiscale Mission (MMS); Deep Space Climate Observatory (DSCOVR); Ice, Cloud, and land Elevation Satellite (ICESat-II) Advanced Topographic Laser Altimeter System (ATLAS); and Space Environment Testbeds (SET).

- Post-launch FSSE support continues for Global Precipitation Measurement (GPM); Tropical Rainfall Measuring Mission (TRMM); Terra; Aqua; Aura; Cassini Composite Infrared Spectrometer (CIRS); Fermi; Lunar Reconnaissance Orbiter (LRO); and Solar Dynamics Observatory (SDO) - with Swift Burst Alert Telescope (BAT) only if/as needed.

The FSSE lab facility has configuration-controlled versions of the software on-board the spacecraft, in addition to supporting equipment including original spacecraft simulators.

The Contractor shall possess knowledge and technical expertise in the areas of Flight Software (FSW) design, development, integration, and testing. The FSSE engineer shall not only be familiar with the inner workings of the FSW itself and all peripheral systems and tools that exercise the FSW, but also how spacecraft subsystems interact with the FSW. Specific specialized experience shall be required in the following areas related to Multi-Mission FSSE support:

a) Flight computers, including the 1750A, M68000, Pentium, Intel 8085, 80386, 80486, Mongoose, R 6000, PowerPC, UTMC69R000, and Coldfire processors.
b) Flight software languages, including C, C++, Ada, Jovial, JAVA, FORTRAN, Assembler (1750A, 386, 486, Motorola 68000, 80C85, UTMC 69R000), Perl, SQL, HTML, Artisan Studio code generator, Matlab/Simulink FSW modeling, RealTime Workshop code generator, Rational Rose Realtime, and Java Script.
c) Onboard operating systems, including VxWorks, VRTX (real-time), Real Time Operating System (RTEMS), MMS Executive, TLD Ada Kernel, and TRW FSW Executive.
d) Ground systems, including Advanced Spacecraft Integration & System Test Software (ASIST), Integrated Test and Operations System (ITOS), Integrated Trending and Plotting System (ITPS), New Technology Ground Support Equipment (NTGSE), GSFC Mission Services Evolution Center (GMSEC) software, AstroRT, and Eclipse.
e) All FSW functional areas, including Attitude Control, Telemetry and Command Management, Flight Operating Systems, Telemetry Monitors, Science Management, Spacecraft Health and Safety, Navigation/Orbit Control, Failure, Detection, and Correction, Instrument Management, Core Flight Executive/Core Executive System (cFE/CFS), and Robotics.
f) End-to-end FSW Sustaining Engineering processes, as included in the FSSE Plan and Operations Interface Agreement (OIA), and for FSW patches, FSW Independent Verification and Validation (IV&V), FSW tutorials, FSW lab recertification, multi-mission FSW support configuration management planning, Technical Exchange Meetings (TEMs), FSW Test Facility Move Process/Checklist, FSW Table Build Process, FSW Weekly Input Standard, FSW monthlies, and archiving of FSW products.
g) FSW simulation and testing support, including Spacecraft simulators, build test, IV&V, lab certification test, and acceptance test.
h) On-orbit FSW anomaly support, including FSW on-orbit anomaly troubleshooting, analysis, solution recommendation, and installation support and monitoring.
i) FSW algorithms, mathematics, including Quaternion mathematics, Runge-Kutta, Kalman filtering, Euler Axis/Rotations, orbital mechanics, Eigen Axis Inertial Guidance Maneuvers, telemetry commutation and de-commutation, control systems, onboard telemetry monitors, closed loop commanding, navigation, flight executives, error checking, and algorithm correction.
j) Spacecraft FSW interface devices, including Earth sensors, star trackers, magnetic torquers, magnetometers, Sun sensors, gyroscopes, reaction wheels, thrusters, solar arrays, transmitters and receivers, antennae, and science instruments.
k) Communications buses and protocols, including 1553B, 1773, 1355, Transmission Control Protocol/Internet Protocol (TCP/IP), RS-232, 422, 423, Consultive

Committee for Space Data Systems (CCSDS), SpaceWire, CCSDS File Delivery Protocol (CFDP), and Astrowire.

3.1 Pre-launch FSSE Roles and Responsibilities

The Contractor shall support several of the pre-launch activities, including the following services:

1. Develop Mission-specific FSW Knowledge.
   Develop insight into FSW requirements, design, code, operations concept, FSW Testbed and tools, FSW tests & expected results, failure scenarios, developer configuration management processes, methods, techniques, discrepancy reporting processes, etc.

2. FSW Testbed Move and Re-certification
   Re-locate and certify the mission's FSW Testbed to long term FSW Branch facilities. These facilities shall be identified and provided by the Government.

3. Develop and certify a FSW Mission Operations software tools set under the guidance of the Flight Software Systems Branch management.

4. Support pre-launch mission simulations
   These include launch and early orbit scenarios, Comprehensive Performance Testing, and mission readiness testing. Support includes preparing loads plus FSW maintenance scenarios, participating in mission simulations by providing FSW-related analysis and support, and developing/generating anomaly situations to be used during the simulations.

5. Develop FSW Regression Tests
   These tests shall be used post-launch in the FSW Testbed for testing overall FSW integrity following implementation of approved changes to the FSW.

6. Develop a mission-specific Library of appropriate documents
   These include FSW User's Guides, simulator manuals, Requirements & Design documents, ground system user's guides, logs of all FSW change requests to date, configuration management plans, Project Database documents, etc.

7. Develop a FSSE Plan, Operations Interface Agreement (OIA), and Configuration Management (CM) Plan, using the Flight Software Branch developed Templates.
   These plans are used to maintain the FSW, Testbed elements, tools, test procedures & results, etc, and to govern FSW-related interface responsibilities between the FSSE team and the Flight Operations Team or other groups who may play a role related to FSSE, anomaly resolution and/or mission operations.

8. Verify pre-launch readiness of the FSW Branch for post-launch FSSE.
   Includes meeting the requirements of the Code 582 FSSE Readiness Checklist.

9. Support launch & in-orbit checkout. This includes supporting flight operations with anomaly resolution as required, addressing questions related to the flight software implementation, and supporting launch and early orbit maneuvers and commanding

10. Support the FSW Development team as assigned
    Support includes FSW unit and build test support, FSW testing (acceptance, system, regression, operational scenarios, etc), or other assignments that aid the FSW Development team's productivity while also providing FSW insight progress for the FSSE engineer(s).

3.2 Post-launch FSSE Roles and Responsibilities

The Contractor shall support several of the post-launch activities, including the following services:

1) Provide FSW Analysis to the FOT and Science Teams (where assigned)
   Investigate FOT and on-orbit science issues, and answer FSW-related questions on functionality of the code, flight hardware/software interface, ground commands to the FSW, telemetry, operational scenarios, anomaly resolution, etc; examine FOT-requested FSW options; provide FSW-related training to the FOT.

2) Perform FSW Anomaly Investigations
   Analyze real-time and playback telemetry, FSW-reported status, memory dumps, ground command sequences, FSW code and data listings; recreate the anomaly in the FSW Testbed to determine its cause; analyze and report on recommended FSW solutions to resolve the anomaly.

3) Support Recovery from FSW-related Anomalies
   Validate proposed recovery solutions in the FSW Testbed; aid the development and execution of spacecraft reconfiguration procedures; flight software changes/enhancements, verify proper FSW functions/execution following recovery by performing functional, performance and regression tests.

4) Provide FSW Products to the FOT and Science Team (where applicable)
   Provide FSW loads, updated FSW documentation, database updates, FSW ground reference image, FSW installation and on-orbit certification procedures, as per the OIA.

5) Develop & Validate All FSW CCB-Approved FSW changes
   FSW table changes and software patches including software workarounds to hardware problems, health and status issues, operations-related support, payload issues and enhancements, and FSW performance improvements.

   Full life cycle process applied, with reviews convened for Requirements and Design, Code Walkthrough and Test plan, and Test Results and Uplink Readiness

6) Support FOT during the Uplink of Each FSW change

Provide the FSW installation procedure; Verify the MOC-to-Testbed uplink test; Coordinate uplink activities to ensure proper ground/flight interfaces; Confirm proper post-uplink FSW functions and performance.

7) Participate in the Post-Launch FSW CCBs
   Ensure that all requests for FSW patches and other FSW-related work are approved, prioritized, and tracked via the FSW Configuration Control Board (CCB). CCB membership includes a Project lead (co-chair), FOT, FSW lead, and other specialists as applicable in the resolution of on-orbit FSW anomalies or approved software changes.

8) Maintain the FSW Testbed(s)
   Ensure the proper functioning of the Testbed, including working with Code 582 and the Mission Systems Administration Team, and mission-specific expertise at GSFC in the maintenance of commercial hardware and software, systems management, security requirements and issues, computer operations, and configuration management of the software development environment.

9) Maintain FSW Expertise
   Ensure availability of FSSE specialists to meet mission needs and requirements.

   Ensure continued Contractor FSW expertise concerning operations performance, anomaly investigating and spacecraft-safeing recovery techniques, the FSW test environment, test cases, test process, and test results for nominal and contingency flight situations.

10) Maintain all Software used for FSW Sustaining Engineering
    Ensure the completeness of the FSW Development, Test, and Mission Operations Tools sets, developing enhancements as necessary to test and analyze FSW changes, support interface changes between the MOC & the Testbeds, improve visibility into FSW characteristics, etc.

    Maintain the Flight Software Systems Branch Dynamic Simulator products, including mission-specific versions of the Goddard Dynamic Simulator (GDS), updating as needed to resolve coding errors or model new hardware features for testing FSW changes, including improving modeling of flight hardware and on-orbit command and data handling capabilities, and other interfaces and onboard functions.

INDEFINATE DELIVERY INDEFINATE QUANTITY (IDIQ) STATEMENT OF WORK REQUIREMENTS (SECTION 4)

4.0 IDIQ Support

The Contractor shall perform IDIQ Task Orders as issued by the CO to provide and support engineering and operations.

Qualified personnel with security clearances up to the top-secret level (as defined in the IDIQ Task Order), shall be required by the Contractor to support certain IDIQ Task Orders. Travel may be required by the Contractor to support certain IDIQ Task Orders, these travel requirements will be identified on a task by task basis.

4.0.1 Division Specific Systems Administration Support

The Contractor shall provide local systems administration and IT security support for mission specific services. The systems administration services include: system or software installation/de-installation, setup, configuration and maintenance; Internet Protocol (IP) address management; system/environment architecture design and implementation; account management; backup; and data removal/cleaning for computer systems in development facilities; for the following:

- Flight software development and maintenance facilities
- Ground software development and maintenance facilities
- Simulation software development and maintenance facilities
- Testbed hardware and software development and maintenance facilities
- Collaborative systems

Work activities include the design, preparation, review, and updating of IT security procedures and processes to ensure consistency with Directorate, Center, Agency and Federal guidelines, reporting of security compromises, identification and repair of security incidents and anomalies, management of Assessment and Authorization activities, and centralizing/consolidating IT security services for the Division and Directorate.

The Contractor shall also provide configuration management support for all software systems and system administration activities managed by the Division. The Contractor supports the configuration management of:

- Web-Based software
- Testbed hardware and software
- Collaboration System software

4.0.2 Software Process Improvement (SPI) Support

The Contractor shall provide support in developing and maintaining the GSFC procedural requirements and guidance with companion process assets, tools, and training, as well as the database driven website containing the library of assets. The Contractor shall provide support in deploying process assets and tools through mentoring, audit programs, and software training programs, implementing the organizational measurement program, and shall provide support to the organization in preparing for CMMI appraisals and other benchmark activities. The Contractor support includes: consultation, logistics support, planning support, coordination, progress tracking, and configuration management support. The Contractor shall provide support in the areas of software research, software process improvement, training, measurement (development and analysis), maintains group communication tools, and the NASA Process Asset Library. The Contractor coordinates with other NASA Centers to communicate and coordinate Agency and Center process improvements.

4.1 Software Systems Engineering, Studies and Analysis

The Software Systems Engineering Branch provides end-to-end software systems engineering for the development and the support of conceptual design, requirements specification, implementation and maintenance of software systems that enable current and future NASA missions, programs and projects. Branch personnel represent expertise in all aspects of information, communication and technology software systems from flight and ground software components to science data systems and management. Branch personnel plan, coordinate, and lead the end-to-end development of such systems.

The Contractor shall perform Software Systems engineering, studies and analysis for requirements definition, operations concept definition, systems engineering, trade studies, and system definition in support of efforts in the formulation, implementation, and/or operations phases for Flight, Ground, and Science Data Systems. The Contractor's duties include: end-to-end systems engineering activities relative to requirements and architecture development, design, verification and validation approaches, risk analysis, safety assessments, integration, and test support. The activities span the entire mission development life cycle from advanced concepts through launch and mission operations.

4.1.1 Requirements Generation

The Contractor shall perform software systems engineering, studies and analysis for requirements definition, operations concept definition, systems engineering, trade studies, and system definition in support of efforts in the formulation, implementation, and/or operations phases for Flight, Ground, and Science Data Systems with applicable documentation.

4.1.2 Documentation, Traceability, & Compliance

The Contractor shall produce specific documentation and evidence in accordance with the requirements defined within the NASA software requirement NPR-7150.2, "NASA Software Engineering Requirements."

The Contractor shall perform an analysis of the project's software with respect to compliance to the NASA Software Safety Standard, NASA-STD-8719.13; identify safety critical software components, evaluation of requirements compliance for safety critical software and verification and validation approaches for safety critical items; coordinate with personnel in other GSFC organizations responsible for safety oversight of flight and ground software systems.

4.1.3 Software Review Process

The Contractor shall participate in various reviews including system and subsystem documentation reviews and provide comments/inputs of the documents that are reviewed; support Government staff on various review panels responsible for review and submittal of comments to the chair of the panels, and if requested perform code analysis.

4.2 Flight Software (FSW) Systems

The Flight Software Systems Branch provides on-board, embedded software products that enable spacecraft hardware, science instruments and flight components to operate as an integrated on-orbit science observatory. This includes flight software and associated high fidelity simulation test systems. Branch personnel provide life-cycle flight software engineering; including early mission formulations and designs, requirements analysis, development, verification and validation, and mission-life sustaining engineering. Flight software leadership strives for

effective advancements in flight hardware and software architectures, operations ground/flight interfaces, onboard autonomy, onboard science data analysis and test-beds. Flight software prototypes are implemented as proofs-of-concept for future missions. Formalized reuse of flight software products plus the utilization of Standards and commercially available products reduce flight program complexities, risks, costs and schedules.

The Contractor shall support the planning, formulating, designing, developing, and testing of flight software systems for instruments and spacecraft associated with in-house GSFC projects and other multi-center commitments in accordance with established organizational compliance of procedures and policies such as NPR 7150.2. The Contractor shall manage, refine, and extend the flight software infrastructure, products, plans, and processes related to new flight software developments, flight software reuse libraries, flight software configuration management systems, flight software test, verification and validation systems, and flight software lessons learned databases. The Contractor shall develop simulation capabilities for all aspects of the flight software including, dynamic simulation, command and data handling simulation and science data simulation. The Contractor shall support the development and advancement of the Branch/Division FSW product suite.

4.2.1 Flight Software Engineering

The Contractor shall provide flight software systems engineering design support for GSFC-managed spacecraft and instrument procurements. The Contractor shall provide flight software system engineering for the new spacecraft and/or new instrument proposals by conducting trade studies, provide support to the design of the software systems architecture, requirements and interfaces. The Contractor shall participate in investigative panels that oversee new GSFC projects or other multi-center projects.

4.2.2 Flight Software Development

The Contractor shall provide flight software systems engineering, and development services. These services shall include requirements analysis, the design, development, and integration of flight software targeted to specific flight hardware components. The Contractor shall also provide the design, development, integration and test of target-specific flight hardware diagnostic software.

4.2.3 Flight Software Verification and Validation

The Contractor shall support the flight software test program including build verification and validation planning, verification testing, system validation testing, and flight software test tools development for the mission. The Contractor shall utilize flight software test-beds and simulators required for verification and validation of flight software related products.

4.2.4 Flight Software High Fidelity Testbeds and Simulations

The Contractor shall provide systems engineering and development services to perform requirements analysis, design, development, integration, and verification of flight software test-beds and simulations.

4.2.5 Flight Software Infrastructure/Support

The Contractor shall support identifying, developing, and deploying improved flight software engineering processes, along with supporting artifacts (policies, processes, procedures, standards,

guidelines, templates, tools, etc.). The Contractor shall participate in the continued development of standards, support the flight software standards Configuration Control Board (CCB) and provide support in the implementation of these standards.

4.2.6 Flight Software Technology Development

The Contractor shall provide services for research, evaluation and development of new technologies and products, including the design, development, implementation, test, and analysis of flight software systems technologies.

4.3 Ground Software and Systems

The Ground Software Systems Branch provides software products and expertise that satisfy ground system requirements for Earth and Space science missions, as well as Other Government Agencies (OGA) with similar ground system requirements. Branch personnel perform requirements analysis, design, implementation, verification, validation, deployment and sustaining engineering for all types of ground software applications and architectures. System functionality includes: spacecraft command and control, flight dynamics, mission planning and scheduling, event monitoring and assessment, and telemetry trend analysis. Branch personnel also investigate and apply state-of-the-art technologies and commercially available products to ensure cost effective solutions that optimally meet customer needs.

The Contractor shall perform new or on-going development and sustaining engineering of ground software, simulators and data systems associated with in-house GSFC projects and other multi-center commitments in accordance with established organizational compliance of procedures and policies such as NPR 7150.2. Contractor activities include participation as a part of a mission or project ground system development team. Ground systems development includes: software design, development, test, and deployment, and associated hardware integration, test, and delivery. The software encompasses commercial off-the-shelf (COTS), government off-the-shelf (GOTS), new development, or some combination of the aforementioned.

4.3.1 Ground Software Architectures

The Contractor shall enhance and extend government-developed architectures, such as the Goddard Mission Services Evolution Center (GMSEC) architecture (see http://gmsec.gsfc.nasa.gov), to comply with evolving software engineering concepts, standards, and customer/mission requirements, to include new functions and capabilities, and to provide compatibility with external systems.

4.3.2 Ground Software Development

The Contractor shall perform the requirements analysis, design, implementation, verification, validation, documentation, and deployment into operations of ground hardware and software systems and applications, including applicable scripts, procedures and databases. The functions of these systems include, but are not limited to, planning and scheduling, spacecraft command and control, event monitoring and assessment, automation, telemetry trend analysis, flight dynamics, and performance analysis for spacecraft instruments and missions. The Contractor shall ensure developed systems and applications are compliant with the current GMSEC architecture, when appropriate.

4.3.3 Ground Software Sustaining Engineering

The Contractor shall perform sustaining engineering of existing ground software systems and applications, including associated hardware and software, for systems that are in use at the start of the contract and those that are developed over the contract life. Existing ground software applications include, but are not limited to, the Integrated Testing and Operations System (ITOS), the Advanced Spacecraft Integration and System Test (ASIST) system, the Integrated Trending and Plotting System (ITPS), the GMSEC core components and Application Programming Interface, the New Technology Ground Support Equipment (NTGSE), and the Data Access Toolkit (DAT).

4.4 Flight System Verification, and Validation

The Mission Validation and Operations Branch provides expertise in operations engineering, operations planning and systems validation to ensure optimal operability of information systems. In support of the Earth Science, and Space Science Missions, and the Exploration and Technology focus areas, the Branch develops and analyzes operational concepts, requirements, plans, schedules and documentation for planning, conducting, and evaluating spacecraft operations. Branch personnel plan, coordinate, and take responsibility for the end-to-end testing of mission systems. Pre-launch end-to-end simulations of launch and early orbit scenarios are developed, coordinated and tested by this Branch to ensure launch readiness of ground and flight systems. Branch personnel direct the mission Flight Operations Teams in preparation and training for launch, in-orbit checkout and daily mission operations. Branch personnel prepare and define budgets and schedules for operations functions. The Branch works closely with other Center personnel, other NASA Centers and Contractor personnel, to assure compatibility of performance, interfaces, schedules and budgets.

The Contractor shall support flight mission operations, including but not limited to; build verification testing, system validation testing, and flight operations test tools development for the mission.

4.4.1 Validation and Verification Functional Areas

The Contractor shall utilize flight software test-beds and simulators required for verification and validation of flight and ground software related products. The Contractor shall also support mission readiness testing to include communication and functional test of the mission ground system, ground station interfaces, and end-to-end testing of the communication path from the spacecraft to the ground and/or science operations systems.

The Contractor shall generate and/or review Verification Plans; support the design, drawing, and specification reviews; prepare documentation and/or review of system qualification requirements; and prepare and/or review hardware and software integration plans and procedures, and witnessing execution. Prepare and/or review detailed functional and environmental test plans and procedures, and witness test execution. Ensure that the technical aspects of shipping requirements and equipment are met.

The Contractor shall provide comments and/or recommendations to ensure: 1) that designs meet specification and interface requirements, 2) that appropriate parts standards are compatible with specified mission requirements and risk levels, 3) that detailed specifications are compatible with mission requirements, including margin and error budgets, 4) and that proper consideration is

given to cost, reliability, safety, non-flight fabrication requirements, contamination control, magnetic materials/interference, launch requirements, and space environmental requirements.

The Contractor shall prepare and/or review plans for launch site checkout, integration and testing of flight systems, including adequacy of the launch site facility. Analyze data from spacecraft telemetry data sources to ensure total system compatibility. Analyze flight performance from flight data.

4.5 Supporting Services

The Computing Environments and Collaborative Technologies Branch provides a diverse variety of services and tools in support of activities within the SED. Branch personnel integrate, maintain and manage the secure Information Technology (IT) environment supporting research, engineering, and administrative information requirements. The branch further develops web based collaborative and knowledge management systems; while deploying prototypes to foster the adoption of these systems in partnership with customer groups. The branch provides technical expertise supporting projects in satisfying NPR 7150.2(a) and GPR 7150.1-4 requirements.

The Contractor shall perform engineering services to provide a diverse variety of services and tools to maintain and manage the secure IT environment, which supports research, engineering, and administrative information and computing requirements managed by the Division. The Contractor shall develop and maintain test bed and operational labs in support of flight, ground, and science software based activities. The Contractor shall also be required to support the design, development, test and deployment of web-based collaborative and knowledge management systems, network design, and performance studies.

4.5.1 Network Engineering Support

The Contractor shall research, design, develop, test, evaluate, integrate, validate, and demonstrate information assurance solutions for end-to-end mission/project networks. Areas of investigation include network security, network scheduling, cryptographic modernization and key management, and cross-domain solutions to meet the demands of network centricity and to resolve issues regarding current technology and capability shortfalls. The Contractor shall perform network tests for latency and packet loss spanning across the network layers associated with the IP protocol in a mission and development lab environment.

4.5.2 Education and Outreach

The Contractor shall design, implement, verify, validate, documentation, and perform sustaining engineering of software and systems for education and outreach applications.

4.5.3 Software Engineering Support for Application Development

The Contractor shall provide engineering studies and analysis for requirements definition, operations concept definition, systems engineering, trade studies, and system definition in support of efforts focused on developing web services for mission systems traditionally not web based or combining several existing web based systems. The Contractor shall develop prototypes and demonstrate solutions to meet capability needs, ensuring the necessary IT security and usability constraints and requirements are met.

4.5.4 Infrastructure Support

The Contractor shall provide institutional type support to provide support in the areas of property management, facilities upgrade/maintenance/management, and conference and meeting support.

4.6 Science System Development

The Science Data Systems Branch is responsible for the specification, design, development, installation, validation, modification, and operation of data systems for the acquisition, production, and distribution of data products that support NASA's science and Exploration missions. These systems range in complexity from those that handle single, small instrument data streams with a limited user community to multi-mission data systems serving diverse multidisciplinary user communities. The Branch supports all aspects of the science data management life cycle, including; processing systems, archives, distribution systems, networking, query systems, and user interfaces. Branch personnel have expertise in metadata definition, data formats, mass storage technologies and cost modeling. In addition, the Branch supports new and evolving data system concepts, such as virtual data systems, grid computing, distributed archives, data workflows, visual data queries, and data modeling.

The Contractor shall provide science data system engineering, software system engineering and software engineering services to design, develop and deploy science systems and applications for science operations, data processing, data management, and data analysis and visualization. Data system engineering includes: problem definition, solution analysis, process planning and control, system documentation development and maintenance, system integration, and product evaluation. Software system engineering includes: requirements definition and analysis, software design, process planning and control, software documentation development and maintenance, verification, validation and test, and software integration. Software engineering includes: detailed software design, implementation, and unit testing. The science system software includes: COTS, GOTS, new development, legacy code, or some combination of the aforementioned. Science systems development includes: hardware definition, integration, test and deployment.

4.6.1 Science Data Systems Engineering

The Contractor shall perform requirements analysis, software and data systems design, process planning, process control, and verification, validation, and testing of science systems. This work includes: evaluation of generated data products and documentation, definition of functional, performance and external requirements, definition of the system architecture, developing detailed system designs, determining tasks and their priorities, and preparing for and participating in various system reviews.

The Contractor shall maintain existing and newly developed science data systems. This work includes: the definition, acquisition, implementation and maintenance of the associated hardware and software.

4.6.2 Science Operations Systems

The Contractor shall plan, design, develop, implement and test science data operations systems. This work includes: science instrument command definition, processing, and upload; and user interfaces. This work includes: definition, acquisition, implementation and maintenance of the associated hardware and software.

4.6.3 Science Data Processing Systems

The Contractor shall plan, design, develop, implement and test science data processing systems for level-0 and higher level products. This work includes: science data and metadata definition, algorithm development, user interfaces, distributed processing systems and environments. This work includes: definition, acquisition, implementation and maintenance of the associated hardware and software.

4.6.4 Science Data Management Systems

The Contractor shall plan, design, develop, implement and test science data management systems for science data distribution and archive. This work includes: science data and metadata definition, data query systems, user interfaces, distributed data systems and environments. This work includes: definition, acquisition, implementation and maintenance of the associated hardware and software.

4.6.5 Science Data Analysis and Visualization Applications

The Contractor shall design, develop, implement and test science analysis and visualization systems. This work includes: science data query systems, user interfaces, algorithm development, distributed data systems and environments. This work includes: definition, acquisition, implementation and maintenance of the associated hardware and software.

4.7 Advanced Concepts

The Science Data Processing Branch is responsible for the design, development, implementation and integration of science data processing applications and science data processing technology for flight, in-situ and ground based systems. The Branch supports all phases of instrument, spacecraft and mission development, from concept through post-mission analysis, for Earth Science, Space Science and Exploration Systems customers. Areas of expertise include embedded science data processing, modeling/simulation, data visualization, image/sensor data processing, sensor webs, application architectures/frameworks, automation, intelligent agents, algorithm development, data compression, distributed systems, data mining, human-computer interaction, information fusion and the development of data analysis tools.

Systems engineering and consultative services are also provided to support the development of end-to-end system concepts, requirements and functional specifications for flight project, study and proposal efforts. The Branch works in collaboration with other Divisions within the AETD (500), Science and Exploration Directorate (600), Flight Projects Directorate (400), other government agencies, university and industry organizations to develop effective science data processing solutions that enable scientific investigation and meet customer needs.

4.7.1 Science Data Processing Applications and Data Processing

The Contractor shall formulate and develop advanced technology concepts and the advancement of their associated technology readiness level (TRL). The Contractor shall plan and accomplish the infusion of the resulting technology into mission or project systems for data processing or the implementation of data processing prototypes. The Contractor shall design and develop advanced concepts for all aspects of mission including hardware, complex electronics, reconfigurable computing, and software solutions to meet highly complex mission data processing objectives.

The Contractor shall deploy systems for missions. This work includes identifying requirements, performing trade studies, configure/enhancing existing systems, and software delivery, integration, testing, documentation, and training.

4.8 Reserved.

4.9 Systems Software Engineering support Wallops Flight Facility (WFF)

The Wallops Systems Software Engineering Branch is the Software Engineering Division's engineering service provider at WFF. WFF works with flight projects, principal investigators, Divisions within the AETD, and other organizations to develop flight and ground data systems for sub-orbital and special orbital Earth and space science missions. WFF develops integrated systems applying state-of-the-art technologies, commercial-off-the-shelf products, and custom developed products to provide cost-effective solutions to meet the customers' needs. WFF provides system engineering, system planning, conceptualization, requirements analysis, design, implementation, test, verification, and sustaining engineering. WFF products support the planning, execution, and analysis of missions and include mission visualizations and simulations, carrier, payload, and ground system monitoring and control, and data display and analysis.

The Contractor shall provide software system engineering services related to the design, development, and deployment of ground and flight software for WFF missions. Software system engineering includes: requirements definition and analysis, software design, process planning and control, software documentation development and maintenance, verification, validation and test, software integration, system deployment, operational support, and post-mission data analysis. The software systems include: COTS, GOTS, new development, legacy code, or some combination of the aforementioned.