

Systems Engineering Advance Services (SEAS)

All deliverables and requirements must follow the guidelines in NNG15CR66C with no exceptions

Task Order Statement of Work (SOW)

Date: 18 August 2020

Task Name: MMS FPI Science Software Systems Technology Support

Task No./Mod: 24/7 → Changes are noted in **RED** text

Task Monitor (TM): Barbara Giles

Contract number: NNG15CR66C

Contract SOW Reference: 3C. Software Systems Technology Services; 3A. Instrument Systems Technology Services

The purpose of this mod is to extend the period of performance to 14 April 2021.

I. Scope

a. Background

Magnetospheric Multiscale (MMS) is a Solar Terrestrial Probes mission comprising four identically instrumented spacecraft that 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 and can be studied in situ only in our local solar system and most efficiently only in Earth's magnetosphere, where reconnection controls the dynamics of the geospace environment and plays a critical role in the process known as "space weather". The Fast Plasma Investigation (FPI) is one of the instrument suites onboard MMS; the suite consists of 64 particle spectrometers and 4 IDPUs. FPI is operated and managed by the Code 673 Geospace Physics Laboratory out of Building 21 on the Goddard campus. FPI data volumes are approximately a half of a terabyte per month.

The FPI team has need for:

- (1) an experienced engineer to research and develop advanced software systems for FPI science data processing, distribution, and short- and long-term archival activities;
- (2) (descoped as of mod 3)
- (3) an experienced lead engineer to research, develop, maintain, and operate advanced technical and software systems for FPI performance in orbit; and
- (4) a support engineer to research, develop, maintain, and operate advanced technical and software systems for FPI performance in orbit.

II. Subtask 1: Sustaining Software Engineering

Required skills/Knowledge:

- Knowledge of NASA software systems development requirements and best practices;
- Advanced programming skills in IDL, C, Python, Perl, multiple shell scripting languages; ability to operate within a variety of OS including Linux, Windows, Mac; proficiency with common software development applications such as SVN, LabView, MatLab; some proficiency with the GSFC Common Data Format (CDF).
- Detailed knowledge of the FPI GSEOS, MMS FPI data products; the FPI data processing systems, protocols, and limitations; and the FPI operations macros and tables and their update/build/validation processes.

Specific Tasks:

- The contractor shall provide technical support for the design and development of MMS FPI data processing, data distribution, data validation, and data archive software applications;
- Enable the efficient, accurate generation of the full range of CDF data files for engineering, instrument housekeeping and science data products;
- Oversee the development of, and advise on, advanced data processing architectures including the deployment of distributed processing and archival processes across multiple institutions; and
- Enable the production and validation of FPI flight macros and tables.

Deliverables/Schedules/Milestones:

- The deliverable for this item is a monthly progress report.
- Schedules are determined by the MMS data delivery schedules
- Attend meetings as required by the Team

III. Subtask 3: Sustaining mission operation support

Required skills/Knowledge:

- minimum bachelor degree in aerospace, electrical, or mechanical engineering or equivalent;
- operations experience with NASA spacecraft missions and satellite subsystems;
- understanding of NASA Systems Engineering process (NPR 7120.5) and experience with developing Local Operating Procedures (LOPs) consistent with this approach;
- skill and innovation in operational aspects of NASA mission subsystems;
- demonstrated programming skills with proficiency utilizing Python, IDL, and/or the GSFC Common Data Format (CDF);
- ability to develop specialized data products, statistical analyses, processes, and procedures as required to support instrument performance V/V and anomaly investigation and resolution;

- demonstrated skill communicating professionally and effectively; candidate will communicate with full FPI team (instrumenters and scientists), the MMS operations groups: mission operation at GSFC; payload operations at SWRI; and science operations at LASP;
- ability and desire to gain (1) detailed knowledge of the design specifics, operational procedures, and anomaly resolution processes for the FPI instruments (DES, DIS, and IDPU); (2) detailed knowledge of FPI flight operation systems, protocols, schedules, requirements and limitations and the principles and history of the FPI operation macros and tables and their update/build/validation procedures; and (3) detailed knowledge of DES/DIS calibration challenges and procedures.

Specific Tasks:

- Provide technical leadership and overall coordination of efforts related to the MMS FPI payload and its ground systems and equipment;
- provide cross team coordination of operations engineering information and issues as well as interfacing with internal and external Subject Matter Experts (SMEs), MMS payload operations center (POC), and the MMS Mission operations center (MOC);
- support the FPI lead and MMS Science Working Group (SWG) in instrument and science systems engineering as needed, including but not limited to science operations concepts and assessment of the impacts of mission phase, orbit, and configuration changes;
- provide technical support to the MMS FPI payload and its support equipment including implementation and further development/refinement of concept of operations, on-orbit verification of requirements, routine maintenance and continuity of operation; and anomaly tracking and resolution;
- further develop MMS FPI engineering software systems to improve reliability, efficiency, and accuracy of end-to-end architecture and functionality;
- provide engineering support and data reductions to perform statistical and thematic trend analysis on MMS FPI performance, proposing new methodologies to improve and/or maintain data quality;
- provide innovative solutions and continuous process improvements for MMS FPI calibrations and data validation;
- refine and document operation procedures, trends, anomaly resolution, and performance histories in a form that is presentable, sustainable, and offers clarity throughout the team; and
- support maintenance, production, and validation of FPI flight command tools including macros and tables.

Deliverables/Schedules/Milestones:

- Deliverables are weekly operation status reports, development/implementation status reports, LOP, white papers,

presentations, and entries to the FPI monthly report. Attend meetings as required by the TM or designee.

III. Subtask 4: Sustaining mission operation support

Required skills/Knowledge:

- minimum bachelor degree in aerospace, electrical, or mechanical engineering or equivalent;
- operations experience with NASA spacecraft missions and satellite subsystems;
- understanding of NASA Systems Engineering process (NPR 7120.5) and experience with developing Local Operating Procedures (LOPs) consistent with this approach;
- skill and innovation in operational aspects of NASA mission subsystems;
- demonstrated programming skills with proficiency utilizing Python, IDL, and/or the GSFC Common Data Format (CDF);
- ability to develop specialized data products, statistical analyses, processes, and procedures as required to support instrument performance V/V and anomaly investigation and resolution;
- demonstrated skill communicating professionally and effectively; candidate will communicate with full FPI team (instrumenters and scientists), the MMS operations groups: mission operation at GSFC; payload operations at SWRI; and science operations at LASP;
- ability and desire to gain (1) detailed knowledge of the design specifics, operational procedures, and anomaly resolution processes for the FPI instruments (DES, DIS, and IDPU); (2) detailed knowledge of FPI flight operation systems, protocols, schedules, requirements and limitations and the principles and history of the FPI operation macros and tables and their update/build/validation procedures; and (3) detailed knowledge of DES/DIS calibration challenges and procedures.

Specific Tasks:

- provide technical support to the MMS FPI payload and its support equipment including implementation and further development/refinement of concept of operations, on-orbit verification of requirements, routine maintenance and continuity of operation; and anomaly tracking and resolution;
- further develop MMS FPI engineering software systems to improve reliability, efficiency, and accuracy of end-to-end architecture and functionality;
- provide engineering support and data reductions to perform statistical and thematic trend analysis on MMS FPI performance, proposing new methodologies to improve and/or maintain data quality;
- provide innovative solutions and continuous process improvements for MMS FPI calibrations and data validation;

- refine and document operation procedures, trends, anomaly resolution, and performance histories in a form that is presentable, sustainable, and offers clarity throughout the team; and
- Enable the production and validation of FPI flight macros and tables.

Deliverables/Schedules/Milestones:

- Deliverables are weekly operation status reports, development/implementation status reports, LOP, white papers, presentations, and entries to the FPI monthly report. Attend meetings as required by the TM or designee.

IV. Period of Performance

(Tasks will be issued with no more than 12-month periods of performance unless otherwise justified and approved)

The period during which the work for this task shall be performed is from task award thru 14 April 2021.~~1 July 2020 thru 14 October 2020.~~

V. Government Furnished Facilities, Equipment, Software and Other Resources

The Government will provide account and passwords to government-furnished workstations where existing versions of various relevant software packages shall be maintained. It shall be the contractor's responsibility to complete any GSFC required security-related training courses.

The contractor shall provide Systems Administration service and support equipment required for both onsite and offsite contractor functions.

VI. Facilities

All work will be performed on site at GSFC.

VII. ODC (Travel and Procurement)

~~While this task has May include~~d occasional travel, no travel is anticipated during this period of performance., which can include limited foreign travel. For budgeting purposes, assume one 4 day trip per task to Boulder, CO.

VIII. Applicable function and title, sub-section/paragraph from the SEAS SOW

Under the SEAS Contract SOW:
 Function 3 – Research and Technology Services
 A. Instrument Systems Technology Services
 C. Software Systems Technology Services