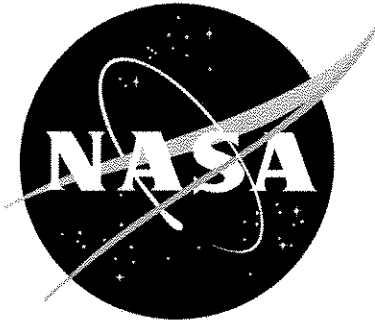


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9/2008



**NASA**  
**GODDARD SPACE FLIGHT CENTER**

**STATEMENT OF WORK**

**FOR**

**MULTIDISCIPLINARY**  
**ENGINEERING AND TECHNOLOGY SERVICES (METS II)**

**FOR THE**

**APPLIED ENGINEERING AND**  
**TECHNOLOGY DIRECTORATE (AETD)**

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## **INTRODUCTION**

The National Aeronautics and Space Administration (NASA) was established to plan, direct, and conduct aeronautical and space activities for peaceful purposes for the benefit of all mankind. The operational aspects of NASA's work are divided among field installations around the country and involve research and development activities under the responsibility of six technical program offices at NASA Headquarters.

The Goddard Space Flight Center (GSFC) is located in Greenbelt, Maryland and Wallops Island, Va . The GSFC is chartered to expand the knowledge of the earth and its environment, the solar system, and the universe through observations from space. To this end, the GSFC's primary emphasis is in scientific investigation, in the development and operation of space systems, and in the advancement of essential technologies. In accomplishing this responsibility, the GSFC has undertaken a broad program of scientific research, both theoretical and experimental, in the study of space phenomena and earth sciences. The program ranges from basic research to flight experiment development, and from mission operations to data analysis.

Within the GSFC, the Applied Engineering Technology Directorate (AETD) plans, organizes, and conducts a broad range of technical research and development activities in support of science applications. The AETD is responsible for providing engineering expertise and support in the formulation, design, development, non-flight fabrication, integration, test, verification, and operation of components, subsystems, systems, science instruments, and complete spacecraft for multiple projects. The specific components, subsystems, systems, and science instruments are ultimately integrated into the spacecraft to form a science observatory. It is these observatories that are launched to fulfill the mission of the GSFC. The AETD comprises five engineering divisions: the Mechanical Systems Division (MSD), the Software Engineering Division (SED), the Instrument Systems and Technology Division (ISTD), the Electrical Engineering Division (EED), and the Mission Engineering and Systems Analysis Division (MESAD).

To fulfill these responsibilities and ultimately achieve their missions, the AETD must acquire a wide range of engineering services in support of its divisions to implement the GSFC mission.

## SCOPE OF WORK

The purpose of this contract is to acquire engineering and related services to MESAD, ISTD, EED, and related organizations, as required, for the formulation, design, development, non-flight fabrication, integration, testing, verification, and operations of space flight and ground system hardware and software, including development and validation of new technologies to enable future space and science missions. The emphasis in engineering services will be in the areas of systems engineering; guidance, navigation, and control systems; information technology; and radio frequency (RF) systems.

To this end, the contractor shall provide on/off-site multidisciplinary engineering services, pursuant to task assignments issued by the Contracting Officer. These services shall include the personnel, facilities, and materials (unless otherwise provided by the Government) to accomplish the tasks. **In addition, security clearances may be required for some assignments ranging from Secret to Top Secret and SCI, specifically in the rf communications discipline.**

Tasks assignments will be issued to perform services in all aspects of mission and instrument development and implementation for components, subsystems, systems, science instruments, observatories, launch, ground system, spacecraft, and suborbital craft (e.g., aircraft, sounding rockets, UAVs, balloons), including attached shuttle or Space Station, payloads, free-flying spacecraft, suborbital craft payloads, and Space Station payloads as well as ground support equipment, simulators, non-flight models, prototypes and flight hardware; candidate, feasibility, and systems definition studies; project management; systems engineering; analysis; preliminary design; detailed design; non-flight and flight fabrication; assembly; integration; test and verification; test instrumentation; data systems management; launch and post-launch operations; research and technology unique to system development; documentation; maintenance; sustaining engineering; configuration management; mission assurance; architectural trades, performance, cost, risk assessment, and systems safety.

### I. GENERAL RESPONSIBILITIES

The Contractor's responsibilities shall include the management of personnel, timely and effective implementation of task assignments, control and monitoring of contract and subcontract performance, management of scheduled deliveries, and timely and effective reporting to the Government. These responsibilities shall also include efficient cost management methods as well as procedures to ensure that the Government is aware of task assignment status and progress achieved.

The Contractor shall be responsible for ensuring that all contractor and subcontractor personnel engaged in performance of this Statement of Work have appropriate qualifications, knowledge, and certification to perform work in accordance with the task assignments.

## **II. PERFORMANCE MEASUREMENT**

Performance-based statements of work/specifications will be used for establishing contract requirements. Therefore, each task assignment issued by the Contracting Officer will include, as a minimum, the following:

1. Statement of Work, including the requirements to be met, the standard(s) of performance/quality of work, and required deliverables (or other output)
2. Performance Specification (if applicable)
3. Applicable Documents (if required)
4. Period of Performance
5. Incentive Structure
6. Surveillance Plan

The Contractor shall be required to adhere to the performance measurements detailed in each task assignment.

## **III. TASKS**

Services shall be required in one or more of the areas described in the scope above for any given task assignment. Services within the scope of this Statement of Work and specified in task assignments shall include, but not be limited to, the specific services delineated in the following sections.

**FUNCTION 1 – PRE-FORMULATION AND FORMULATION SERVICES: CANDIDATE, PRELIMINARY ANALYSIS, AND SYSTEMS DEFINITION STUDIES**

The Contractor shall provide engineering services for mission concept development that integrate the aspects of flight systems, ground systems, instrument systems, and launch systems.

In general, the Contractor shall:

1. Produce pre-formulation and formulation phase study inputs for spacecraft, suborbital craft, and instruments.
2. Develop mission needs (mission objectives, measurement concept, and instrument concept) and mission design (mission requirements, architectural design, and operations concept).
3. Develop preliminary, relative cost and schedule estimates based on design alternatives, and identify and assess high-risk elements in designs
4. Document the history of design, qualification, flight experience, and modifications where existing components or subsystems are to be utilized
5. Identify interface requirements for pre-launch, launch, on-orbit servicing, or retrieval of flight hardware
6. Define interface engineering and management requirements
7. Prepare mission systems and operations documentation
8. Prepare requirements and specification packages that conform to applicable standards defined within task statement
9. Identify interfaces and prepare interface control documents
10. Provide technical inputs for problem-solving and/or design inputs in selected spacecraft, instruments, suborbital craft, ground system, and data disciplines
11. Analyze various reports (i.e., progress reports) delivered by the GSFC mission contractor(s) and provide recommendations to the project
12. Provide liaison and coordination services for project activities

13. Provide design services that include performance of preliminary design (leading to a Preliminary Design Review) of the subsystems, components, and assemblies that comprise the instrument/spacecraft/platform/launch system.

#### **A. Candidate Study Services**

The Contractor shall provide study services for the conceptual design and development of subsystems and systems, thereby participating in the identification of scientific objectives, mission requirements and technical concepts. Study products produced during this phase shall include, but not limited to:

1. Strategic technology planning
2. Integration of joint missions, partnerships, and other collaborative efforts
3. Research/science/technology/cost trade studies
4. Candidate operations concepts
5. Candidate system architectures
6. Cost, schedule, and risk estimates
7. Research and technology unique to system development
8. Customer development support and outreach

#### **B. Preliminary Analysis Study Services**

The Contractor shall provide preliminary analysis study services focusing on analyzing mission requirements and establishing mission architectures in order to demonstrate that a credible, feasible design(s) exist(s). The Contractor shall develop top-level requirements and evaluation criteria, identify alternative operations/logistics concepts, and identify project constraints and system boundaries. Study products produced during this phase shall include, but not limited to:

1. **Analysis Services Specific Tasks** – The Contractor shall perform analysis services tasks, including but not limited to:
  - a. Preliminary system design of a feasible, but not necessarily optimum configuration
  - b. Assessment of technical risks, including identification of technical problems and the criticality of their solution to follow-on efforts, identification of those problems currently being addressed, and a judgment of effort and time likely to be necessary to find a practical solution
  - c. Identification of all recommended systems characteristics, including launch and control capability, tracking and data acquisition, facility considerations, and institutional base activities



- d. Implementation plans, which include the identification of all major systems and subsystems
  - e. Preparation of the system design that forms the basis for implementing system development (hardware or software)
  - f. Provide alternative design concepts including feasibility and risk studies, cost and schedule estimates, and advanced technology requirements
  - g. Prepare for and support the appropriate Phase A project and technical reviews and prepare Phase A project documentation as appropriate (see the NASA Systems Engineering Handbook, SP-6105, December 2007)
2. **Documentation Specific Tasks** – The Contractor shall document all results from the study in a Feasibility Study Report.

### C. System Definition Study Services

The Contractor shall provide system definition and preliminary design study services to establish (and evolve) the project baseline(s). These shall include:

1. **Analysis Services Specific Tasks** – The Contractor shall perform system definition analysis services specific tasks, including:
  - a. Defining system requirements, system budgets (e.g., mass, power, memory), error budgets, system/subsystem requirements, software requirements, ground support equipment requirements, and integration and test requirements
  - b. Identifying all recommended system characteristics, defining the subsystem components and assemblies, identifying the required complement of flight and ground support equipment, specifying internal and external interfaces, and verifying that the recommended design approach's critical subsystems and components are within the state-of-the-art
  - c. Providing a formal flow down of project-level performance requirements to a complete set of system and subsystem design specifications for both flight and ground elements. Phase B baseline information shall be developed including system requirements and verification requirements matrices, system architecture and work breakdown structures, operations concepts, "design-to" specifications at all levels, and project plans including schedule, resources, and acquisition strategies
  - d. Performing risk assessments of all critical elements, describing the risks and control methods. The knowledge and use of Probability Risk Assessment (PRA), Failure Modes and Effects Analysis (FMEA) and Fault Tree Analysis (FTA) is required.
  - e. Preparing the system design that shall form the basis for implementing/developing the system (hardware or software); defining the tasks and sequence of tasks that shall be performed to provide orderly technical development, design, review,

interface, test, and integration of the system; and providing the required plans (modeling, analysis, and simulation; configuration; logistics; information; software; verification; integration and test, etc.) for the effort

f. Describing and documenting integrated mission architecture

g. Preparing for and supporting the appropriate Phase B project and technical reviews and prepare Phase B project documentation as appropriate (see the NASA Systems Engineering Handbook, SP-6105, June 1995).

2. **Documentation Specific Tasks** – The Contractor shall document all results from the study effort in a Definition Study Report.

## **FUNCTION 2 – IMPLEMENTATION PHASE SERVICES - MULTI-DISCIPLINARY FUNCTIONS**

The Contractor shall provide services to design, develop, unit test, system integrate, verify, integrate, deploy, and operate hardware and software on spacecraft, platform, and/or payload as defined by this Statement of Work. The implementation phase services shall include:

### **A. Multi-disciplinary Analyses and Design Services**

The Contractor shall provide analytical and detailed design support that includes multi-disciplinary system analyses and trade studies involving, but not limited to, mechanical, thermal, optics (including radiometrics and stray light), contamination, control, guidance, navigation, detector, electrical, electronic, and software aspects of flight and ground systems, including associated ground support equipment. Services shall include the definition, development and use of models and simulations to study and quantify system performance and to conduct system trade studies. This includes, but is not limited to, such specific efforts as EMI/EMC analysis, environmental testing, magnetics testing, thermal vacuum testing, systems performance error budgets, power and weight budgeting and tracking, microphonics analyses, fracture control analyses, microwave communication system analyses (including link margin availability), controls-structures analyses, control-structural-thermal-optical analyses, instrument system analyses (including system sensitivities), computer performance analyses (including CPU, memory, simulations, etc), and systems reviews of selected critical subsystems. Services shall also include the development of measurement tools and models, analysis of measurement data, defect tracking, process improvement, cost estimation of hardware and software systems, modeling of organizational processes, electrical parts analyses, electrical board layouts, thermal analysis, non-flight electrical board fabrication, mechanical enclosure design, and technical writing documentation.

The Contractor shall provide design services that include performance of detailed (leading to a Critical Design Review) design of the subsystems, components and assemblies that comprise the instrument/spacecraft/platform. This effort includes hardware and software (flight and ground) as well as ground support equipment (electrical, thermal, contamination, mechanical, and cryogenic). Documentation, including technical reports, drawings, schematics, block diagrams, layouts, parts and materials list, and equipment lists, shall be provided.

**Documentation Specific Tasks** – The Contractor shall document all results from the modeling, simulations, analyses, and design effort and shall provide supporting materials and documentation.

### **B. Fabrication, Assembly and Testing Services**

The Contractor shall provide non-flight fabrication, assembly and testing services, including breadboards, engineering models, and other non-flight models, including:

1. **Planning Specific Tasks** – The Contractor shall provide planning services, including:
  - a. Implementation and maintenance of overall production and quality engineering plans
  - b. Manufacturing, integration and test plans, describing sequences, qualification and acceptance test levels, and facilities needed to accomplish assembly, integration, alignment, testing, quality control, and checkout
2. **Non-Flight & Flight Fabrication Specific Tasks** – The Contractor shall provide fabrication services, including:
  - a. Optical, mechanical, detector, electrical/electronics, and microwave, including antennas. Mechanical systems shall include pressurized propulsion systems containing hazardous fluids.
  - b. Ground support equipment, including mechanical and electrical, and optical
  - c. Laboratory control systems
  - d. Wiring harnesses
  - e. Special parts
  - f. Surface mount printed circuit boards, including leadless chip carriers and chip-on-board techniques
3. **Non-Flight & Flight Assembly Specific Tasks** – The Contractor shall provide assembly services, including:
  - a. Optical, mechanical, detector, electrical/electronics, and microwave, including antennas mechanical systems shall include pressurized propulsion systems containing hazardous fluids.
  - b. Ground support equipment including mechanical, electrical, and optical
  - c. Test equipment and fixtures
  - d. Wiring harnesses

### **C. Integration, Test, and Verification Services**

The Contractor shall provide engineering and test-conductor services that include integrating and verifying the flight, ground systems, and science data system, preparing and executing test procedures, documenting all non-conformances and dispositions, providing operating manuals, reference documents, training, and launch site support.

1. **Integration, Test and Verification Specific Tasks** – The Contractor shall provide integration, test, and verification services including mission systems engineering,

systems engineering, independent software verification and validation, acceptance testing, regression testing, software support and system-level support of products during box, instrument, spacecraft and observatory I&T including:

- a. Major program reviews
- b. Space flight subsystems
- c. Space flight instruments
- d. Space flight payloads
- e. Suborbital craft instruments
- f. Ground instrumentation
- g. Ground support systems
- h. Science data systems/applications
- i. Spacecraft and science operations control rooms
- j. Suborbital craft subsystems

#### **D. Laboratory and Test Instrumentation Services**

The Contractor shall provide the services necessary for conceptualization, prototyping, system engineering, design, development, integration, test, sustaining engineering, maintenance and utilization of laboratory and test instrumentation.

#### **E. Launch and Post-Launch Operations Support**

The Contractor shall supply launch and post-launch mission systems level, systems level, software, and ground systems support services for ELV, NSTS, sounding rocket, balloon, and aircraft-based missions, including:

1. **Launch Site Preparation Specific Tasks** – The Contractor shall provide system services at the launch site, including:
  - a. Supports to payload system and its support equipment
  - b. Interfaces to the mission operations control centers
  - c. Technical services to facilitate interfacing with the launch site organization
  - d. Development of launch site support requirements
  - e. Development of launch site plans and procedures
  - f. Assistance in shipment of the flight hardware and associated support equipment to and from the launch site
2. **Launch Operations Specific Tasks** – The Contractor shall provide launch and post-launch operations services for ELV, NSTS, sounding rocket, balloon, and aircraft-based missions, including:

- a. Assuring flight readiness of the payload and observatory system
  - b. Pre-launch testing of the payload and observatory system
  - c. Operation of associated ground support equipment
  - d. Services to the launch vehicle team for payload integration to the vehicle at the launch facility
3. **Mission Operation Support Specific Tasks** – The Contractor shall provide mission operation engineering services, including services for the payload and for carrier and flight support system during mission operations.
  4. **Landing and De-Integration Specific Tasks** – The Contractor shall provide landing and de-integration services, including services at the landing site for payload de-integration, post-flight testing, and payload shipment. This shall include suborbital craft and payloads recovery.
  5. **Refurbishment of Recovered Systems Specific Tasks** – The Contractor shall provide refurbishment services for recovered flight systems.
  6. **Data Reduction Specific Tasks** – The Contractor shall provide data reduction services, including:
    - a. Compiling and analyzing systems performance data during and after the mission
    - b. Reviewing and contributing to the implementation of proposed science data processing systems to ensure timely flow of accurate science data sets
    - c. Reviewing the design and implementation of information data systems to identify sources of science data for investigative purposes, including existing databases and newly acquired data requirements to be scheduled
    - d. Analyzing the development of data transfer systems and data status accounting systems for multiple science data processing centers
    - e. Integrating activities with the Information Systems Division (ISD)
  7. **Documentation Specific Tasks** – The Contractor shall provide post-flight summary reports, analyzing the performance of the system during flight.

#### **F. Mission Assurance and Systems Safety Services**

For all levels of flight hardware and software provided by the Contractor and specified by this Statement of Work, the Contractor shall establish and maintain a mission assurance program commensurate with mission requirements as specified by the task. The mission assurance program shall incorporate a system safety program which meets the requirements of NSTS 1700.7B, “Safety Policy and Requirements for Payloads Using the Space Transportation System” and 2.45 SPW S-100/KHB 1700.7B, “Space Shuttle Payload Ground Safety Handbook” for shuttle missions. For ELV missions at ETR or WTR, the system safety

program shall meet the requirements of EWR 127-1, "Eastern and Western Range Safety Requirements."

The contractor shall establish and maintain practices, procedures, and processes that are ISO 9001 compliant.

1. **Performance Assurance Specific Tasks** – The Contractor shall provide performance assurance services, including:
  - a. Reviewing payload designs to assure their compliance with performance assurance, reliability, and safety specifications
  - b. Developing, analyzing, and monitoring performance assurance, reliability, system safety plans, and procedures, non-flight fabrication assembly, integration and test, verification, and launch support
  - c. Analyzing basic plans for system safety, contamination control, integration, and testing of subsystems and systems
  
2. **Safety Specific Tasks** – The Contractor shall provide safety services which conform to the system safety/mission assurance program, including:
  - a. Establishing and documenting a systems safety plan in concert with the appropriate launch vehicle and NASA safety policy
  - b. Conducting and assessing system safety analyses for flight designs and launch/retrieval operations to satisfy NASA safety and reliability requirements
  - c. Analyzing design changes related to minimizing hazard levels
  - d. Participating in system safety reviews
  - e. Reviewing the proposed systems design to ensure that proper considerations are given to safety-critical areas, and that safety problems exposed in prior analyses, testing, and operational use of instruments and subsystems are corrected
  - f. Conducting project test/validation programs for flight and critical ground systems software
  - g. Preparing the Safety Data Package, including writing and editing
  - h. Performing hazards analysis of flight system, shuttle interface equipment, and ground support equipment
  - i. Participating in required inspection/testing to fulfill safety data requirements
  - j. Coordinating with the GSFC safety officer and participating in formal safety reviews
  - k. Preparing final safety data packages

## **G. Configuration Management Services**

The Contractor shall provide overall management and oversight of the Configuration Management (CM), Documentation Management (DM), and Quality Control Management (QCM) disciplines

throughout the life cycle of flight hardware and software provided within the scope of this Statement of Work. Each discipline shall require the development, establishment, and implementation of procedures and processes and establishment of mechanisms and tools for consistency.

The Contractor shall support the planning, identification of processes, and leading GSFC Project efforts in these disciplines. This support shall also include the necessary planning and associated process development to assist the GSFC Project in meeting conformance requirements to NASA procedures and guidelines as well as the ISO standards and Level II CMMI practice standards.

The main CM/DM/QCM functions shall include:

- Configuration identification, configuration control, configuration accounting and reporting
- configuration verification and configuration auditing
- implementation and maintenance of a DM system

The Contractor shall be responsible for providing the necessary tools and databases to accomplish the above functions; developing and establishing procedures and guidelines and training in the configuration management, documentation management, and ISO 9001 disciplines.



## FUNCTION 3 – IMPLEMENTATION PHASE SERVICES - DISCIPLINE SPECIFIC SERVICES

### A. Project Management

The Contractor shall provide management services, including establishment of a management organization that ensures that all assigned task objectives are accomplished within specified schedule and cost constraints. Management shall provide frequent and timely status to the Government via cost, schedule, progress and other reports during all phases of work.

### B. Mission Systems Engineering

The Contractor shall provide systems engineering support for project development, reporting progress and conformance to appropriate practices and specifications (see the GPG 7120.5 Systems Engineering). This shall include:

1. **Systems Engineering Specific Tasks** – The Contractor shall perform key mission and spacecraft-level systems engineering functions that include, but are not limited to:

#### **a. Operations Concept Development & Support:**

- a1. Developing the operations concept
- a2. Preparing/reviewing mission operations concepts in regards to the intended functionality and interfaces among the flight subsystems and the ground
- a3. Generating Mission Operations Concept Documents (ConOps)
- a4. Participating in user interface meetings and joint integrated mission simulation training aimed at developing viable user operations
- a5. Supporting satellite operations
- a6. Analyzing flight anomalies and recommending implementing appropriate actions
- a7. Working with principal investigator and science working group in planning operations
- a8. Supporting “lessons learned” presentations
- a9. Preparing plans for and supporting mission disposal operations

#### **b. Architecture & Design Development:**

- b1. Defining systems and conducting trade-off studies/design studies for spacecraft, suborbital craft, instruments, space segments and ground segments
- b2. Reviewing software development and software system test activities
- b3. Generating and maintaining and/or reviewing system block diagrams

#### **c. Requirements Analysis, Identification and Management:**

- c1. Generating and managing and/or reviewing Level 1 and 2 requirements
- c2. Conducting requirements traceability
- c3. Documenting specified and lower level derived requirements to demonstrate that performance requirements are met

- c4. Reviewing/performing independent design and development requirements analyses, and submitting comments and recommendations
- c5. Reviewing technical specifications, and submitting comments and recommendations
- c6. Providing specification of Requirements for Design, non-flight fabrication, and checkout of ground support equipment
- c7. Reviewing contamination control requirements
- c8. Reviewing operating plans and procedures for cryogenics, fuels, and other hazardous materials

**d. Validation and Verification:**

- d1. Generating and/or reviewing Verification Plans
- d2. Performing design, drawing, and specification reviews
- d3. Providing 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.
- d4. Documentation and/or review of system qualification requirements
- d5. Preparing and/or reviewing hardware and software integration plans and procedures, and witnessing execution
- d6. Preparing and/or reviewing detailed functional and environmental test plans and procedures, and witnessing test execution
- d7. Ensuring that the technical aspects of shipping requirements and equipment are met
- d8. Preparing and/or reviewing plans for launch site checkout, integration and testing of flight systems, including adequacy of the launch site facility
- d9. Analyzing data from spacecraft telemetry data sources to ensure total system compatibility
- d10. Analyzing Flight performance from flight data

**e. Interfaces and ICDs:**

- e1. Reviewing and analyzing design interfaces
- e2. Identifying interface control requirements for engineering and design of components for launch, on orbit servicing, or retrieval of flight hardware
- e3. Preparing, reviewing, and analyzing interface documentation for mission systems
- e4. Preparing interface control documents and verifying proper implementation for flight and ground subsystems and systems
- e5. Controlling external interface documentation and requirements

**f. Mission Environments:**

f1. Defining and/or reviewing subsystem and hardware specifications to ensure that they meet the specific mission or spacecraft environment. Mission or spacecraft environment includes the following discipline areas:

- Mechanical systems
- Electrical systems
- EMI/EMC
- Grounding
- Thermal
- Radiation shielding
- Parts engineering
- Contamination
- Reliability
- Charging
- Timing and time distribution
- Data rates
- Safety
- Orbital debris assessment

**g. Technical Resource Budget Tracking:**

- g1. Documenting and controlling and/or Review of budget plans, including power, thermal, data storage, computer processing and communication through-put , attitude control, timing, mass properties, etc., both at the flight system level and allocated to lower levels of assembly; this shall include error margins, where applicable
- g2. Documenting command and telemetry signal margin plan, including bit error rates

**h. Risk Analysis, Reduction, and Management:**

- h1. Identifying high risk elements and developing/executing contingency plans for controlling the high risk elements
- h2. Reviewing contractor risk management plans and commenting on alternate approaches

**i. System Milestone Review Candidates:**

- i1. Conducting and documenting internal design reviews
- i2. Supporting standards definition and review
- i3. Attending and conducting technical meetings/design reviews, and submitting comments and recommendations
- i4. Preparing and presenting of technical information for technical conferences/reviews/briefings

**j. Configuration Management and Documentation:**

- j1. Analyzing configuration, design, anomaly resolutions, and procedural changes submitted to change control boards. Providing the services and functions stated in Section G of this document.

**k. Systems Engineering Management Plan:**

- k1. Generating System Engineering Management Plans (SEMP)
- k2. Documenting/reviewing system, subsystem and organizational processes in terms of ISO compliance and CMMI assessments
- k3. Developing or reviewing existing systems engineering tools for applicability as required
- k4. Review of Fabrication Plans

**C. Instrument Systems Engineering**

The Contractor shall provide instrument systems engineering support for project development, reporting progress and conformance to appropriate practices and specifications (see the GPG 7120.5 Systems Engineering). This shall include:

1. **Systems Engineering Specific Tasks**– The Contractor shall perform key Instrument systems engineering functions that include, but not limited to:

**a. Instrument Data Processing Development & Support:**

- a1. Developing Instrument data processing concept.
- a2. Developing hardware and software designs for the Instrument Data Processing Center.
- a3. Performing Systems analysis of Instrument Data Processing Center to verify performance.
- a4. Developing Instrument operations concept.
- a5. Supporting instrument operations.
- a6. Analyzing flight anomalies and recommending implementing appropriate actions.
- a7. Working with principal investigator and science working group in planning operations.
- a8. Supporting “lessons learned” presentations post-launch.

**b. Instrument Architecture & Design Development:**

- b1. Defining systems and conducting trade-off studies/design studies for instruments, space segments and ground segments.
- b2. Developing Instrument Architecture.
- b3. Reviewing subsystem development and test activities.
- b4. Generating and maintaining and/or reviewing system block diagrams.

**c. Requirements Analysis, Identification and Management:**

- c1. Generating and managing and/or reviewing Level 1 and 2 requirements.
- c2. Conducting requirements traceability.
- c3. Documenting specified and lower level derived requirements to demonstrate that performance requirements are met.
- c4. Reviewing/performing independent design and development requirements analyses, and submitting comments and recommendations.
- c5. Reviewing technical specifications, and submitting comments and recommendations.
- c6. Providing specification of Requirements for Design, non-flight fabrication, and checkout of ground support equipment.
- c7. Reviewing contamination control requirements.
- c8. Reviewing operating plans and procedures for cryogenics, and other hazardous materials.

**d. Validation and Verification:**

- d1. Generating and/or reviewing Verification Plans.
- d2. Performing design, drawing, and specification reviews.
- d3. Providing 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.
- d4. Documentation and/or review of system qualification requirements.
- d5. Preparing and/or reviewing hardware and software integration plans and procedures, and witnessing execution.
- d6. Preparing and/or reviewing detailed functional and environmental test plans and procedures, and witnessing test execution.
- d7. Ensuring that the technical aspects of shipping requirements and equipment are met.
- d8. Preparing and/or reviewing plans for launch site checkout, integration and testing of flight systems, including adequacy of the launch site facility.
- d9. Analyzing data from spacecraft telemetry data sources to ensure total system compatibility.
- d10. Analyzing Flight performance from flight data.

**e. Interfaces and ICDs:**

- e1. Reviewing and analyzing design interfaces.
- e2. Identifying interface control requirements for engineering and design of hardware for launch, on orbit servicing, or retrieval of flight hardware.
- e3. Preparing, reviewing, and analyzing interface documentation for Instrument systems.
- e4. Preparing interface control documents and verifying proper implementation for flight and ground Instrument subsystems and systems.

e5. Controlling external interface documentation and requirements

**f. Mission Environments:**

f1. Defining and/or reviewing subsystem and hardware specifications to ensure that they meet the specific mission environment. Mission environment includes the following discipline areas:

- Mechanical systems
- Electrical systems
- EMI/EMC
- Grounding
- Thermal
- Radiation shielding
- Parts engineering
- Contamination
- Reliability
- Charging
- Timing and time distribution
- Data rates
- Safety
- Orbital debris assessment

**g. Technical Resource Budget Tracking:**

- g1. Documenting and controlling and/or Review of budget plans, including power, thermal, data storage, computer processing and communication through-put , attitude control, timing, mass properties, etc., both at the flight system level and allocated to lower levels of assembly; this shall include error margins, where applicable
- g2. Documenting command and telemetry signal margin plan, including bit error rates

**h. Risk Analysis, Reduction, and Management:**

- h1. Identifying high risk elements and developing/executing contingency plans for controlling the high risk elements
- h2. Reviewing contractor risk management plans and commenting on alternate approaches

**i. System Milestone Review Candidates:**

- i1. Conducting and documenting internal design reviews
- i2. Supporting standards definition and review
- i3. Attending and conducting technical meetings/design reviews, and submitting comments and recommendations
- i4. Preparing and presenting of technical information for technical conferences/reviews/briefings

**j. Configuration Management and Documentation:**

- j1. Analyzing configuration, design, and procedural changes submitted to change control boards

**k. Systems Engineering Management Plan:**

- k1. Generating System Engineering Management Plans (SEMP)
- k2. Documenting/reviewing system, subsystem and organizational processes in terms of ISO compliance and CMMI assessments
- k3. Developing or reviewing existing systems engineering tools for applicability as required
- k4. Review of Fabrication Plans

**D. Optical Engineering Services**

The Contractor shall provide, on an as-needed basis, engineering services for state-of-the-art optical systems. These services shall include, for example, the design, development and analysis of optical components, diffraction and stray light/energy analyses, component/system alignment and/or calibration, and/or other services, as required.

**E. Detector Engineering Services**

The Contractor shall provide, on an as-needed basis, engineering services for state-of-the-art X-Ray, Gamma Ray, Visible, RF, and Microwave detection systems requiring low noise levels and calibrations traceable to physical standards. These services shall include, for example, Field Programmable Gate Arrays design and analyses, and/or other services, as required.

**F. Data Systems Management Services**

The Contractor shall provide data systems management services, including:

- a. Ensuring that all software (ground and/or flight) packages and associated interfaces are being properly managed and problems adequately identified and resolved.
- b. Developing, reviewing, and analyzing software requirements and specifications
- c. Analyzing software designs and design interfaces and making recommendations for solutions in specific problem areas
- d. Reviewing, analyzing, evaluating, and preparing data systems documentation such as feasibility studies, automatic data processing (ADP) plans, design, design interfaces, procedure handbooks, and other documentation materials
- e. Defining systems for end-to-end data processing

- f. Developing schedules for the data processing system in the areas of milestone development, network planning, milestone real-time tracking, and schedule impact analysis
- g. Contributing to the design, development, validation, implementation, certification, and maintenance of ground or on-board computer system simulators/emulators, including validation of flight systems software for ascent, transfer, or on-orbit phases and near real-time reprogramming and validation of modifications for recovery from anomalous situations
- h. Analyzing the design and implementation of simulators/emulators for ground crew training, systems testing and procedure validation

## **G. Guidance, Navigation and Control (GN&C) Engineering Services**

The Contractor shall provide GN&C engineering support for all phases of project development, monitoring and reporting progress and conformance to appropriate practices and specifications. This shall include:

1. **GN&C Systems Engineering Specific Tasks** – The Contractor shall perform specific GN&C systems engineering tasks that include:
  - a. Flight Project GN&C Subsystem Engineering, including requirements development; analysis; trade studies; ICD development; verification and validation; risk management; general coordination of all GN&C elements; maintenance of mass, power, and pointing budgets; operations planning
  - b. GN&C Conceptual Design, Modeling and Simulation
  - c. GN&C Science and Instrument Interface Engineering
  - d. Spacecraft Reentry Systems Engineering
  - e. Re-entry Debris Analysis, Modeling and Simulation
  - f. GN&C Engineering Support to Integrated Mission Design Center (IMDC)
  - g. Advanced GN&C Systems Technology Development, including the design, analysis, non-flight fabrication, assembly, and test of hardware and/or software
  - h. Advanced GN&C Testbeds, Tools and Methods Development
  - i. Balloon, UAV and Sounding Rocket GN&C Engineering
  - j. Formation Flying Test Bed (FFTB) Design and Development
  - k. Technical Consultation and Support ( Proposals, Peer, Design, and Anomaly Reviews)
2. **Flight Dynamics Engineering Specific Tasks** – The Contractor may be called upon to perform specific Flight Dynamics engineering tasks that include (tasking in this area is expected to be minor and should be treated as such in contractor responses):
  - a. Attitude Design, Analysis and Simulation
  - b. Trajectory Design, Analysis and Simulation



- c. Attitude Control Design, Analysis and Simulation
- d. Trajectory Control Design, Analysis and Simulation
- e. Vehicle Guidance Analysis and Algorithm Design, Analysis and Simulation
- f. Space and Launch Vehicle Dynamics Analysis and Simulation
- g. Control/Structure Interaction Analysis and Simulation
- h. Mission (Attitude and Trajectory) Planning and Design
- i. Attitude and Trajectory Estimation Design, Analysis and Simulation
- j. Aerodynamics Design, Analysis and Simulation
- k. Space Vehicle Autonomous Control Design, Analysis and Simulation
- l. Formation Flying/Constellation Flight Dynamics Design, Analysis and Simulation
- m. Flight Dynamics Technology Development
- n. Flight Dynamics Catalog/Database Maintenance

3. **Component and Hardware Systems Engineering Specific Tasks** – The Contractor shall perform specific GN&C component and hardware systems engineering tasks that include:

- a. Advanced GN&C Sensor/Actuator Design, Development, and Test (hardware and/or software)

4. **Propulsion Engineering Specific Tasks** – The Contractor shall perform specific spacecraft propulsion systems engineering tasks that include:

- a. Spacecraft Propulsion Subsystem Engineering
- b. Advanced Propulsion Technology Development, including advanced chemical propulsion, electrical propulsion (EP), MEMS, micro-propulsion components; test equipment and instrumentation to support development & testing of sub-microN thrusters
- c. Fluid Systems Engineering including transient flow, vapor diffusion, fluid slosh and plume impingement analyses
- d. Power & Electric Propulsion System Engineering, including low thrust trajectory design; EP system design & trades; EMI testing, analysis and mitigation
- e. Nanocalorimetry
- f. Propulsion Chemical Analyses
- g. Propulsion GSE Design and Development
- h. Propulsion System Engineering Support to IMDC and advanced mission studies
- i. Propulsion System Engineering Support to Flight Project, including technical consultations and engineering support for design reviews, analyses, proposal development, and anomaly resolution. Data Acquisition Engineer, including software and hardware design, development and test.
- j. Mechanical and Thermal Engineering Support specific to propulsion system design and analysis.

5. **Propulsion System Technician Specific Tasks** - The Contractor shall perform specific spacecraft propulsion system technician tasks that include:

- a. Mechanical Technician tasks for the fabrication, assembly, integration and test of propulsion subsystems, including subsystem manifold fabrication, precision cleaning, certified welding, integration of propulsion subsystem components, and clean room operation
- b. Electrical Technician tasks for the fabrication, assembly, integration and test of propulsion subsystems, including certified soldering, crimping, staking, harness fabrication, electrical component test and integration.
- c. Advanced Propulsion Technology Development Technician tasks, including conducting micro-Newton thrust stand tests; vacuum system assembly, maintenance and operation; chemical handling; fluid system assembly and operation.

#### **H. Robotics Specific Services**

The Contractor shall provide engineering support for all phases of robotic project development. These shall include:

- a. Articulated Mechanism Dynamics
- b. Force Feedback Control
- c. Remote Teleoperation
- d. Machine Vision
- e. Range Sensor Processing
- f. Motion Planning
- g. Collision Prediction
- h. Gravity Compensation

#### **I. RF Communication/Electrical Engineering Services**

The contractor shall provide independent systems engineering analysis and evaluation in support of customer mission-related activities as well as analysis and support of new capabilities considered for inclusion into the NASA Space Network (SN) and Ground Network (GN) as well as GPS Navigation. This also includes RF communications systems engineering support to independently evaluate and assess current space and ground network capabilities, system improvements, and new services to meet future mission needs.

Additionally, tasks may include performing SN analyses for current space elements (TDRS Flight-1 through Flight-10 and TDRS K,L,M & N) including the ability for modeling of multiple access interference signals and the corresponding current ground elements at the White Sands Complex (WSC), Guam Remote Ground Terminal, and Space Network Expansion (SNE) Terminals. Tasks may encompass analysis related to the Ground Network assets that are used for mission support to include analysis for other networks and

commercial ground stations. Maintenance & development of analytical tools to perform the required analysis and associated data bases to support the analysis are included in this task.

This task supports standards and protocol activities. Maintenance & extension of Space and Ground Network Users Guides are also encompassed in this task. This task includes the development and review of RF Interface Control Documents as well as technical reports on special studies. Analysis of new modulation schemes and transmission techniques including lasers are additionally covered under this task activity including the ability to perform analysis of atmospheric effects of higher communication frequency bands (e.g. 37 GHz).

Ability to perform dynamic analyses for S/C & launch vehicles which requires expert knowledge of trajectories, orbital mechanics & the 3-dimension modeling S/C to enable S/C & ELV antenna design to be compatible with the SN & GN.

Qualified personnel with security clearances at least a DoD SECRET level, and in some cases higher (as defined in the specific Task Order), may be required by the Contractor to support certain Task Orders. In addition, some projects require the involved staff to hold Sensitive Compartmented Information (SCI) clearances based on current single-scope background investigations. Some special projects must be accomplished in an SCI facility and the ability to access to an SCI facility and material is required. All contractor staff providing support to these special projects must obtain and maintain SCI clearances. The contractor must also comply with applicable NASA, DoD, National Industrial Security Program Operating Manual (NISPOM) and Director of Central Intelligence Directives (DCIDs) security regulations.

#### Place of Performance:

Task order activities that involve access to classified meetings and information will be performed at a NASA or other U.S. Government agency facility.

#### Access and handling of proprietary data:

Contractor access to vendor proprietary data may be required. Proprietary information obtained under this contract will not be used for any purpose other than that for which it was intended. The contractor may be required to execute a non disclosure agreement with other vendors prior to being granted access to proprietary data.

## **FUNCTION 4 – RESEARCH AND TECHNOLOGY SERVICES**

The contractor shall provide advanced research and technology support to MESAD, EED, ISTD and related organizations. These services may include development, test and analysis work in support of the Research and Technology activities.

### **A. Instrument Systems Technology Services**

The Contractor shall provide research, design, development, and testing, and analysis services for instrument systems, including:

1. **Instrument Systems Specific Tasks**– The Contractor shall provide services for the research and development of advanced analytical, engineering, integration, testing, and software engineering techniques including:
  - A. Instrument Systems Performance modeling
  - B. X-Ray, Ultraviolet, Optical, and Infrared Instrument systems performance testing and analysis
  - C. Particle and field Instrument design development and analysis
  - D. Instrument Systems signal to noise analysis
  - E. Advanced hyperspectral imaging concepts
  - F. Microwave and submillimeter wave radiometer advanced concepts and performance modeling
  - G. Lossless and lossy compression algorithms
  - H. Science data archival formats
  - I. Science data distribution methods
  - J. Instrument applications of computational optics
  - K. Synthetic Aperture Radar advanced concepts
  - L. Computational Image enhancement
  - M. Autonomous Instrument systems

### **B. Instrument Electronics Systems Technology Services**

The Contractor shall provide services for research, design, development, test, and analysis of advanced signal processing electronics for space flight systems, including support for language-based microelectronics development. The Contractor shall provide services for sensor signal processing technology tasks, digital signal processing technology tasks and advanced applications technology tasks.

### **C. Computer Support Technology Services**

The Contractor shall provide computer technology services, including:

1. **Computer Support Specific Tasks** – The Contractor shall provide computer technology services, including:
  - a. Engineering support to analyze data acquisition, processing, distribution, archival/storage, and measurement problems
  - b. Data reduction to include statistical and thematic trends analyses
  - c. Diagnostics assistance for instrument checkout between test consoles and test components
  - d. Program services to utilize test instruments in aerospace system test and analysis, including GPIB type operation and GUI based software system
  - e. General in-house computer software maintenance to include, but not be limited to, updating and debugging programs
  - f. Design, coding, integration, test, documentation, and maintenance of special applications programs
  - g. Updating of existing technical in-house computer databases
  - h. Transfer of programs from one system to another and testing for functional operations and real time data transfer between dissimilar systems
  - i. Debugging of general utility programs, such as graphic packages
  - j. Assistance in analyzing and implementing solutions to computer hardware interface problems
  - k. Assistance in network and operating system configurations, troubleshooting, installation, and maintenance
  - l. Design and debug of test procedures
  
2. **IT Systems Security and System Administrator Function** – The contractor shall provide Windows, Macintosh, Linux, UNIX, Web, LAN systems administration services to desktops, workstations and servers, including:
  - a. Logging, reporting, diagnosing and correcting system faults
  - b. Configuring systems for performance, security and network compatibility
  - c. Performing updates of the operating system and associated software for desktops and workstations
  - d. Assisting in the preparation and updating of IT security and system administration documentation
  - e. Working with the Code 297, CNE, and SET on implementing IT security initiatives
  - f. Assisting users with software/hardware installation
  - g. Performing Help Desk functions including problem diagnosis and answering user questions regarding applications
  - h. Monitoring system and network security and availability
  - i. Repairing workstations, desktops and printers on an emergency basis
  - j. Data backup, archive, and retrieval

In addition to any other requirements of this contract, all individuals who perform tasks as a system administrator or have authority to perform tasks normally performed by system administrator shall be required to demonstrate knowledge appropriate to those tasks. This demonstration, referred to as the NASA System Administrator Security Certification, is a NASA funded two-tier assessment to verify that system administrators are able to –

1. Demonstrate knowledge in system administration for the operating systems for which they have responsibility.
2. Demonstrate knowledge in the understanding and application of Network and Internet Security.

Certification is granted upon achieving a score above the certification level on both an Operating System test and the Network and Internet Security Test. The Certification earned under this process will be valid for three years. The criteria for this skills assessment has been established by the NASA Chief Information Officer. The objectives and procedures for this certification can be obtained by contacting the IT Security Awareness and Training Center at (216) 433-2063.

A system administrator is one who provides IT services, network services, files storage, web services, etc. to someone else other than themselves and takes or assumes the responsibility for the security and administrative controls of that service or machine. A lead system administrator has responsibility for information technology security (ITS) for multiple computers or network devices represented within a system; ensuring all devices assigned to them are kept in a secure configuration (patched/mitigated); and ensuring that all other system administrators under their lead understand and perform ITS duties. An individual that has full access or arbitrate rights on a system or machine that is only servicing themselves does not constitute a "system administrator" since they are only providing or accepting responsibility for their system. An individual that is only servicing themselves is not required to obtain a System Administrator Certification.

3. **Web Page Development and Maintenance Function** – The contractor shall provide web development services to help promote organizational capabilities, including:
  - a. Development, maintenance, and upgrade of web sites
  - b. Management of mission test facilities that require significant computer capabilities
  - c. Compliance to Agency and Center policy (GSFC Webmaster) such as 508 compliance and Post 9-11 accessibility compatibility
  - d. Defining with customer the look and feel of the web site, and reviewing web site requirements
  - e. Developing prototype web sites for maturing web based concepts
  - f. Providing maintenance services to keep web site up to date and compliant

#### **D. Software Systems Technology Services**

The Contractor shall provide technology services for the research and development of advanced software topics, including:

1. **Software Systems Technology Specific Tasks** – The Contractor shall provide services for research, design, development, implementation, test, and analysis of software systems technology, including:
  - a. Automation and artificial intelligence applications
  - b. Software engineering
  - c. Distributed processing
  - d. Internet applications
  - e. Flight software
  - f. Scientific data analysis
  - g. Visualization and virtual environments
  - h. Data processing, archival and distribution
  - i. Simulation and modeling
  - j. Human-computer interfaces
  - k. Middleware
  - l. Software standards
  - m. Software methodologies
  - n. Reuse

#### **E. Demonstration, Presentation and Conference Services**

The Contractor shall provide technology services for hardware and software demonstrations, technical/project/conference presentations, and conference planning/implementation for items within the scope of this Statement of Work, including:

1. **Demonstration Specific Tasks** – The Contractor shall provide hardware, software, support equipment, and technical services for onsite and offsite demonstrations.
2. **Presentation Specific Tasks** – The Contractor shall provide materials for inclusion in technical/project/conference presentations, including viewgraphs, information, photographs, etc. In addition, the Contractor shall perform the presentation.
3. **Conference Specific Tasks** – The Contractor shall assist the Government by providing services in the planning and implementation of conferences.

## **F. Systems Technology Services**

The Contractor shall provide services for the research and development of advanced technologies for end-to-end mission architectures, systems, subsystems, components, devices, and elements for spacecraft, balloons, UAV's, sounding rockets, instruments, and other platforms, including:

1. Technology Validation
2. Technology Infusion
3. Technology State-of-the-Art and Gap Analyses
4. Strategic Technology Planning and Roadmapping
5. Technology Study/Proposal Support
6. Technology Infrastructure/Facility Requirements Planning
7. Technology Special Studies, including the development and refinement of technology enabled missions
8. Technology Tracking, Documentation and Reporting
9. Technology Prototyping

The Contractor shall provide these services for the research and technology support for a broad range of systems technologies, including, but not limited to, the following:

1. Distributed Space System Concepts
2. Autonomous constellation operations and control systems
3. Modular spacecraft concepts
4. Reconfigurable Space Systems
5. Solar sails
6. Sparse aperture large space telescopes
7. Sensor webs and data driven sensing networks
8. Ultra Low Power Systems
9. Design for demise concepts
10. Satellite servicing



## **FUNCTION 5 – DOCUMENTATION SERVICES**

The Contractor shall provide documentation services for all levels of hardware and software within the scope of this Statement of Work, as specified in task assignments. Documents shall conform to applicable documents and specifications. These shall include pertinent NHBs, SMAP, and/or Program/Project specific performance assurance guidelines, quality standards, GSFC standards, documents of other NASA Centers, Federal standards, military standards, and commercial standards.

### **A. Document Services**

The Contractor shall provide documentation services, including instrument conceptual designs, program plans, systems analyses, illustrations, technical and implementation plans, test plans, test procedures, test scripts, software documentation, and the full range of system hardware and software documentation. These shall also include up-to-date drawings, specifications, certifications, reports, interface control documents, and agreements.

1. **Document Services Specific Tasks** – The Contractor shall provide electronic media and document services, including:
  - a. Technical writing
  - b. Editing
  - c. Drafting
  - d. CAD/CAM
  - e. Photographic
  - f. Video
  - g. Reproduction
  - h. CD, DVD
  - i. Posters and Displays
  
2. **Photo and Video Specific Tasks** – The Contractor shall use photos and video for maintenance, engineering, or as documentation to explain a problem. They shall become supplemental to assist in unit repair or future development and maintenance. A scale shall be included to indicate relative dimensions in photographs and/or video, where appropriate.

## **FUNCTION 6 – MAINTENANCE SERVICES**

The Contractor shall provide maintenance support to ensure long term reliability through an integrated and efficient approach, including:

### **A. Preventive Maintenance**

The Contractor shall perform preventative maintenance on hardware and software within the scope of this Statement of Work as specified in task assignments.

### **B. Emergency Repair Services**

The Contractor shall provide expeditious emergency repair services for hardware and software within the scope of this Statement of Work, as specified in task assignments. The Contractor shall respond to the Government within four hours of notification to determine and implement a mutually agreeable course of action. In some cases, there shall be 24-hour coverage during flight hardware and software evaluation, verification, and test. This service shall comprise of repair, modification, or replacement of components, codes, subassemblies, and assemblies. Documentation updates shall be required as a result of any change.

## **FUNCTION 7 – SUSTAINING ENGINEERING SERVICES**

The Contractor shall provide sustaining engineering services for hardware and software within the scope of this Statement of Work, including:

1. Modifications of hardware/firmware and software, including installation of elements for improved reliability and/or performance
2. Modifications of wiring to improve circuit performance
3. Non-flight and flight fabrication, assembly, wiring, and testing of printed circuit assemblies where necessary to update old circuitry or improve reliability
4. Engineering, non-flight and flight fabrication, testing of assemblies or sub-assemblies to replace outdated circuitry to eliminate component or circuit failures
5. Engineering, non-flight fabrication, assembly, and testing of engineering circuits to correct problems encountered
6. Modifications of mechanical assemblies, structures, and mechanisms to correct or improve the design
7. Update of drawings, manuals, and technical data to reflect current status at the time of modifications
8. Firmware and software modifications in response to approved changes, including problem fixes.

## **FUNCTION 8 – EDUCATION SERVICES**

The Contractor shall provide education services, including:

1. Supporting the AETD Systems Engineering Education and Development (SEED) program
2. Supporting educational outreach programs with universities and NASA headquarters
3. Supporting MESAD, ISTD, EED division or branch-level educational programs and training

## **FUNCTION 9 – STANDARDS AND PROCESS**

The Contractor shall provide support for engineering standards work and engineering process work, including:

1. International Standard Organization (ISO) documentation and process generation
2. Engineering standards documentation and review
3. Engineering process documentation
4. Activities in support of engineering process improvement

These work shall include providing support for systems engineering capability assessment and improvement services such as tasking in support of the Systems Engineering Working Group (SEWG) and Systems Engineering process improvement activities.

## APPLICABLE DOCUMENTS AND SPECIFICATIONS

The contractor shall adhere to all applicable portions of the following documents and/or specifications in the performance of this contract. The latest updated version shall apply:

### General:

NPR 7120.5B, "NASA Program and Project Management Processes and Requirements"

### Launch Vehicles:

EWR 127-1, "Eastern and Western Range Safety Requirements"

NSTS 1700.7B, "Safety Policy and Requirements for Payloads Using the Space Transportation System"

2.45 SPW S-100/KHB 1700.7B, "Space Shuttle Payload Ground Safety Handbook"

### Conformal Coating and Staking:

NASA-STD-8739.1, "Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies"

### Soldering – Flight, Surface Mount Technology:

NASA-STD-8739.2, "Surface Mount Technology"

### Soldering – Flight, Manual (hand):

NASA-STD-8739.3, "Soldered Electrical Connections"

### Soldering – Ground Systems:

Association Connecting Electronics Industries (IPC)/Electronics Industry Alliance (EIA)  
J-STD-001C, "Requirements for Soldered Electrical and Electronic Assemblies"

### Electronic Assemblies – Ground Systems:

IPC-A-610, "Acceptability of Electronic Assemblies"

### Crimping, Wiring, and Harnessing:

NASA-STD-8739.4, "Crimping, Interconnecting Cables, Harnesses, and Wiring"

### Fiber Optics:

NASA-STD-8739.5, "Fiber Optic Terminations, Cable Assemblies, and Installation"

### Electro-Static Discharge (ESD) Control:

ANSI/ESD S20.20, "Protection of Electrical and Electronic Parts, Assemblies and Equipment" (excluding electrically initiated explosive devices)

Printed Wiring Board (PWB) Design:

500-PG-8700.2.2, Electronics Design and Development Guidelines  
500-PG-8700.2.4, Mechanical Design and Development Guidelines,  
GSFC X-673-64-1F, "Engineering Drawing Standards Manual" (December 1994)  
IPC-2221, "Generic Standard on Printed Board Design"  
IPC-2222, "Sectional Design Standard for Rigid Organic Printed Boards"  
IPC-2223, "Sectional Design Standard for Flexible Printed Boards"  
IPC D-275 "Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies"

PWB Manufacture:

GSFC 311-INST-002, "Instructions for EEE Parts Selection, Screening, and Qualification"  
IPC A-600, "Acceptability of Printed Boards"  
IPC-6011, "Generic Performance Specification for Printed Boards"  
IPC-6012, "Qualification and Performance Specification for Rigid Printed Boards"  
Flight Applications – Supplemented with: GSFC/S312-P-003, Procurement Specification for Rigid Printed Boards for Space Applications and Other High Reliability Uses  
IPC-6013 "Qualification and Performance Specification for Flexible Printed Boards"  
IPC-6018 "Microwave End Product Board Inspection and Test"

IT System Administration

NASA PIC 04-03, "04-03 Procurement Information Circular"

**REFERENCE DOCUMENTS AND SPECIFICATIONS**

The following documents and/or specifications are provided as reference material for the performance of this contract. The latest updated version shall apply:

SP-6105, The NASA Systems Engineering Handbook, December 2007