

**Statement of Work (SOW)
Wallops Flight Facility
Engineering Services Contract**

1.0 Scope

- 1.1 Introduction - NASA Goddard Space Flight Center (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 system, 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 developments and from mission operations to data analysis. Within this program, NASA Wallops Flight Facility (WFF) enables low-cost aerospace-based science and technology research by enabling scientific research through the development and deployment of low-cost, highly capable suborbital and orbital research carriers; enabling aerospace technology advances supporting NASA's Mission Directorates through advanced technology development and testing; and enabling education, commercial development of Space and other innovative partnerships. To fulfill these responsibilities and achieve our mission, NASA must acquire a wide range of engineering services to support activities at the GSFC WFF. The purpose of this SOW is to convey the type and scope of the effort required.
- 1.2 Breadth of Support - The Contractor shall provide the labor, material/parts and equipment to support a wide range of engineering, education, outreach and technical support services for the WFF, in the following areas: Technology Development, Systems Engineering, Electrical Engineering, Software Engineering, Mechanical Engineering, Guidance/Navigation and Control Systems, Safety Engineering, Metrology, Project Management and Support, Facilities Engineering. Support shall be provided for WFF activities including Applied Engineering and Technology Directorate (AETD), Suborbital and Special Orbital Projects Directorate, Sciences and Exploration Directorate, Facilities Management Branch, and Ground Network activities.

2.0 General Requirements

2.1 Management and Administration

2.1.1 Personnel Administration and Management

The Contractor shall provide for the management and support of its personnel. This includes the necessary training, guidance, and supervision of qualified personnel to accomplish task orders. The Contractor is responsible for ensuring that all personnel maintain current and appropriate professional certifications for their position descriptions.

2.1.2 Contract Administration and Management

The Contractor shall establish processes and assign appropriate resources to effectively administer the contract. This includes timely and effective implementation of task assignments, management of scheduled deliveries, efficient cost management methods and timely and effective reporting to the Government to ensure that the Government is aware of task assignments status and progress achieved. Contract administration shall be conducted electronically via the Agency-provided Task Order Management System (TOMS) or a contractor-provided equivalent. The contractor shall provide training to all personnel, civil servant and contractor, involved in using the system.

2.1.3 Subcontract Management

The Contractor shall be responsible for any subcontract management necessary to perform work, and shall be responsible and accountable for subcontractor performance on each task order.

2.2 Quality Management

2.2.1 Quality Management System

The Contractor's quality system shall be compliant with ISO 9001 and AS9100. The Contractor shall follow the GSFC Quality Management System when providing on-site support using GSFC procedures. The most current versions of Government policies, directives, and standards shall be applicable, as required, to the work performed under the contract. Further quality requirements may be specified within a task order.

2.3.2 Configuration Management

The Contractor shall provide configuration management services throughout the life cycle of products provided within the scope of this Statement of Work and as specified within task orders.

2.3.3 Reviews

The Contractor shall conduct and support reviews of products and services provided consistent with the project supported and as specified within a task order. Reviews may include independent reviews, peer reviews, and system reviews such as concept reviews, requirements reviews, preliminary or critical design reviews, pre-environmental reviews, airworthiness reviews, mission readiness reviews, or range readiness reviews.

2.3 Education and Outreach- The Contractor shall support various events and activities related to education and outreach. The Contractor shall be responsible for the preparation of educational materials via written, electronic, web and audio-visual methods and formats that include, publications, posters, instruments, apparatus, items,

videos, software, hardware, CD ROM, laser discs and other technology based mediums.

- 2.4 Technology Development- The Contractor shall provide services for research and evaluation of new technologies and applications to AETD and related organizations at WFF. These services may include the design, development, implementation, test, and analysis of systems and subsystems.
- 2.5 Formulation Support - The Contractor shall support formulation activities by providing concept studies, feasibility studies, research/science/technology/cost trade studies, preliminary schedule and cost estimates, risk assessments, operations concepts, research and technology unique to system development studies and requirements definition.
- 2.6 Systems Engineering – The Contractor shall provide systems engineering support for all phases of project development for small satellites, sounding rockets, balloons and a broad range of technology development efforts. The Contractor shall provide support to: review, analyze, document, and control system interfaces, requirements, and configurations; conduct trade-studies and support the definition of systems; produce system technical budgets; present systems information at peer and design reviews; lead design teams; and identify and produce plans to control risk.
- 2.7 Electrical Systems - Electrical systems support shall be required for conception, analysis, design, development, integration, testing, and operations of communications and electrical systems applications. Support is integrated with that of appropriate mission designers and may require development of orbital or suborbital electrical and communication systems using current and advanced technology.
- 2.7.1 Electrical Systems Design and Analysis
The Contractor shall provide electrical design and analysis for spacecraft, scientific balloons, launch vehicles, instrument/science research systems, aircraft, ground network systems, and ground support equipment systems. The Contractor shall provide support for the following areas:
- Flight electronics: The Contractor shall provide design and analysis for flight data systems and related components.
 - Component Technologies and radiation effects: The Contractor shall provide expertise to determine environmental effects on Electrical, Electronic, and Electromechanical (EEE) components and systems. The Contractor shall support designers in the selection, application, and testing of EEE components.
 - Flight power systems: The Contractor shall provide design and analysis of systems required for energy storage, distribution, management, and conditioning.
 - Instrumentation systems: The Contractor shall provide design and analysis of systems supporting fixed and mobile range control centers, range safety data processing, real-time telemetry data and control

functions, instrumentation power systems, radar, timing, radio communications, and command/destroy systems.

- Ground systems: The Contractor shall provide design and analysis support for ground systems required for test and operations of flight systems. These systems include those required for ground network technology development as well as various electrical ground support equipment, such as flight system simulators, power support simulators, data and RF simulation equipment, and umbilical consoles.
- Microwave systems: The Contractor shall provide design and analysis support for RF, microwave, millimeter wave and higher frequency components and systems for communications and instrument applications. These systems support telemetry, command, and tracking of launch and flight operations, and include antennas, antenna systems, receivers, transmitters, and other RF systems.

2.7.2 Electrical Systems Integration and Test

The Contractor shall perform integration and testing of electrical systems, including complete functional and environmental testing and verification. This testing shall be performed at all levels of assembly, and may include thermal-vacuum, vibration, magnetic, and EMI/EMC testing.

2.7.3 Electrical Systems Manufacturing

The Contractor shall provide manufacturing and assembly of electrical systems including breadboards, engineering models, protoflight, flight, ground support, and wiring and fiber optic harnesses.

2.7.4 Electrical Systems Operations

The Contractor shall provide checkout and short-term deployment operations support for flight and ground systems listed above.

- 2.8 Software Systems - Software engineering support shall be required in the areas of conception, analysis, design, development, rapid prototyping, integration, testing, documentation, user support, and administration of a wide variety of software systems and applications. Support is integrated with that of appropriate mission planners and may require the deployment of flight systems, ground systems, engineering tools, institutional, administrative, or enterprise tools using current or advanced technologies. Development environments vary from handheld systems to high-end platforms using a variety of desktop, workstation, or embedded/real time operating systems, including but not limited to Windows XP, Server 2003, UNIX, Linux Red Hat, Apache and MAC OS 10. Development tools and languages are, likewise, selected based on applicability to missions or requirements. The Contractor shall provide supporting functions such as configuration management, certified system administration, and other functions associated with development activities are likewise included.

2.8.1 Software Systems Conceptualization, Design, Development, and Analysis

The Contractor shall provide software support for spacecraft, balloons, launch vehicles, ground systems, aircraft, engineering analysis systems, institutional, administrative, enterprise systems, and outreach systems.

Support shall be provided in the following areas and sub-disciplines:

- Software and Data Systems Engineering: The Contractor shall provide technical consultation on data systems-related operational concepts, architectures, and life-cycle costs. The Contractor shall also provide consultation and implementation of software process improvements and applicable standards.
- Flight Software: The Contractor shall provide end-to-end life cycle products and services associated with embedded software for spacecraft, scientific instruments, control systems, and flight components.
- Mission Applications Systems: The Contractor shall provide end-to-end life cycle products and services associated with the support of real-time and non-real time systems supporting Exploration Systems, Space Operations, Science, and Aeronautics Research missions. The Contractor shall develop mission and science planning and scheduling tools, guidance navigation and control software and related systems.
- Flight Data and Ground Data Systems: The Contractor shall provide end-to-end life cycle products and services associated with the support of flight data and ground data systems used for integration, test, and operation of orbital and sub-orbital missions.
- Computing Environment Tools and Applications: The Contractor shall provide end-to-end life cycle products and services associated with the support of institutional, administrative, enterprise and outreach tools including advanced web applications, databases, and engineering and administrative toolsets.
- Data Management and Analysis: The Contractor shall provide end-to-end life cycle products and services associated with the support of science data algorithm development, processing, archival, distribution, display, visualization, and analysis.
- Advanced Architectures and Systems: The Contractor shall provide end-to-end life cycle products and services associated with the exploration, evaluation, and development of state of the art software tools and technologies. The Contractor will at times work in partnership with NASA, other government, academic, and industry personnel to solve high risk information systems technology challenges.
- Modeling and Simulation: The Contractor shall provide end-to-end life cycle products and services associated with three dimensional modeling and simulation of launch and range vehicle trajectories and range support assets.

2.8.2 Products

The Contractor shall create products resulting from Software Development activities that are activity-dependent and may include, but are not limited to: feasibility analyses, requirements analyses, preliminary designs, critical designs, flowcharts, object diagrams, pseudo-code, source code, test plans, user documentation, architecture descriptions, Interface Control Documents (ICD's), training materials, cost analyses, trade studies, prototype systems, web sites, presentations, white papers, quality assurance procedures, development metrics, and development tools.

2.8.3 Certifications

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 the skills assessment has been established by the NASA Chief Information Officer.

A system administrator is defined as a person 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.

- 2.9 Mechanical Systems Engineering – Mechanical systems support shall be required for conception, analysis, design, fabrication, integration, testing, deployment, maintenance, and certification of mechanical and payload carrier systems, mechanisms, electro-mechanical systems and related ground support and test

equipment. The Contractor shall develop appropriate Interface Control Documents (ICD's), Specification Documents, Verification Test Plans, and Work Order Authorizations as required. The Contractor shall prepare presentations and present at various Preliminary Design Reviews, Critical Design Reviews and Technical Peer Reviews.

2.9.1 Mechanical and Structural Design and Analysis

The Contractor shall perform mechanical design studies, and provide designs and drawings of spacecraft, carriers, aircraft instruments, balloons, science instruments, and mechanical ground support equipment (including launchers and instrumentation trailers).

The Contractor shall perform stress and margin of safety analyses of hardware structures, mechanisms, electromechanical devices, composite structures and balloon envelope structures. Classical, finite element, and kinematic analyses shall be required. The Contractor shall also perform selected random vibration, frequency response, vibro-acoustic, and aerodynamic analyses to simulate test and flight related events and environments. The Contractor shall provide Finite Element Models of mechanical structures.

The Contractor shall produce detailed design, assembly, installation, layout and fabrication drawings (two and three-dimensional as required) of mechanical hardware in Computer Aided Design (CAD) format, fully compatible with the current releases of Pro-Engineer, AutoCAD/Mechanical Desktop/Inventor, and I-DEAS.

2.9.2 Thermal Engineering

The Contractor shall perform thermal analysis and design for spacecraft, carriers, balloon vehicles, balloon payloads, and instruments using manual methods and current release of Thermal Desktop software. The Contractor shall develop analytical models representing conductive, radiative, and convective heat transfer; determine heat fluxes, temperature distributions, and gradients for hardware components; develop plans and procedures to support thermal environmental testing and model validation testing; provide specifications for thermal subsystem components and coatings; and provide contamination engineering support to determine contamination requirements, develop contamination control plans, analyze and test to verify compliance.

2.9.3 Materials Engineering

The Contractor shall provide materials engineering and analysis to support characterization of composites, metals, and balloon and other thin films. The Contractor shall fabricate test articles and experimental films, and shall develop and perform various tests such as tensile, creep, brittleness, pressure, ultraviolet and permeability tests. The Contractor shall provide

analysis of test data, reliability and quality assurance, and technical documentation support.

The Contractor shall also provide materials engineering to support selection of materials and lubricants used in flight and ground systems.

2.9.4 Manufacturing

The Contractor shall provide flight and non-flight hardware fabrication and assembly of structures, components, mechanisms, and thermal systems for spacecraft, carriers, balloon, aircraft interface, and mechanical ground support equipment (including launcher systems).

2.9.5 Integration and Test

The Contractor shall perform integration and testing of mechanical systems at various levels of assembly, including complete functional and environmental testing and verification. This testing may include functional tests, mass properties, fit checks, alignments, deployment tests, vibration tests, modal surveys, acoustic tests, load tests, or thermal-vacuum/thermal-balance tests.

The Contractor shall support integration and testing of mechanical systems at various launch sites.

The Contractor shall support the operations and maintenance of general environmental test facilities, such as thermal-vacuum test facilities.

2.9.6 Launcher and Launch Vehicle Systems

The Contractor shall support operations, maintenance, testing, and certification of rocket launcher systems, ground handling equipment, and firing circuit consoles. The Contractor shall support launch pad and launch vehicle assembly and launch operations, and logistics.

2.10 Guidance, Navigation, and Control Systems (GN&C)

2.10.1 GN&C System Development

The Contractor shall provide support for conception, analysis, design, fabrication, integration, testing, and operations of GN&C systems including: attitude/trajectory determination and control systems for space vehicles (flight and ground), balloons, and aircraft; guidance systems for launch vehicles; flight propulsion systems; components, sensors and actuators; and, GN&C technology demonstration products in the areas of autonomous systems, components, and attitude systems.

2.10.2 GN&C Analysis

The Contractor shall develop GN&C algorithms and perform associated analysis including: attitude control, attitude determination and orbital

dynamics studies; rocket trajectory and performance analysis, including six degree of freedom and flexible body dynamics; high speed and low speed aerodynamics analysis; thermodynamics and trajectory analysis as it relates to performance and design of lighter-than-air flight vehicles with application to terrestrial and planetary flight scenarios; and, Global Positioning System applications for navigation, differential navigation, and attitude determination.

- 2.11 Safety Engineering– The Contractor shall provide safety engineering and analyses in support of efforts assigned to the Applied Engineering and Technology Directorate or unique WFF projects. Tasks may include engineering design, development, testing, or assessments of ground or flight safety systems and missions; certification support of range systems; and certification support of vehicle flight termination systems.
- 2.12 Metrology –The Contractor shall provide analytical, mechanical and electronic support in the installation, maintenance, repair, overhaul, troubleshooting, calibration, modification, construction, cleaning, and testing of inspection, measurement and test equipment. The Contractor shall manage calibration laboratory equipment and standards, and institute configuration management of manuals, standards and forms. The Contractor shall enter information into the Met/Track Database to document actions taken on equipment as prescribed by GPR 8730.1, Calibration and Metrology and 500-PG-8730.1.1, Calibration and Metrology Process at Wallops Flight Facility. The contractor shall follow calibration standards set forth by NPD 8730.1 Metrology and Calibration.
- 2.13 Facilities Engineering Support –The Contractor shall provide inspection services to the Facilities Management Branch of WFF, and assistance on maintenance and operational issues. Specifically, the Contractor shall: participate in the development and monitoring of major facilities projects from conception through final acceptance; perform field inspection of construction, repair and modification projects; providing support on O&M issues; and escorting Contractors, suppliers and vendors due to increased security requirements. Provide facility assessment services for facility conditions, recording collateral equipment and Report of Conditions, to include verification of floor plans and dimensions.
- 2.14 Electronic and Information Technology (EIT) Section 508 Compliance - In order to comply with the Section 508 Electronic and Information Technology Accessibility Standards, the contractor shall perform all work required under this contract in compliance with the following technical standards delineated in Code of Federal Regulations (CFR) Title 36:
- 1194.21 Software Applications and Operating Systems
 - 1194.22 Web-based Intranet and Internet Information and Applications
 - 1194.25 Self Contained, Closed Products

1194.26 Desktop and Portable Computers

3.0 Quality Assurance Plan – The contractor shall provide a written Quality Assurance Plan (QAP) addressing the approach for quality services throughout the duration of the contract. This plan shall identify the procedures for continuous monitoring, surveillance and identification/correction of deficiencies. Additionally, the QAP shall identify the Contractors methodologies for ensuring performance requirements are met throughout the duration of the contract and shall identify measurements for quality of services provided. The QAP shall address the following quality standard areas:

- Contractor’s Quality Management System for this effort
- Contractor’s methodology for ISO 9001 compliance
- Procedures for utilization of the quality system
- Methodologies for continuous improvement and process performance measures
- Capability Maturity Model Integration compliance (CMMI)
- Description and procedures for other corporate process initiatives applicable

4.0 ACRONYM LIST

AS	Aerospace Standard
CAD	Computer-Aided Design
EEE	Electrical, Electronic, and Electromechanical
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GN&C	Guidance, Navigation and Control
GPR	Goddard Procedural Requirements
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
ISO	International Organization for Standardization
NASA	National Aeronautics and Space Administration
NPR	NASA Procedural Requirements
OSH	Occupational Safety & Health
PG	Procedures and Guidelines
RF	Radio Frequency
SOW	Statement of Work
TOMS	Task Order Management System
WFF	Wallops Flight Facility

5.0 Applicable Documents

The most current version of the following Government policies, directives, and standards shall be applicable, as required, to the work performed under the contract. Others may be applicable based on the Contractor’s approach to meet the contract requirements. Further quality requirements may be specified within a task order. Documents can be found at NASA’s

Technical Standards Program (<https://standards.nasa.gov>); NASA's Online Directives Information System (NODIS) (<http://nodis3.gsfc.nasa.gov>); the Goddard - Directives Management System (GDMS) (<http://gdms.gsfc.nasa.gov>). The latest updated version shall apply. This attachment includes all policies, directives, and standards referenced in the SOW for a comprehensive reference.

500-PG-8715, "AETD Safety Manual"
AS9100C, "Quality Management System Standard"
NASA-STD-8719.13, NASA Software Safety Standards
NPR 7150.2, NASA Software Engineering Requirements
ISO 9001, "Quality Management"
NASA-STD-8739.1, "Workmanship Standard for Polymeric Application on Electronic Assemblies"
NASA-STD-8739.2, "Workmanship Standard for Surface Mount Technology"
NASA-STD-8739.3, "Soldered Electrical Connections"
NASA-STD-8739.4, "Crimping, Interconnecting Cables, Harnesses, and Wiring"
NASA-STD-8739.5 "Fiber Optic Terminations, Cable Assemblies, and Installation"
GPR 8730.6, Electrostatic Discharge (ESD) Control
GSFC X-673-64-1F, "Engineering Drawing Standards Manual" (December 1994)
500-PG-8700.2.5 GSFC "Engineering Drawing Standards"
541-PG-8072.1.2A "GSFC Fastener Integrity Requirement"
NPD 8730.1 "Metrology and Calibrations"
GPR 8730.1, "Calibration and Metrology"
500-PG-8730.1.1, "Calibration and Metrology Process at Wallops Flight Facility"
GPR 8730.7 A- "Laboratory Management Program"

6.0 Reference Documents

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

RSM-2002, "Wallops Range Safety Manual dated June 14, 2008"
NPR 7120.5 "NASA Program and Project Management"
500-PG-8700.2.2, "Electronics Design and Development Guidelines"
500-PG-8700.2.4, "Mechanical Design and Development Guidelines"
NASA SP-2007-6105 Rev1, "The NASA Systems Engineering Handbook"
GSFC-STD-7000 "General Environmental Verification Standard (GEVS)"
GPR 7123.1 "Systems Engineering"