

SECTION C – STATEMENT OF WORK

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## **Statement of Work (SOW) Structure**

The Statement of Work includes a Management and Administrative Requirements section, (Section 1.0), which includes activities that are fairly constant, predictable, and provide the framework under which the ordered work may occur; and an Ordered Products section (Section 2.0) that provides for the ordering and delivery of products and services. Task orders (TOs) under Section 2.0 can be either completion form or level of effort (LOE). Multiple task orders will be in effect during the performance period of the contract. Technical and performance requirements will be specified in the task orders.

The structure of the SOW should not be construed as defining a required organizational configuration. The types of work and services described herein may more aptly be distributed over multiple organizations whose purpose is to provide the products and services required by the Engineering and Astromaterials Research and Exploration Science (ARES) Directorates and their customers.

### **1.0 Management and Administration Requirements**

#### **1.1 Management**

##### **1.1.1 Contract Management**

The contractor shall develop and implement management functions to ensure that all work activities are accomplished in accordance with contract provisions. The contractor shall provide and maintain management systems for the planning, organization, control, and reporting of all activities required by this contract. These systems shall assure accomplishment of technical and schedule requirements and cost objectives. The contractor shall document these management functions and systems in the Contract Management Plan, in accordance with Data Requirement Description (DRD) MGMT-01 which defines and integrates all work activities and requirements across the contract, including subcontractor effort. The contractor's management approach shall fully integrate all related plans and activities, including those of subcontractors and major vendors.

The contractor shall provide and maintain a Contract Work Breakdown Structure (WBS) in accordance with DRD MGMT-02, Work Breakdown Structure and Dictionary. The contractor shall use the Contract WBS as the framework for contract planning, budgeting, cost reporting, and schedule status reporting to the Government.

The contractor shall provide reporting in accordance with DRD MGMT-03. The contractor shall conduct monthly Contract Management Reviews (CMRs) with NASA management to status the contractor's financial and technical activities under the contract per DRD MGMT-03.

The contractor shall develop and implement a plan to continuously identify and propose initiatives to infuse advanced technology, innovations, and industry best practices, that promote improvements in quality, capability, and overall efficiency within all areas of responsibility defined in this Statement of Work (SOW) per DRD MGMT-11, Technology, Innovations, and Process Improvement Plan and Report (TIPI) Plan. The contractor shall report potential initiatives per DRD MGMT-03, Management Report. The initiatives will be implemented through task orders under Section 2.

The Contractor shall develop and implement an External Customer Plan in accordance with DRD MGMT-10 and clause H.16, EXTERNAL CUSTOMER EFFORT, to recruit and secure external customers. The intent of the plan is to allow the contractor to market and use the Engineering and Astromaterials Research and Exploration Science (ARES) Directorate unique facilities (and other facilities as directed), contractor personnel, limited NASA personnel, and equipment for the purposes of retaining skills and offsetting the government's cost of maintaining and improving technical capabilities without compromising safety, process integrity or infrastructure resources. The contractor shall identify potential external customers or external customer initiatives per Management Report DRD MGMT-03.

The contractor shall develop and implement an Organizational Conflict of Interest (OCI) Mitigation Plan in accordance with DRD MGMT-12.

### **1.1.2 Financial Management**

The contractor shall provide financial reporting by cost element and include subcontractor financial data. The contractor shall provide financial and supplemental reporting in accordance with the DRD BP-01, NF533 Cost and Data Reporting.

The contractor shall develop and upon the Contracting Officer's approval, implement a method of tracking and applying all costs associated with the SOW Section 1. These costs shall be appropriately allocated to each task order issued under Section 2.

### **1.1.3 Property Management**

The contractor shall provide, and implement, a Government Property Management Plan in accordance with DRD BP-09. The contractor shall provide Logistics Reporting in compliance with DRD BP-07. Initial Property accountability to be transferred to the Contractor is given in Appendix J-4 Government Furnished Property (off-site).

### **1.1.4 Data Management**

The contractor shall develop and implement a Data Management Plan in accordance with DRD BP-02. This plan shall describe the management, preparation, control, and dissemination of data required under this contract. This plan shall define an integrated approach for data management

including management of documentation. The data management plan shall include provisions for electronic on-line access to contractor management systems including, access and interface requirements. The contractor shall provide the Government with required training to access and use these systems.

The contractor shall maintain, operate, and secure data and software systems which provide for the management, collection, preparation, publication, control and dissemination of information and technical data required by this contract. Proprietary or non-standard applications, protocols, or Information Technology (IT) systems shall not be utilized without prior NASA contractual authorization.

The contractor shall develop and implement uniform IT management and operational approaches for all IT associated with this contract. The contractor shall develop and implement an IT capital planning and investment control process in accordance with DRD IT-01, Information Technology Capital Planning and Investment Control (CPIC) Document and an IT Security Plan in accordance with DRD IT-02. IT management and Security shall extend to all corporate (non-government provided) IT areas. It will not cover NASA provided workstations, facility equipment, software, networks, or IT Data.

### **1.1.5 Procurement**

The contractor shall procure supplies, services and materials required in the performance of the SOW. Purchases under this contract may include a wide range of components, assemblies and commercial items. Purchases authorized by Task Order (Section 2) should be charged to that Task Order.

For all flight materials and products and as directed by task order, the contractor shall maintain identification data throughout the life of this contract including: material/product receipt, all stages of production, delivery, and installation.

The contractor shall perform off-site shipping and receiving functions for the JETS including receiving and stocking of materials, mechanical and electronic parts, and inspection and receiving of finished products.

## **1.2 Institutional Compliances**

### **1.2.1 Safety and Health**

The contractor shall comply with JPR 1700.1, "JSC Safety and Health Handbook" for work done on-site at the JSC. The contractor shall develop and implement a Safety and Health Plan in accordance with DRD SMA-03; conduct a Safety and Health Program Self Evaluation in accordance with DRD SMA-04; and provide a Lessons Learned Program Plan and Lessons Learned in accordance with DRD SMA-05.

The contractor shall support compliance with the JSC Voluntary Protection Program (VPP) STAR certification through VPP audits and other activities.

### **1.2.2 Environmental**

The contractor shall conduct all on-site work in compliance with JSC's Environmental Management System (EMS) in accordance with JPR 8550.1, Johnson Space Center Environmental Compliance Procedural Requirements.

### **1.2.3 Quality Management**

JSC has SAE AS9100 registration and intends to maintain it. The contractor shall perform all work on-site in accordance with the JSC Quality Management System and shall ensure work involving this contract performed off-site is in accordance with SAE AS9100. The Contractor shall develop and implement a Quality Plan in accordance with DRD SMA-01 for work conducted off-site. On-site quality assurance functions, responsibilities, and tasks will be specified, if required, per Task Order.

The contractor shall register with and be a participative member of the Government-Industry Data Exchange Program (GIDEP). The contractor shall respond to all GIDEP notifications and NASA Advisories issued from the JSC NASA-Advisory/GIDEP Documents Status Tracking System in accordance with DRD SMA-07.

The contractor shall report and resolve problems involving spaceflight equipment, spaceflight-like equipment and critical Ground Support Equipment in accordance with DRD SMA-06 Problem Reporting and Corrective Action (PRACA) for the JSC Government Furnished Equipment (GFE) and Flight Products.

The contractor shall comply with the requirements in Attachment J-24, Quality Requirements.

### **1.2.4 Configuration Management**

The contractor shall develop and implement a Flight Products Configuration Management (CM) Plan in accordance with DRD BP-03. The plan shall define processes for CM of hardware, software and firmware, engineering drawings, hardware parts lists, as-designed vs. as-built vs. as-qualified hardware, configuration accounting, and maintenance. The plan shall define processes for documentation and tracking of shelf life, operational life, and time cycle life, for life limited components and assemblies. The contractor shall prepare and coordinate appropriate configuration control board directives, waivers, deviations, exceptions, and maintain accurate, complete, and current CM data.

The following requirements are applicable:

- A. Hardware and software shall be designated per the definitions provided in JPR 1281.8, Product Identification and Traceability.
- B. Class I, Class II and Ground Support Equipment (GSE) design shall be documented in released drawings or electronic files.
- C. The drawing release/review process shall comply with JPR 8500.4.
- D. Class I, Class II and GSE hardware and software as built configuration shall match a released configuration.
- E. The plan shall address hardware and software configuration control processes defined in Section 9.0 of EA-WI-027.
- F. The CM plan shall address all of the requirements of the applicable documents in Section 5.0 of EA-WI-027.

## **2.0 Ordered Products**

### **2.1 Product Safety and Mission Assurance**

The contractor shall perform tasks associated with product design, development, test, and operations including: hazard analyses, risk assessments, system safety planning, reliability and maintainability predictions, Failure Modes and Effects Analysis (FMEA), and development of Critical Item Lists (CIL), life-cycle (wear-out) estimates for maintainable items, Limited Life Items identification, and qualitative maintainability assessment.

The contractor shall provide documentation including: hazard analysis reports, risk assessment reports, FMEA worksheets, Critical Items Lists, limited life item lists, certification data packages, and acceptance data packages. The contractor shall comply with the appropriate DRD based upon the Program/Project supported.

### **2.2 Hardware and Software**

Deliverable end items may include: hardware and software, support equipment, prototypes, electronic and computer and camera systems, mockups, test articles, training hardware, laboratory test equipment, and research instruments. The government may require support for Government developed flight hardware, or may ask for turnkey delivery of flight equipment, or anything in between. The requirements will be specified in a TO.

The types of activities requested may include, but are not limited to:

- Advanced studies
- Analysis and trade studies
- Concept definition

- Systems Engineering and Integration
- Mission architecture definition, design, and planning
- Engineering Design and Development
- Manufacturing, testing, verification, and certification
- Sustaining engineering activities [hardware resupply, refurbishment, mission hardware support activities, failure analysis, repair, operating procedures]
- Flight Hardware Requirements Survey, Assessment, and Consolidation
- Engineering, Quality, and Safety Analyses

Types of Data and Design Documentation required may include but is not limited to:

- Design review documentation
- Safety review documentation
- Test, verification, and certification data
- Management Documentation
- Analysis Data Products

The work processes and procedures used to satisfactorily complete GFE and flight products are documented and located in the JETS Technical Library and specified on each task order.

### **2.2.1 Hardware and Software Products**

The contractor shall perform tasks associated with product development including: design, fabrication, test, maintenance, repair, hardware and software integration, pre and post use processing, procedure development, and procedures for operational use for system and subsystem components for NASA program products.

The contractor shall provide documentation including: engineering drawings, analysis reports, technical specifications and reports, test procedures and reports, and operations manuals as appropriate for hardware or software type.

### **2.2.2 Flight Hardware and Software Certification**

The contractor shall certify flight hardware and software. The contractor shall perform tasks including: analyses, certification test plan development, certification, verification, and acceptance testing of hardware and software components, subsystems and systems.

### **2.2.3 Hardware and Software Testing**

The contractor shall perform or support testing, including the development and execution of plans and procedures, and the generation and analysis of data, and reports which document the performance of the product under test.

Testing is used in all phases of product development, i.e. design, development, evaluation, certification/qualification, and life determination. Testing is applied to materials, components,

sub assemblies, and complete assemblies. Testing often involves the modification of test systems and parameters to produce the environment required by the requester to meet particular objectives and margin demonstrations. Validation of test system readiness, including pre-test reviews is often required.

Types of testing include but are not limited to:

- Thermal
- Vacuum and Thermal Vacuum
- Shock and Vibration
- Acoustics
- Oxygen Acceptance and initial wetting
- Electromagnetic Interference/Electromagnetic Compatibility
- Ionizing Radiation
- Vacuum Ultraviolet Light
- Atomic Oxygen
- Static/Dynamic Loads
- Contrast Ratio, Bi-directional Reflectance Distribution Function (BDRF)
- Function Performance
- Life Demonstration
- Software Verification and Validation
- Destructive Analysis and Lot Acceptance
- Failure Detection, Isolation, and Recovery
- Energy storage and conversion
- Power Distribution
- Failure modes
- Toxicity Screening by analytical means
- Off-gassing
- Wet Chemistry
- Metallurgy

#### **2.2.4 Training**

The contractor shall develop and maintain training capabilities, materials, and systems and provide training to users, including astronauts.

#### **2.2.5 Database Development**

The contractor shall design, develop, test, implement, acquire, and document databases required to support data requirements. Technical databases include: real-time data acquisition, data archival, data analysis, requirements development, design criteria data, flight parameters data, and hardware lists.

### **2.2.6 Website Development**

The contractor shall design, develop, modify, test and install Websites. The contractor shall provide configuration documentation and training on new and modified websites.

## **2.3 Analysis and Assessment**

### **2.3.1 Engineering Analysis and Assessments**

The contractor shall provide assessments which include: space flight materials usage, metallographic, fracture control, structural integrity, loads model verification, avionics systems integrity, electrical systems integrity, hardware and software integration, hardware and software requirements, change requests, specifications, and test plans, test procedures, results and analyses, crew procedures, flight rules and flight techniques, critical technologies, data and products to support software independent verification and validation, and safety products for hardware and software.

### **2.3.2 Analytical Capability**

The contractor shall develop and implement analytical tools, and math models; and modify existing analytical tools, and math models to support evolving engineering and science analysis requirements. The contractor shall validate the math model implementations and tool configurations using data from bench tests, ground tests, flight tests, and/or crosschecks with other equivalent independently configured tools. The contractor shall develop computational capabilities, and modify existing computational capabilities necessary to support the generation of the engineering and science analysis products. The contractor shall develop documentation on the definition, configuration, and verification of the analytical math models. The contractor shall also develop documentation on the configuration and verification of the NASA unique and commercial off the shelf software tools. The contractor shall provide training on how to use the NASA unique software tools to perform the associated engineering and science analyses.

### **2.3.3 Analytical Products**

The contractor shall provide analytical products associated with engineering and science requirements. Products shall include analytical math models, and results including data, databases, algorithms, and interpretation of results.

This section includes but is not limited to analytical products associated with engineering and science requirements such as: aerodynamics and aerothermodynamics; communications and tracking; environmental control and life support; fracture mechanics and fracture analysis; guidance, navigation, and control; imagery; meteoroid and orbital debris; space environments and contamination; structural loads and stress; autonomous flight management; contact

dynamics; electronics; fluid dynamics; intelligent systems; kinematics including robotics; mass properties; power management and distribution; propellant management; rendezvous, proximity operations, and capture; structural dynamics and vibration; electromagnetic effects; thermal management; and spacecraft shielding designs.

#### **2.3.4 Mission Services**

The contractor shall perform technical, administrative, and documentation duties for continuous operation of Space Vehicle missions including: preparation before flight, pre-flight timeline reviews, real-time console support, and follow-up after each flight and expedition.

#### **2.3.5 Technical Services for Reviews, Boards, and Panels**

The contractor shall coordinate technical meetings, prepare system documentation, provide mission related products, and provide technical and administrative support to program reviews, design reviews, control boards, panels, and similar efforts.

### **2.4 Facilities**

#### **2.4.1 Facility Operations & Maintenance**

The contractor shall perform facility maintenance and operations. The contractor shall operate, administer, and maintain computational, analytical, data and control systems and Government owned networks in support of facilities.

Tasks may include but are not limited to: integration of requirements; verification of operational readiness; test buildup, preparation of hardware and software interface equipment, instrumentation, and control systems; new procedure and process development; maintenance of facility work instructions, databases and websites; identification and control of hazards, conduct of operations in hazardous environments which include human rated test operations, use of robotics, vibration and acoustic, and electromagnetic, structural testing, extreme temperatures, gaseous and liquid oxygen, gaseous hydrogen, methane, carbon monoxide, carbon dioxide, nitrogen, cryogenics, high pressure gas systems and toxic materials, such as anhydrous ammonia; and mitigation of hazardous conditions.

Tasks may also include but are not limited to: operating, administering and maintaining the computational, analytical, data and control systems and Government owned networks in support of facilities. This includes: mainframes; mini computers; servers; workstations (including laptops); software, and applications (including COTS and non-COTS); instrumentation; acquisition and control systems; and associated support equipment. Tasks may also include configuration management of facility documentation and systems, including pressure vessel compliance.

### **2.4.2 Facility Modifications**

The contractor shall evaluate, design, fabricate, install, and test facility equipment and systems. The contractor shall modify facility operational readiness status and verify readiness of facility equipment and systems.

### **2.4.3 Facility and Laboratory Oversight and Integration**

The contractor shall implement common processes and approaches across multiple facilities to enhance the efficiencies and capabilities of facilities.

## **2.5 Research and Development**

### **2.5.1 Engineering Research**

The contractor shall perform research and development in areas such as: dexterous robotics, vision and perception technologies, automated systems including rendezvous and mating systems, materials technology, thermal control systems (passive and active), life support systems, space suit systems, mechanical systems, Micro-electromechanical Systems (MEMS), Nanotechnology, Guidance and Navigation control systems, Entry, Decent, Landing, energy storage and conversion systems, propulsion systems, pyrotechnics, in-situ resource utilization systems, propellant liquefaction and storage systems, on-orbit manufacturing systems, electromagnetic systems, sensor systems, tracking systems, power transmission systems, avionics architecture systems, communication systems, microwave systems, instrumentation and wireless instrumentation, and artificial intelligence systems.

### **2.5.2 Astromaterials, Curation, and Sample Handling**

The contractor shall perform curation of samples including: Apollo Lunar samples, Antarctic meteorites, Genesis mission samples, Stardust mission samples, Hayabusa mission samples, cosmic dust collected at high altitude, and space exposed hardware. The contractor shall perform tasks which characterize and preserve collections in pristine condition, store them under controlled conditions, maintain security appropriate to the type of samples, distribute information about materials to the scientific and academic communities, prepare and distribute samples for allocation to approved investigators for scientific and educational purposes in accordance with allocation plans developed by NASA panels, document and inventory such samples, in accordance with approved procedures for each collection. The contractor shall perform research and development tasks in support of future sample return missions and mission proposals.

### **2.5.3 Planetary Exploration and Science Mission Development**

The contractor shall conduct planetary exploration development in analog science mission operations; robotic and human science and exploration mission operations; and science data system development, management and analysis. The contractor shall test and develop new approaches for conducting science and exploration operations, document lessons learned and apply them to the other planetary exploration development activities to build successful end-to-end missions or mission concepts.

### **2.5.4 Astromaterials Research**

The contractor shall conduct research in basic and applied space and planetary science in order to achieve science objectives, and for mission planning and operations. The contractor shall share their results through publications, conference presentations, education, and outreach activities. Contractor personnel shall participate as Principal Investigators or Co-Investigators on externally-funded research and mission proposals. Mission planning and operations includes instrument development and calibration, laboratory utilization, and applying “ground truth” derived from samples to remotely-sensed planetary datasets. The contractor shall follow approved sample handling procedures in accordance with each collection in order to preserve scientific integrity, security, and documentation requirements.

### **2.5.5 Earth Science**

The contractor shall facilitate broad use of Earth imagery from crewed platforms for science, education, outreach, and general public interests by performing real-time and on-call mission services. The services include: Crew Earth Observation (CEO) photography, other means of photographic and imagery collection for all crewed vehicles, ephemeris planning and operational resolution for Earth Science remote sensing payloads. The contractor shall operate the Earth Observation Laboratory and maintain desktop CEO operational software for conducting CEO operations. The contractor shall geolocate, interpret, catalog, maintain, and distribute returned imagery. The contractor shall train astronauts in Earth science and remote sensing mission objectives for Earth viewing missions.

### **2.5.6 Image Science and Analysis**

The contractor shall perform quantitative engineering image analyses and imagery integration for: problem solving, mission safety, vehicle design, vehicle maintenance, vehicle performance, and the Certification of Flight Readiness process. The contractor shall utilize the Image Science and Analysis Laboratory and other tools for NASA programs for problem solving, mission safety, vehicle maintenance, vehicle performance and the Certification of Flight Readiness Process. The contractor shall perform analyses on film (still and motion), video, and electronic imagery acquired from ground, airborne, ship-based and flight cameras. The contractor shall provide expertise in image analysis which includes static 2D and 3D measurements, high

resolution motion tracking, comprehensive imagery screening and camera calibrations. The contractor shall also provide expertise on imagery formats, visible imagery, IR imagery, high speed imagery, optics, resolving capability, imagery management, imagery integration, launch and landing imagery screening, vehicle inspection techniques and parachute imagery analysis. The contractor shall provide on-call support for vehicle anomaly investigations, and damage assessments. The contractor shall support planning forums, integration activity, and image accountability scheme development to ensure the acquisition of imagery suitable for assigned analysis tasks.

### **2.5.7 Orbital Debris**

The contractor shall perform research in the measurement and modeling of orbital debris. The contractor shall define the orbital debris environment and assess its risks. The contractor shall maintain and verify orbital debris environmental models, which include long-term prediction models for evaluating debris mitigation practices. The contractor shall provide spacecraft and reentry risk assessments for satellite breakups. The contractor shall develop debris mitigation techniques and practices to limit the generation of debris.

### **2.5.8 Hypervelocity Impact Technology and Risk Assessment**

The contractor shall assess short and long term risks from micrometeoroids and orbital debris (MMOD) and secondary ejecta to spacecraft and surface elements, including the International Space Station, extravehicular activity mobility units, lunar/asteroid landers, robots and other spacecraft. The contractor shall evaluate and develop MMOD risk reduction techniques to meet MMOD protection requirements. The contractor shall inspect returned spacecraft surfaces for MMOD damage, recover samples for analysis of residual projectile materials, and compare actual damage found in the ground-inspections or seen on-orbit to predicted damage. The contractor shall maintain and upgrade MMOD risk assessment software and shielding design tools.

### **2.6 Special Projects**

The contractor shall perform research, planning, designing, and execution of special projects in support of NASA objectives.

### **2.7 Education and Outreach**

The contractor shall plan and implement educational and outreach activities including special projects, curriculum development, demonstrations, displays, seminars, special events, conferences, and presentations. The contractor shall develop outreach materials including brochures, multi-media products, exhibit materials, and newsletters.

**SOW Appendix**

**Contractor Innovations and Corporate Capital Investments**

**(b) (4)**

**PURSUANT TO 5 USC 552**

**PAGES C16 through C24 ARE EXEMPT FROM RELEASE IN THEIR ENTIRETY**

**PER FOIA EXEMPTION (b)(4)**