ATTACHMENT J-1
STATEMENT OF WORK
For
SPECIAL EQUIPMENT DESIGN SUPPORT

1.0 Scope

The contractor, Teledyne Brown Engineering, shall support the design, analysis, and output (in the form of concepts, CAD and FEM models, stress packages, drawings, reports, etc.) of Special Test Equipment (STE), defined as any non-flight*, non-GSE*, or non-Facility** structure, hardware, or equipment intended to be used for testing or simulation, or associated with the manufacturing, process development, and preparation of MSFC facilities for testing or simulation. Designs include but are not limited to test stands, test beds, load reaction and application structures, load line components, flight hardware mockups and simulators, hardware support stands and dollies, personnel access stands, lifting and handling hardware, and tooling used to facilitate the fabrication and/or assembly of flight/non-flight hardware such as master drill templates or alignment/ clamping fixtures used during machining and welding processes.

* Flight hardware and Ground Support Equipment (GSE) is defined in MSFC ISO9000 document MPD 1280.1 (Marshall Management Manual).

** Facility hardware is defined in MSFC ISO9000 document MPR 8823.1 (Design Control of Facilities).

2.0 Task Order Management and Reporting

A. Contractor Management

The Contractor shall provide the planning, coordination, technical direction, and surveillance of the activities necessary to assure disciplined performance of work and timely application of resources for the accomplishment of all tasks issued under the order. The Contractor shall be responsible for maintaining communication with each supported organization and alerting the Contracting Specialist immediately of any problems that would prevent meeting established milestones.

B. Data Requirements Descriptions (DRDs)

The contractor shall report and document this work and fulfill the requirements of associated Data Requirement Descriptions (DRD's) as outlined in Data Procurement Document (DPD) 1227 (Attachment J-2). The contractor shall determine the data restriction that applies to each data deliverable and mark or transmit the data restriction in accordance with section 2.3.3 of the Data Procurement Document.

1. The Contractor shall submit a Monthly Status Report in accordance with DRD 1227MA-001. Any presentation, reports, analyses or technical memorandum that is developed

during the execution shall be pre-coordinated with the Task Order Monitor and final copies provided to the Task Order Monitor.

The Contractor shall provide NASA with necessary information on project progress to allow the Government to monitor product assurance, identify significant problems, and implement corrective action as applicable based on the Contractor's performance.

The Contractor shall develop and maintain a Work Breakdown Structure (WBS) defining all task elements contained in this Task Order and in accordance with established GSA rates per hours worked.

2. The Contractor shall submit a Badged Employee and Remote IT User Listing in accordance with DRD 1227MA-002.

3. The Contractor shall submit a Contractor Employee Clearance Document in accordance with DRD 1227MA-003.

4. The Contractor shall submit a Position Risk Designation for Non-NASA Employees in accordance with DRD 1227MA-004.

5. The contractor shall be responsible for information and information technology (IT) security when physical or electronic access to NASA's computer systems, networks, or IT infrastructure is required or when NASA information is stored, generated or exchanged with NASA or on behalf of NASA, regardless of where the information resides. The contractor shall prepare a Contract Information Technology Security Program Plan (CITSPP) that documents how the contractor will be responsible for information and IT security in accordance with DRD 1227CD-001.

6. The contractor shall establish and implement an industrial safety, occupational health, and environmental program that (1) prevent employee fatalities, (2) reduce the number of incidents, (3) reduce the severity of employee injuries and illnesses, and (4) protects the environment through the ongoing planning, implementation, integration and management control of these programs in accordance with DRD 1227SA-001. The SHE Plan shall address each of the following MSFC SHE core program requirements in detail that are applicable to the contracted effort:

   a. Management leadership and employee involvement.
   b. System and worksite analysis.
   c. Hazard prevention and control.
   d. Safety, health and environmental training.

7. The contractor shall report mishaps and safety statistics to the MSFC Industrial Safety Office in accordance with DRD 1227SA-002. The contractor shall submit direct to the NASA Incident Reporting Information System (IRIS) or shall use the forms listed in section 15.4 of DRD 1227SA-002 or electronic equivalent to report mishaps and related information required to produce the safety metrics.

3.0 Technical Requirements

The contractor shall be responsible for information and information technology (IT) security when physical or electronic access to NASA's computer systems, networks, or IT infrastructure is required or when NASA information is stored, processed, generated or exchanged with NASA or on behalf of NASA, regardless of where the information resides.

All data files and reports electronically delivered shall comply with Technical Standard 1194.21 of the Rehabilitation Act of 1973, Section 508.

Required inputs for these designs shall be developed as a collaborative effort with other members of the project team. It is assumed that the requirements and design inputs being developed by other members of the project will be available in a timely manner. Access of contractor generated design drawings and models to team members shall be required, as well as the use of design drawings and models to compare contractor fabricated parts and assemblies to as-designed versus as-built. Other office automation software will be utilized as appropriate to create the associated design documentation and reports. It is assumed that the NASA project office will schedule design and safety reviews. Engineering data will be delivered in electronic and/or paper media format as appropriate.

Evaluation of design concepts and feasibility studies shall be accomplished by a combination of the following methods:

- Calculations to verify that the design meets required load, size, and functional constraints.
- Comparisons with any similar designs.
- Discussions with stress, materials and fabrication personnel.
- Creation of, or use of, 3D CAD models to verify part interface requirements.
- Contacts with vendor sources for off-the-shelf solutions.

Guidance on Geometrical Dimensioning and Tolerancing (GDT) shall be accomplished by review of detail drawings generated by TBE or MSFC personnel, creation of suggested tolerance methods for common problems, and meetings with MSFC personnel to discuss specific problems.

The MSFC Initiator and/or MSFC Requestor will be responsible for providing design requirements and schedule milestones.

Design and Fabrication Drawings should adhere to applicable sections of the latest versions of the following MSFC ISO9000 Documents:

- MPR 8060.2, Non-Flight and Non-Facility Design and Development
- MWI 8060.2, Special Equipment Design Branch Support Request (MSFC FORM 4405)
- ET50-OI-001, ET50 Design and Development
- ET50-OI-002, ET50 Design Requirements
- ET50-OI-003, ET50 Control of Quality Records

- ET50-OI-005, ET50 Drawing Standards

For work package management support technical approach, see Task 3.3.

3.1 Upper Stage Structural Test Support – Closed June 2010

Design Engineers supporting this task must be well-versed in standard engineering practices, familiar with current steel and aluminum design and welding codes and techniques (including welded and bolted connections), knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.), and proficient in producing models and detailed drawings using Pro/Engineer CAD software.

Designer/Drafters supporting this task must be proficient using Pro/Engineer CAD software to produce models and detailed drawings of steel and aluminum structural/ mechanical assemblies and components (including welded and bolted connections), and be knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.).

3.2 Upper Stage Manufacturing Demonstration Article Support – Closed June 2010

Design Engineers supporting this task must be well-versed in standard engineering practices, familiar with current steel and aluminum design and welding codes and techniques (including welded and bolted connections), knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.), and proficient in producing models and detailed drawings using Pro/Engineer CAD software.

Designer/Drafters supporting this task must be proficient using Pro/Engineer CAD software to produce models and detailed drawings of steel and aluminum structural/ mechanical assemblies and components (including welded and bolted connections), and be knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.).

3.3 Work Package Management Support for Vehicle Integration – Closed June 2010

In supporting the Vehicle Integration work for EV30, the contractor shall directly support the EV30 VI work package manager in fulfilling EV30 VI work package responsibilities including integration, technical implementation, and the on-time delivery of quality products to the VI project office and other customers. In the discharge of these duties, the contractor shall:

- Provide daily on-site support to the government customer.

- Evaluate, select, and apply standard engineering techniques, procedures, and criteria.
- Be responsible for making minor adaptations and modifications.
- Lead and facilitate complex tasks and trade studies as well as independently manage subtasks with minimum government oversight.
- Provide program management specialist skills in the integration of integrated vehicle design and analyses, including, but not limited to, vehicle requirements analysis, modeling and simulation, design and analysis cycle (DAC) planning and execution, and verification methods.
- Shall perform and/or lead trade study and decision analysis efforts, including technical disciplines, and facilitate decision making for a wide range of Ares I technical issues.
- Evaluate technical quality and status; provide integration of analyses; and design products and documentation in support of vehicle design, development, operational flight tests and flight operations for the Ares program.
- Review technical reports, requirements documents, and engineering memorandums for technical adequacy and content.
- Support development of all key vehicle integrated design and analysis products for key project milestones.
- Prepare and deliver technical and programmatic briefings as requested by the government customer.
- Provide requirements development and verification support.
- Have experience with NASA or DOD requirements development and verification processes.
- Support CxP/VI project with architecture integration activities including architecture development and feasibility analyses, physical configuration definition, architecture reference documentation, mission modeling and simulation.
- Support and/or lead, as needed, EV30 VI work package discipline integration, DAC planning, implementation, and re-integration tasks. Integration responsibilities include (but are not limited to) planning, evaluations, status of technical disciplines, establishing, tracking, coordinating, and addressing technical actions from Project and Engineering. Other duties shall also include supporting and/or providing, as needed, status reviews, project monthly reviews, associated metrics and risk identification, mitigation, and tracking responsibilities for IDA.
- Conduct and support trade study planning, Level 2, Level 3, and Level 4 coordination (as needed) and support the coordination and technical resolution, as needed, for the following documents: System Requirement Document (SRD), Interface Requirements Document (IRD), and technical Data Requirement Description (DRD).
- Provide subject matter expert support to verification and validation activities for models and simulations used for IDA work package.
- Have past experience and/or working knowledge (specifically strengths, weaknesses, and areas of applicability) of the tools and tests used to perform analyses typical to human rated space launch vehicles or similar vehicles specifically in the areas mentioned above.

- Support identification, preparation and implementation of analyses and trade studies efforts, documentation and presentation of related work to the various working groups and control boards, as well as issues tracking and resolution.
- Support development of the ADAC/IDAC plans, integrated analysis schedules, as well as requirements coverage and design feasibility assessments.

The contractor shall provide technical subject matter expertise for integration of the following IDA disciplines for human rated space launch vehicle or similar vehicle:

- Static and dynamic structural loads determination through estimation, analyses, and test, including finite element analyses
- Aeroelastic analyses
- Aerodynamics, aerothermal, flight acoustics analyses
- Thermal analyses
- Propulsion and lift-off acoustics
- Solid and cryogenic liquid systems

3.4 NESC Shell Buckling – Closed October 2008

Design Engineers supporting this task must be well-versed in standard engineering practices, familiar with current steel and aluminum design and welding codes and techniques (including welded and bolted connections), knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.), and proficient in producing models and detailed drawings using Pro/Engineer CAD software.

Designer/Drafters supporting this task must be proficient using Pro/Engineer CAD software to produce models and detailed drawings of steel and aluminum structural/ mechanical assemblies and components (including welded and bolted connections), and be knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.).

3.5 MSFC NESC Support

The Contractor shall provide design and test support for shell-buckling tests.

Designer/Drafters supporting this task must be proficient using Pro/Engineer CAD software to produce models and detailed drawings of steel and aluminum structural/ mechanical assemblies and components (including welded and bolted connections), and be knowledgeable about industry-standard, vendor-supplied structural and mechanical components (such as structural steel and aluminum shapes, steel fasteners, linear and rotational bearings, hydraulic cylinders, screw jacks, hoisting equipment, etc.).

3.6 MSFC-ILN Mission 1 Systems Engineering

Design, Develop, Test, and Evaluate (DDT&E) hardware in support of the International Lunar Network (ILN) and the Space Systems Department (SSD) at NASA's Marshall Space Flight Center (MSFC). Work with a team of engineers in the design of structures and mechanisms using Pro-Engineer (Wildfire 3.0), produce detailed fabrication and assembly drawings, and conduct necessary test programs. Participate in meetings, both at MSFC and Johns Hopkins University (JHU) Applied Physics Laboratory (APL), as requested.

3.7 Avionics Integration & Vehicle Systems Support – Closed July 2010

3.8 HDS Support – Closed June 2010

3.9 Upper Stage Thermal Protection System (TPS)

The Contractor shall generate models and drawings in support of the Thermal Protection Spray Tooling Horizontal Configuration. This includes conducting dimensional studies on the entire assembly to validate design and facility interface tolerances and providing guidance to the fabrication shop during fabrication and assembly of the TPS tooling.

3.10 Upper Stage Reaction Control System – Closed October 2009

3.11 US – First Stage Roll Control System – Closed February 2010

3.12 Upper Stage SQ02A Test Support (ET30) – Closed February 2010

3.13 US Vibration Isolation Support – Closed June 2010

3.14 ET Test & Evaluation Analysis

The Contractor needs to possess skills in Finite Element Modeling (FEM) techniques (MSC Nastran is preferable) and be able to review and evaluate the FEM packages produced by others within the Branch; relative to the accuracy of the model and the results generated in an effort to expedite drawing signature (Branch Chief responsibility) for stress approval. The analyst must have knowledge in the area of pressure systems analysis (ASME B31.1, ASME B31.3, and ASME B & PV Code Section VIII Divisions I and II) and structural analysis (both large scale and small scale structures) to ensure adequate safety factors (2 on yield strength and 3 on ultimate strength for structures and code allowable for pressure systems) are maintained. The analyst will provide written documentation to the Branch Chief to support signature application.

3.15 FITO Ares Scale Model Acoustic IOP Training

The Contractor shall provide stress analysis for Ares Scale Model Acoustic Testing. The Contractor needs to possess skills in Finite Element Modeling (FEM) techniques (MSC Nastran is preferable).

3.16 J-2X Augmented Spark Igniter Support

Review the design to support the J-2X ASI Igniter Bath to support the Phase 3 J-2X ASI Testing.

3.17 MSFC Special Equipment Design Support

(Authorization to proceed with this subtask will be provided by the Contracting Officer in written direction.)

The contractor shall support the design, analysis, and output (in the form of concepts, CAD and FEM models, stress packages, drawings, reports, etc.) of Special Test Equipment (STE), or equipment intended to be used for testing or simulation, or associated with the manufacturing, process development, and preparation of MSFC facilities for testing or simulation. Designs include but are not limited to test stands, test beds, load reaction and application structures, load line components, flight hardware mockups and simulators, hardware support stands and dollies, personnel access stands, lifting and handling hardware, and tooling used to facilitate the fabrication and/or assembly of flight/non-flight hardware such as master drill templates or alignment/ clamping fixtures used during machining and welding processes.

4.0 Travel

The contractor shall travel as requested to accomplish each technical requirement. Any travel must be approved by the Contractor Officer‘s Technical Representative (COTR) or task order technical monitor, prior to travel.

The contractor’s monthly report shall contain travel detail to include travel destination, dates of travel, number of people who traveled, and purpose of the travel.

5.0 Materials

No materials are currently required for this order. However, this may change based on the customer’s requirements as directed by the Contractor Officer‘s Technical Representative (COTR) or task order technical monitor. Any materials being purchased must be approved by the Contracting Officer prior to purchase.

6.0 Reserved

7.0 Personnel Skill Levels

The Contractor shall provide skills at a level to perform the subtasks in this order.

8.0 Technical Milestones and Deliverables

Specified under Section 2.B of the SOW; any additional deliverables for specific subtasks are specified under Section 3.0.