

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 14
Task Order Number: NNJ13HC68T TO#12		Revision Number: 7		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 13/14/15		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: lawrence.l.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ISS/COTS Aerosciences and GN&C Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
Summary	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract			
Material			
Travel			
NLR Misc			
Burden on Non-Labor			
Total Non-Labor			
Total Costs			
Fee (7.0%)			
SOW 1.0			
Total	\$5,136,277	-\$83,837	\$5,052,440

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name:		CHRISTIAN GASPARD	
Signature: _____ Date: _____		Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.16 08:21:03 -05'00'	
Signature: _____ Date: _____		Signature: _____ Date: 7/16/15 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ13HC68T-TO12 REV 7

Originator: DENA HAYNES (EG1) (281) 244-5122 TMR: DENA HAYNES (EG) (281) 244-5122

Revision Summary:

5.6 -CCTCap Descope due to products moving into FY16 due to program milestone slips.

a. Dragon - dCDR from 6/15 to 12/15. SRP Phase III from 7/15 to 12/15. DM-1 Uncrewed from 3/16 to 12/16. DM-2 Crewed from 10/16 to 3/17.

b. CST-100 - dCDR from 1/15 to 3/15 but is incomplete. SRP Phase II from 12/15 to 6/16 but not accepted. OFT Uncrewed demo no earlier than (NET) 4/2017.

c. CFT - Crewed from no earlier than (NET) 7/2017.

1. FROM Title of Effort: ISS/COTS Aerosciences and GN&C Engineering Services **Updated Rev 5**

1. Title of Effort: FY15/14 ISS/COTS Aerosciences and GN&C Engineering Services

2. Date of Request: 07/09/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c.

4. Period of Performance **Updated Rev 4**

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

5. Product Requirements

5.1 ISS Visiting Vehicle Plume Analysis

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide technical and engineering service associated with the simulation and modeling of Reaction Control System plume flow fields from a variety of spacecraft, and the contractor shall provide engineering predictions of the heating rate environments and thermal response resulting from the impingement of these plumes upon the International Space Station (ISS).

5.1.1 ISS Visiting Vehicle Plume Analysis Updated Rev 4 Project Code:

The JETS contractor shall prepare documentation of above plume models and the background on their development. This document is intended to supersede the current plume modeling document developed primarily for the Space Shuttle Orbiter. The JETS contractor shall also provide updates to the Best Practices document for Data Parallel Line Relaxation (DPLR) computational fluid dynamics (CFD) and DAC DSMC simulations of scarfed nozzle plumes. The JETS contractor shall prepare documentation of above plume impingement engineering predictions of the heating rate environment and thermal response. Additionally, the JETS contractor will provide developmental and engineering support for the Direct Simulation Monte Carlo (DSMC) Analysis Code (DAC), NASA's primary software for simulating rarefied gas dynamics environments including plumes and plume impingement. Finally, the JETS contractor shall provide maintenance of the RPM3D analysis tool, the Space Station Modulator (SSM) grid generation tool and of the associated ISS geometry models.

b. Applicable Documents

Document Number	Document Name	Rev.
EG-WI-00015	Advanced Studies Process for EG3/Applied Aerosciences and CFD Branch Work Instruction	G
EG-WI-00353	Aeroscience Process for Supporting Flight Design	F
JSC-26507	Model for Predicting Orbiter PRCS Plume Impingement Loads and Heating	A
JSC-26583 Added Rev 4	The Three-Dimensional Reaction Control System Plume Model Software, RPM3D Ver. 16.0	B
SO-999-M-JSC-0047	System Security Plan for the Aeroscience and Flight Mechanics Division	06-30-2011

c. Required DRDs

5.1.1 ISS Visiting Vehicle Plume Analysis		
DRD #	DRD Title	Quantity/Frequency
TD-08 Updated Rev 6	Engineering Analysis	15

d. Products

5.1.1 ISS Visiting Vehicle Plume Analysis		
Product(s)	Quantity	Delivery Date
Update to RPM3D Tool and Users Guide	4	9/30/13, 3/31/14, 9/30/14, 6/30/15
Update to plume model document (JSC-26507)	2	6/30/13, 3/31/15
Update to Best Practices document for DPLR CFD and DAC DSMC simulations of scarfed nozzle plumes	3	7/31/13, 7/31/14, 12/31/14
DSMC Analysis Code development status reports	5	9/30/13, 3/31/14, 9/30/14, 3/31/15, 9/30/15
Plume Analysis Summary Report	10	6/30/13, 9/30/13, 12/31/13, 3/31/14, 6/30/14, 9/30/14, 12/31/14, 3/31/15, 6/30/15, 9/30/15
DSMC High Fidelity Plume Assessment for Worst Case Plume Loads	4	Special Analysis as needed

RPM3D Plume Heating Assessment Deleted Rev 6	1/Per flight	Per Visiting Vehicle Flight Schedule
RPM3D Plume Heating Assessment for Dual-Dock Operations Added Rev 6	1	9/30/15

e. **Product Verification**

5.1.1 ISS Visiting Vehicle Plume Analysis
i. Update to RPM3D Tool and Users Guide
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
ii. Update to plume model document (JSC-26507)
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
iii. Update to Best Practices document for DPLR CFD and DAC DSMC simulations of scarf nozzle plumes
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
iv. DSMC Analysis Code development status reports
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
v. Plume Analysis Summary Report
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
vi. DSMC High Fidelity Plume Assessment for Worst Case Plume Loads
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
vii. RPM3D Plume Heating Assessment Deleted Rev 6
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Deleted Rev 6
viii. RPM3D Plume Heating Assessment for Dual-Dock Operations
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6

5.2 ISS Dynamics & Control Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical and engineering services associated with the implementation and verification of the International Space Station (ISS) GN&C systems.

5.2.1 ISS Dynamics & Control Analysis Updated Rev 3

Project Code:

The scope of work includes performing Design Analysis Cycle (DAC) and Verification Analysis Cycle (VAC) of ISS US Attitude Control System (ACS), both propulsive and non-propulsive, and Russian Segment Motion. The JETS contractor shall document and present the analysis results to various ISSP forum as part of the ISS mission Certification of Flight Readiness (CoFR) process. The JETS contractor will modify, document, validate, and maintain the ISS GN&C Space Station Multiple Rigid Body Simulator (SSMRBS) analysis tool, and its ISS system

models. In addition, the JETS contractor will perform DAC and VAC assessment of Dual Docked operations and new ISS operational capabilities.

This work was transitioned to Boeing effective 3/5/2014.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC-28702	Space Station Multi-Rigid Body Simulation (SSMRBS) Vb3 9 User's Guide (UG)	Q
JSC-29033	Space Station Multi-Rigid Body Simulation (SSMRBS) Developer's Guide	D
JSC-29133	Space Station Multi-Rigid Body Simulation (SSMRBS) Configuration Management Plan	Current
SO-999-M-JSC-0047	System Security Plan for the Aerospace and Flight Mechanics Division	06-30-2011

c. Required DRDs

5.2.1 ISS Dynamics & Control Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08 Updated Rev 3	Engineering Analysis	8

d. Products

5.2.1 ISS Dynamics & Control Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
SSMRBS Version Baseline Software Releases	1/FY	9/30/13, 3/5/14
SDFast Mass Properties, Reboost performance, Thruster performance, CMG Desaturation accuracy	2	Prepare and publish on a bi-annual basis. August 2013, February 2014
Verification Analysis Cycle Assessment Reports	2	9/30/13, 3/5/14
Dual Docked VAC Assessment Report	1	9/30/13
Design Analysis Cycle	2	9/30/13, 6/30/14, 3/5/14

e. Product Verification

5.2.1 ISS Dynamics & Control Analysis	
i. SSMRBS Version Baseline Software Releases	
- Regression testing on validation suite as specified in SSMRBS Developer's Guide.	
ii. SDFast Mass Properties, Reboost performance, Thruster performance, CMG Desaturation accuracy	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iii. Verification Analysis Cycle Assessment Reports	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iv. Dual Docked VAC Assessment Report	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
v. Design Analysis Cycle	

- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.

5.3 ISS Visiting Vehicle RPO Analysis

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide analysis and engineering services of ISS Rendezvous Proximity (RPO) Visiting Vehicles.

5.3.1 ISS Visiting Vehicle RPO Analysis Updated Rev 5

Project Code:

The JETS contractor shall provide analysis and engineering assessments for ISS Rendezvous Proximity (RPO) Visiting Vehicles. This work will include:

- Providing engineering assessments and trajectory analysis for the rendezvous and proximity operations.
- Analyzing sensor performance, trajectory dispersions, and other GN&C rendezvous, proximity operations, and docking issues.
- Providing simulation-based design, development, and analysis of functional performance and capability required in order to support key programmatic decisions.
- Performing trade studies and performance assessments.
- Provide engineering recommendations and assessments for requirement closure regarding RPO Visiting Vehicles.
- Maintain Generic RPOP Capability
- Identify and Track Jet Firing History Scenarios, update Initial Conditions Data Base (ICDB) case matrix and conduct pre-screening evaluation of delivered data.
- Participate in Joint Mission Simulation Training (JMST), develop tools for real time ground console monitoring of key parameters and provide certified MER console support during missions,
- Provide engineering support in development of Ops products such as flight rules and vehicle demonstration plans.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SO-999-M-JSC-0047	IT Security Plan, System Security Plan for the Aerospace and Flight Mechanics Division	06-30-2011
SSP 30459	International Space Station Interface Control Plan	Rev H, April 1999
SSP 41000 Added Rev 6	System Specification for the International Space Station	Rev CD, Aug 25 2014
SSP 50808 Added Rev 6	International Space Station (ISS) To Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD)	Rev F, Dec 2014
SSP 50809 Added Rev 4	International Space Station (ISS) to Commercial Orbital Transportation Services (COTS) Interface Control Document (ICD) for Dragon	Baseline, Nov 2008
SSP 50885 Added Rev 4	International Space Station (ISS) to Commercial Orbital Transportation Services (COTS) Interface Control Document (ICD) for Cygnus	Rev A

c. Required DRDs

5.3.1 ISS Visiting Vehicle RPO Analysis		
DRD #	DRD Title	Quantity/Frequency
TD-08 Updated Rev 6	Engineering Analysis	5

d. Products

5.3.1 ISS Visiting Vehicle RPO Analysis		
Product(s)	Quantity	Delivery Date
ISS Visiting Vehicle GN&C Simulation updates	7	L - 12 wks
ISS Visiting Vehicle PQR Assessment Data Package	7	L - 8 wks
ISS Visiting Vehicle Safety Review Panel Phase III Data Package	7	L - 8 wks
ISS Visiting Vehicle Launch Readiness Review Data Package	8	L - 4 wks
ISS Visiting Vehicle Mission Real-time Engineering Services	8	L + 0 wks
Post-Flt Review Data Package	1	L + 8 wks
ISS Visiting Vehicle GN&C Simulation updates	5	FY15 L-12 wks
ISS Visiting Vehicle PQR Assessment Data Package	5	FY15 L - 8 wks
ISS Visiting Vehicle Safety Review Panel Phase III Data Package	5	FY15 L - 8 wks
ISS Visiting Vehicle Launch Readiness Review Data Package	5	FY15 L - 4 wks
ISS Visiting Vehicle Mission Real-time Engineering Services	5	FY15 L + 0 wks
Post-Flt Review Data Package	5	FY15 L + 8 wks
VV Simulation Update Added Rev 5	2	Biannually FY15
RPOP compatibility tests Added Rev 5	4	Quarterly
Reflector Tool Added Rev 5	1	2nd Quarter Fy15
Vireo real-time propagation monitor update Ver. 2 Added Rev 5	1	3rd Quarter Fy15

e. Product Verification

5.3.1 ISS Visiting Vehicle RPO Analysis	
i. ISS Visiting Vehicle GN&C Simulation updates	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
ii. ISS Visiting Vehicle PQR Assessment Data Package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iii. ISS Visiting Vehicle Safety Review Panel Phase III Data Package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iv. ISS Visiting Vehicle Launch Readiness Review Data Package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
v. ISS Visiting Vehicle Mission Real-time Engineering Services	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
vi. Post-Flt Review Data Package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	

vii. ISS Visiting Vehicle GN&C Simulation updates
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
viii. ISS Visiting Vehicle PQR Assessment Data Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
ix. ISS Visiting Vehicle Safety Review Panel Phase III Data Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
x. ISS Visiting Vehicle Launch Readiness Review Data Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
xi. ISS Visiting Vehicle Mission Real-time Engineering Services
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
xii. Post-Flt Review Data Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
xiii. VV Simulation Update
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 5
xiv. RPOP compatibility tests
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 5
xv. Reflector Tool
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 5
xvi. Vireo real-time propagation monitor update Ver. 2
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 5

5.4 ISS CCiCap and CPC Visiting Vehicle RPOC Assessments

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide analysis and engineering services of ISS CCiCap and CPC Visiting Vehicle Rendezvous Proximity (RPO) for Commercial Resupply Services (CRS)

5.4.1 ISS CCiCap and CPC Visiting Vehicle RPO Analysis and Assessments **Updated Rev 4**

Project Code:

The JETS contractor shall provide analysis and engineering assessments for ISS Rendezvous Proximity (RPO) for the Commercial Crew Integrated Capability (CCiCap) and Certification Product Contract (CPC) Visiting Vehicles. This work will include:

- PDR/CDR and Safety Review analysis and design analysis evaluation.

- Initial/Final Verification and Validation Plan assessment
- Interface Control Document development and Interface requirement updates
- Engineering assessments and tool development for ISS safety and RPOC operational analysis

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SSP 30459	International Space Station Interface Control Plan	Rev H, April 1999
SSP 41000	System Specification for the International Space Station	Rev BY, Sept 21 2012
SSP 50808	International Space Station (ISS) To Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD)	Rev D, Dec 2012

c. Required DRDs

5.4.1 ISS CCIcap and CPC Visiting Vehicle RPO Analysis and Assessments		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	12

d. Products

5.4.1 ISS CCIcap and CPC Visiting Vehicle RPO Analysis and Assessments		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
CCP Initial Verification Plan Assessment	3	2nd quarter FY 2013
CCP Final Verification Plan Assessment	2	3rd quarter FY 2013
CCiCap initial CDR package	2	4th quarter FY 2013
CCiCap Safety Review	2	1st quarter FY 2014
CCP Jet Firing history screening	3	3rd quarter FY 2014
CCP final CDR Package Added Rev 4	3	4th quarter FY 2014

e. Product Verification

5.4.1 ISS CCIcap and CPC Visiting Vehicle RPO Analysis and Assessments	
i. CCP Initial Verification Plan Assessment	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
ii. CCP Final Verification Plan Assessment	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iii. CCiCap initial CDR package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iv. CCiCap Safety Review	

- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
v. CCP Jet Firing history screening
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
vi. CCP final CDR Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 4

5.5 RPOP Application for Visiting Vehicle **Updated Rev 3**

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide the capability for the crew onboard ISS to use the Hand Held Lidar (HHL) in conjunction with Rendezvous Proximity Operations Program (RPOP) to monitor range and range rate for approaching visiting vehicles. In addition, the contractor shall provide Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA). The contractor shall also provide Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA) and provide IDA and STORRM Reflective Element Kit flight certification. **Updated Rev 3**

5.5.1 RPOP Application for Visiting Vehicle **Updated Rev 3** Project Code:

The contractor shall modify RPOP to run on the ISS laptop computers (SSC) and process the HHL data to compare to the visiting vehicle's relative navigation data. This new version of RPOP shall be verified, validated, and delivered. In addition, this task also includes support for training and real-time mission support for the first two Cygnus flights.

In addition, the contractor shall provide Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA) being designed to accommodate the visiting vehicles which will be compatible with the International Docking System Standard. Analyzing options for both centerline and peripheral target/reflector designs, reflector/target visibility analysis, and reflector testing and selection shall also be required. The peripheral docking target will be mounted on the circumference of the IDA and will provide features to allow any incoming crewed vehicle to assess its alignment with the IDA docking mechanism. The peripheral docking target design will include features to allow it to be used with any relative navigation sensor hardware currently in use (camera, feature recognition, LIDAR, and thermal imager). A notional design for a peripheral docking target will also be provided.

In addition, the contractor shall build and test three engineering prototypes of the peripheral docking target. These prototypes will be tested in JSC's Electro Optics Lab (EOL) to help evaluate the performance of the target design and to validate the design and selected surface coatings included in the requirements specification. The objective of the test is to see which surface coatings provide the best combination of visible contrast and thermal contrast between the backplate and the target features. A test report will be generated to record the test setup and procedures, and will contain pictures from the test taken with a visible light camera and a thermal imager. The report will note when such adverse conditions such as blooming or saturation occur, and will evaluate which surface coatings result in the best contrast.

In addition, the contractor shall provide the flight certification of the IDA and the STORRM Reflective Element Kit. This flight certification shall include the Reflective elements that were fabricated and installed on the ISS PMA2 docking target to support the STORRM DTO on STS-135. The purpose is to make the PMA3 docking target look the same as the PMA2 docking target to support visiting vehicle docking missions. This task will flight certify the spare reflective elements that were fabricated for the STORRM DTO.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>

EA-WI-027 Added Rev 3	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
EA-WI-023 Added Rev 3	Project Management of Government Furnished Equipment Flight Projects	Rev G, 2/1/2012
EA-WI-025	GFE Flight Project Software and Firmware Development	C
EG-WI-00002	Rendezvous and Proximity Operations Program (RPOP) Version Development and Delivery Process	E
JSC 66477	RPOP Project Requirements and Validation Document (PRVD) Update for RPOP Dragon and HTV Vehicle Option	11/27/2012 Baseline
JSC-28242	User's Guide for the Rendezvous and Proximity Operations Program (RPOP)	6.1.2

c. **Required DRDs**

5.5.1 RPOP Application for Visiting Vehicle		
DRD #	DRD Title	Quantity/Frequency
RV-10 Added Rev 3	Flight Products Verification and Validation Plan	1
RV-13 Added Rev 3	Flight Products Acceptance Test Procedures	1
TD-06 Added Rev 3	Certification Data Package	1
TD-08	Engineering Analysis	1
TD-09 Added Rev 3	Flight Products Verification and Validation Report	1

d. **Products**

5.5.1 RPOP Application for Visiting Vehicle		
Product(s)	Quantity	Delivery Date
RPOP Project Requirements and Validation Document (PRVD) Update for RPOP Dragon and HTV Vehicle Option	1	6/30/2013
IDA Target Design Requirements Document Update (Rev C)	1	9/30/2013
Update User's Guide for the Rendezvous and Proximity Operations Program (RPOP), JSC-28242	1	6/30/2013
Peripheral Target Notional Design Sketch	1	11/15/2013
IDA Target Design Requirements Document Update (Rev D) Added Rev 1	1	12/31/2013
Peripheral Docking Target Test Report Added Rev 2	1	5/1/2014
Flight Products Verification and Validation Plan Added Rev 3	1	5/15/14
Certification Data Package Added Rev 3	1	7/1/14
Flight Products Verification and Validation Report Added Rev 3	1	7/1/14
Government Certification Approval Request (GCAR) Added Rev 3	1	7/1/14
IDA Target Design Requirements Document Update â€œJSC Version Document (Rev A) Added Rev 4	1	7/31/2014
IDA Target Design Requirements Document Update â€œJSC Version Document (Rev B) Added Rev 4	1	9/30/2014
Series Re-Flight Assessment & Hazards Reports Added Rev 4	4	9/30/2014

e. **Product Verification**

5.5.1 RPOP Application for Visiting Vehicle	
i. RPOP Project Requirements and Validation Document (PRVD) Update for RPOP Dragon and HTV Vehicle Option	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	

ii. IDA Target Design Requirements Document Update (Rev C)	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iii. Update User's Guide for the Rendezvous and Proximity Operations Program (RPOP), JSC-28242	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
iv. Peripheral Target Notional Design Sketch	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.	
v. IDA Target Design Requirements Document Update (Rev D)	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 1
vi. Peripheral Docking Target Test Report	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 2
vii. Flight Products Verification and Validation Plan	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 3
viii. Certification Data Package	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 3
ix. Flight Products Verification and Validation Report	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 3
x. Government Certification Approval Request (GCAR)	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 3
xi. IDA Target Design Requirements Document Update – JSC Version Document (Rev A)	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 4
xii. IDA Target Design Requirements Document Update – JSC Version Document (Rev B)	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 4
xiii. Series Re-Flight Assessment & Hazards Reports	
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate	Added Rev 4

5.6 ISS Crewed Visiting Vehicle RPOC Assessments Added Rev 6

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide analysis and engineering services of Crewed Visiting Vehicle Rendezvous Proximity (RPO) for Commercial Resupply Services (CRS) Added Rev 6

5.6.1 Crewed Visiting Vehicle RPO Analysis and Assessments Added Rev 6

Project Code:

The JETS contractor shall provide analysis and engineering assessments for ISS Rendezvous Proximity (RPO) for the Commercial Crew Demonstration Vehicles. This work will include:

- Provide engineering recommendations and assessments for requirement closure regarding Crewed Visiting Vehicles and Safety Review analysis and design analysis evaluation.

Providing simulation-based design, development, and analysis of functional performance and capability required in order to support key programmatic decisions.

- Maintain joint analysis parameters and document in the appropriate joint Interface Control Document

- Engineering assessments and tool development for ISS safety and RPOC operational analysis

- Identify Jet Firing History Scenarios, Develop Document Data Exchange agreements and conduct pre-screening evaluation of delivered data.

- Participate in Joint Mission Simulation Training, develop tools for real time ground console monitoring of key parameters and provide certified MER console support during missions,

- Provide engineering support in development of Ops products such as flight rules and vehicle demonstration plan.

- The contractor shall modify, verify and validate RPO to support crew monitoring of the approaching Commercial Crew CST-100 and Dragon vehicles.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CCT-REQ-1130 Added Rev 6	ISS Crew Transportation and Services Requirements Documentation	Rev C
SSP 30459 Added Rev 6	International Space Station Interface Control Plan	Rev H, April 1999
SSP 41000 Added Rev 6	System Specification for the International Space Station	Rev CD, Aug 25 2014
SSP 50808 Added Rev 6	International Space Station (ISS) To Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD)	Rev F, Sept 2014

c. Required DRDs

5.6.1 Crewed Visiting Vehicle RPO Analysis and Assessments		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08 Updated REV 7	Engineering Analysis	10

d. Products

5.6.1 Crewed Visiting Vehicle RPO Analysis and Assessments		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>

CVV Initial Verification Plan Assessment Added Rev 6	2	30 calendar days after NASA delivery of Initial Verification Plan
CVV Final Verification Plan Assessment Added Rev 6	2	30 calendar days after NASA delivery of Final Verification Plan
CVV initial CDR package Added Rev 6	2	30 calendar days after NASA delivery of Data Package
CVV Safety Review Updated REV 7	1	30 calendar days after NASA delivery of Data Package
CVV Jet Firing history screening Added Rev 6	2	30 calendar days after NASA delivery of Data Package
CVV Final CDR Package Updated REV 7	1	30 calendar days after NASA delivery of Data Package
CVV Simulation Update Updated REV 7	1	Quarterly 3 FY15
ISS Crew Monitoring RPOP Prototype Release Added Rev 6	1	9/30/15

e. **Product Verification**

5.6.1 Crewed Visiting Vehicle RPO Analysis and Assessments
i. CVV Initial Verification Plan Assessment
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
ii. CVV Final Verification Plan Assessment
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
iii. CVV initial CDR package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
iv. CVV Safety Review
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
v. CVV Jet Firing history screening
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
vi. CVV Final CDR Package
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
vii. CVV Simulation Update
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
viii. ISS Crew Monitoring RPOP Prototype Release
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 8
Task Order Number: NNJ13HC69T TO #13		Revision Number: 6		Appropriation Data: Funded at Contract
SOW WBS: See Item 3 of Performance Work Statement		Fiscal Year(s): 2013/2014/2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Advanced Mission Design Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order #13 Estimated Cost and Fee			
Summary	Previous Value	This Action	Current Value
Total Direct Labor Hrs	(b)	(4)	
Total Direct Labor Cost			
Subcontract			
Material			
Travel			
NLR Misc			
Burden on Non Labor			
Total Non-Labor			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,006,652	\$307,318	\$2,313,969

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

ROCHELLE OVERSTREET

Signature: _____
Contracting Officer

Digitally signed by ROCHELLE OVERSTREET
 DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnoverst, cn=ROCHELLE OVERSTREET
 Date: 2015.09.29 14:04:24 -04'

9/29/15

Date: _____

JSC Engineering, Technology and Science Contract

NNJ13HC69T-TO13 R6

Originator: DENA HAYNES (EG1) TMR: DENA HAYNES (EG) (281) 244-5122

Revision Summary:

Extending POP to 03/31/2016

1. FROM Title of Effort: FY15/14 Advanced Mission Design Engineering Services **Updated R6**

1. Title of Effort: FY16/15/14 Advanced Mission Design Engineering Services

2. Date of Request: 08/20/2015

3. Statement of Work Task Description

a. 2.3 Analysis and Assessment

b. 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.

c. 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.

d.

4. Period of Performance Updated R6

The period of performance does not commence until the CO has granted authorization to proceed.

FROM:

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

TO:

This task order period of performance starts 05/01/2013 and ends 03/31/2016.

5. Product Requirements

5.1 Advanced Mission Design Updated Rev 2

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering analysis, Flight Mechanics Lab specialized IT services, simulation development, and documentation services to the NASA/EG5 Flight Mechanics and Trajectory Branch. Tasks include development of analysis methods, tool development, and application of these methods and tools.

5.1.1 Advanced Vehicle Performance, GN&C Analysis and Simulation Tool Development Updated Rev 6

Project Code:

FROM:

The contractor shall perform detailed trade studies for the Flight Mechanics and Trajectory Design Branch in the areas of ascent, on-orbit, de-orbit, aero-capture and entry trajectory design and analysis. Specific areas of study include:

- Mars/Earth aero-capture trades
- advanced vehicle ascent/entry/orbit studies
- optimization of conceptual ascent, entry, and orbit trajectories
- trade studies for Beyond-Earth-Orbit human missions

The contractor shall also perform Flight Mechanics Lab specialized IT services in the areas of hardware and software upgrades, configuration control, data backups, user tracking, web page design and maintenance, user issues resolution, and security operations.

TO:

The contractor shall perform detailed trade studies for the Flight Mechanics and Trajectory Design Branch in the areas of ascent, on-orbit, interplanetary, cis-lunar, de-orbit, aero-capture, entry and landing trajectory design and analysis. Specific areas of study include:

- Trade studies for Beyond-Earth-Orbit human missions
- Continue development of the on-board trajectory planner software and displays integration
- Continue speed and efficiency improvements of the Copernicus End-to-End Mission Optimizer simulation tool and Copernicus plug-in capability
- Development of add-on modules to Copernicus to support the ISS Follow-on study, (e.g. Orbit Designer and Orbit Maintenance modules for EML2H/EML1H/NRO)
- Modeling and simulation development and entry analyses of CCTCap configurations
- Oversight and technical support of the Terrestrial Return Vehicle (TRV) de-orbit simulation and performance
- Entry simulation and performance analyses of Mid-L/D Vehicles at Mars from entry interface to landing
- Visual graphics support for the Mars Mid-L/D Rigid Vehicle (MRV)

The contractor shall also perform Flight Mechanics Lab specialized IT services in the areas of hardware and software upgrades, integration into the Flight Sciences Lab, configuration control, data backups, user tracking, web page design and maintenance, user issues resolution, and security operations.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EG-WI-00177	Integrated Guidance, Navigation, and Control IG&N&C Work Instructions	C

EG-WI-00181	Flight Control Design and Analysis Process	C
SO-999-M-JSC-0047 Deleted Rev 4	System Security Plan for the Aerospace and Flight Mechanics Division	06/30/2011
SO-999-M-JSC-0047 Deleted Rev 6	System Security Plan for the Aerospace and Flight Mechanics Division	4/2/2014
SO-9999-M-JSC-3173 Added Rev 6	System Security Plan for the Aerospace and Flight Mechanics Division	3/23/2015

c. Required DRDs

5.1.1 Advanced Vehicle Performance, GN&C Analysis and Simulation Tool Development		
DRD #	DRD Title	Quantity/Frequency
FROM:		
TD-08	Engineering Analysis	11
TO:		
TD-08 Updated Rev 6	Engineering Analysis	16

d. Products

5.1.1 Advanced Vehicle Performance, GN&C Analysis and Simulation Tool Development		
Product(s)	Quantity	Delivery Date
Availability assessment summary report for EML2H to E.I.	1	6/30/2013
LEO to EML2H Abort Trade summary report	1	8/30/2013
Human Mission Mid-L/D Trade Study for Mars Entry Summary Report	1	10/31/2013
Libration Point Mission Design and Performance Trade Study Summary Report	1	1/31/2014
Lifting Body Entry Guidance Simulation and Performance Summary Report	1	4/14/2014
Beyond-Earth-Orbit Human Missions Summary Report	1	6/30/2014
MAPP Database - EML2H/ EML1H Orbit Maintenance, Propagation for Chemical and SEP engines	1	9/30/2014
Maraia Capsule Project - Sounding Rocket Flight Test GN&C Simulation Development Status Report Deleted Rev 4	2 Deleted Rev 4	1/15/2015, 3/30/2015 Deleted Rev 4
Lifting Body Entry Hypersonic I-Load Design and validation Added Rev 3	1 Added Rev 3	1/30/2015
Update, Validate and Verify DDS_ESP (Descent Design System_Entry Shaping Processor) Added Rev 3	1 Added Rev 3	3/30/2015
Provide simulated Mid-L/D Mars entry conceptual sequence of events, timing, and performance report Added Rev 4	1 Added Rev 4	5/30/2015
Report on performance assessment of TRV (Terrestrial Return Vehicle) deorbit for CDR Added Rev 4	1 Added Rev 4	7/31/2015
Provide models and simulation of a CCTCap configuration for entry analyses Added Rev 4	1 Added Rev 4	9/30/2015
Complete Orion/SLS End to End Mission Optimizer simulation tool development and add Copernicus Plug-in functionality Added Rev 4	1 Added Rev 4	9/30/2015
Complete integrated Copernicus/IPAS Orion Flight Displays of EM-1 Abort-to-Earth scenario Added Rev 5	1 Added Rev 5	9/30/2015
Provide simulation and performance results of rigid Mid-L/D Mars Vehicle from entry to landing with guidance Added Rev 6	1 Added Rev 6	10/31/2015

Update the simulation and performance of rigid Mid-L/D Mars Vehicle based on new configuration Added Rev 6	1 Added Rev 6	3/31/2016
Evaluation of on-orbit and de-orbit guidance implementation and performance on TRV Added Rev 6	1 Added Rev 6	12/31/2015
Database and tools for cis-lunar orbits definition Added Rev 6	1 Added Rev 6	1/31/2016
SpaceX commercial crew entry sim Added Rev 6	1 Added Rev 6	1/31/2016

e. **Product Verification**

5.1.1 Advanced Vehicle Performance, GN&C Analysis and Simulation Tool Development		
. Availability assessment summary report for EML2H to E.I.		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
i. LEO to EML2H Abort Trade summary report		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
ii. Human Mission Mid-L/D Trade Study for Mars Entry Summary Report		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
v. Libration Point Mission Design and Performance Trade Study Summary Report		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
v. Lifting Body Entry Guidance Simulation and Performance Summary Report		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
vi. Beyond-Earth-Orbit Human Missions Summary Report		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
vii. MAPP Database - EML2H / EML1H Orbit Maintenance, Propagation for Chemical and SEP engines		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
viii. Marisa Capsule Project - Sounding Rocket Flight Test GN&C Simulation Development Status Report Deleted Rev 4		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.		
x. Lifting Body Entry Hypersonic I-Load Design and validation Added Rev 3		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3		
x. Update, Validate and Verify DDS_ESP (Descent Design System_Entry Shaping Processor) Added Rev 3		
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is		

accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3
xi. Provide simulated Mid-L/D Mars entry conceptual sequence of events, timing, and performance report Added Rev 4 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 4
xii. Report on performance assessment of TRV (Terrestrial Return Vehicle) deorbit for CDR Added Rev 4 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 4
xiii. Provide models and simulation of a CCtCap configuration for entry analyses Added Rev 4 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 4
xiv. Complete Orion/SLS End to End Mission Optimizer simulation tool development and add Copernicus Plug-in functionality Added Rev 4 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 4
xv. Complete integrated Copernicus/IPAS Orion Flight Displays of EM-1 Abort-to-Earth scenario Added Rev 5 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 5
xvi. Provide simulation and performance results of rigid Mid-L/D Mars Vehicle from entry to landing with guidance Added Rev 6 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
xvii. Update the simulation and performance of rigid Mid-L/D Mars Vehicle based on new configuration Added Rev 6 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
xviii. Evaluation of on-orbit and de-orbit guidance implementation and performance on TRV Added Rev 6 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
xix. Database and tools for cis-lunar orbits definition Added Rev 6 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6
xx. SpaceX commercial crew entry sim Added Rev 6 <ul style="list-style-type: none"> - Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 6

5.2 Dream Chaser Design and Analysis Cycle Trades

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering analysis, simulation development, and documentation services to the NASA/EG5 Flight Mechanics and Trajectory Branch. Tasks include development of analysis methods, tool development, and application of these methods and tools.

5.2.1 Dream Chaser Design and Analysis Cycle Trades

Project Code:

The contractor shall perform detailed trade studies for the Flight Mechanics and Trajectory Design Branch in the areas of SNC Dream Chaser Entry Performance Trades and X-38 entry guidance implementation.

b. Applicable Documents

Document Number	Document Name	Rev.
EG-WI-00177	Integrated Guidance, Navigation, and Control IGN&C Work Instructions	C
EG-WI-00181	Flight Control Design and Analysis Process	C

c. Required DRDs

5.2.1 Dream Chaser Design and Analysis Cycle Trades		
DRD #	DRD Title	Quantity/Frequency
TD-08 Updated Rev 3	Engineering Analysis	9

d. Products

5.2.1 Dream Chaser Design and Analysis Cycle Trades		
Product(s)	Quantity	Delivery Date
Implementation of X-38 entry guidance into SNC Dream Chaser vehicle entry simulation	1	7/31/2013
Design and Analysis Cycle Summary Report for SNC Dream Chaser Entry Performance Trades	1	12/31/2013
Implementation of Entry Shaping Processor (ESP) and Gliding Return to Launch Site (GRTL) Shaping Processor (GSP) with latest emulated control system for SNC Dreamchaser vehicle Added Rev 1	1 Added Rev 1	10/31/13
Final Report - SNC Dream Chaser Entry Simulation with Guidance Implementation Added Rev 2	1 Added Rev 2	2/28/2014
Transfer Function Digital Autopilot Preliminary Delivery Added Rev 3	1 Added Rev 3	6/21/2014
Report on State-of-the-Entry Design I-Load Set and Recommendations Added Rev 3	1 Added Rev 3	7/1/2014
Comparison with latest 6-DOF. Interface Clean-up and 6-DOF simulation Comparison Added Rev 3	1 Added Rev 3	7/21/2014
Comparison with latest 6-DOF New Model Validation And Verification Analyses Added Rev 3	1 Added Rev 3	8/15/2014

Final Report Entry Shaping Processor Delivery and Documentation Added Rev 3	1 Added Rev 3	9/14/2014
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e. **Product Verification**

5.2.1 Dream Chaser Design and Analysis Cycle Trades
. Implementation of X-38 entry guidance into SNC Dream Chaser vehicle entry simulation
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
i. Design and Analysis Cycle Summary Report for SNC Dream Chaser Entry Performance Trades
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate.
ii. Implementation of Entry Shaping Processor (ESP) and Gliding Return to Launch Site (GRTLs) Shaping Processor (GSP) with latest emulated control system for SNC Dream Chaser vehicle Added Rev 1
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 1
v. Final Report - SNC Dream Chaser Entry Simulation with Guidance Implementation Added Rev 2
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 2
v. Transfer Function Digital Autopilot Preliminary Delivery Added Rev 3
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3
vi. Report on State-of-the-Entry Design I-Load Set and Recommendations Added Rev 3
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3
vii. Comparison with latest 6-DOF. Interface Clean-up and 6-DOF simulation Comparison Added Rev 3
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3
viii. Comparison with latest 6-DOF New Model Validation And Verification Analyses Added Rev 3
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3
x. Final Report Entry Shaping Processor Delivery and Documentation Added Rev 3
- Deliverables shall be delivered to (1) Flight Sciences Laboratory Server or EG AFMD SharePoint Site and (2) DDMS. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Added Rev 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 14
Task Order Number: NNJ13HC70T TO#14	Revision Number: Rev 4	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2013 & 2014	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: MPCV Aerosciences and GN&C Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
Summary	Previous Value	This Action	Current Value
Total Direct Labor Hrs	(b)	(4)	
Total Direct Labor Cost			
Subcontract			
Material			
Travel			
NLR Misc			
Burden on Non-Labor			
Total Non-Labor			
Total Costs			
Fee			
SOW 1.0			
TOTAL	\$5,973,777	\$2,323,615	\$8,297,392

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **9/23/15**
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.23 17:34:46 -0500

JSC Engineering, Technology and Science Contract

NNJ13HC70T-TO14 R4

Originator: DENA HAYNES (EG1) TMR: DENA HAYNES (EG) (281) 244-5122

Revision Summary:

Extending POP to 09/30/2016

1. FROM Title of Effort: FY15/14 MPCV Aerosciences and GN&C Engineering Services **Updated R4**

1. Title of Effort: FY16/15/14 MPCV Aerosciences and GN&C Engineering Services

2. Date of Request: 09/01/2015

3. Statement of Work Task Description

a. 2.3 Analysis and Assessment

b. 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.

c. 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.

d.

4. Period of Performance Updated R4

The period of performance does not commence until the CO has granted authorization to proceed.

FROM:

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

TO:

This task order period of performance starts 05/01/2013 and ends 09/30/2016.

5. Product Requirements

5.1 MPCV Aerosciences Project Integration Deleted Rev 3

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide project integration services to plan, track, and execute the Multi-Purpose Crew Vehicle (MPCV) Aerosciences Project (CAP) specific tasks and products identified in section 5.2 below.

5.1.1 MPCV Aerosciences Project Integration Deleted Rev 3

Project Code:

The contractor shall provide project integration services for MPCV Aerosciences Project (CAP) Integration and Coordination of specific in-line products identified in section 5.2 below.

b. Applicable Documents

Document Number	Document Name	Rev.
EG-WI-00015 Deleted Rev 3	Advanced Studies Process for EG3/Applied Aerosciences and CFD Branch Work Instruction	D
EG-WI-00353 Deleted Rev 3	Aeroscience Process for Supporting Flight Design	C

c. Required DRDs

5.1.1 MPCV Aerosciences Project Integration Deleted Rev 3

DRD #	DRD Title	Quantity/Frequency
RV-01 Deleted Rev 3	Project Schedule	Monthly

d. Products

5.1.1 MPCV Aerosciences Project Integration Deleted Rev 3

Product(s)	Quantity	Delivery Date
Integrated Master Milestone Schedule for CAP tasks Deleted Rev 3	1/Month Deleted Rev 3	Monthly Deleted Rev 3
CAP Project Management Plan (PMP) & WBS Document Deleted Rev 3	1/Quarter Deleted Rev 3	Quarterly Deleted Rev 3
TCSR Budget Package Deleted Rev 3	1/Month Deleted Rev 3	Monthly Deleted Rev 3
OPSR Data Package Deleted Rev 3	1/Month Deleted Rev 3	Monthly Deleted Rev 3
VSPA Schedule Package Deleted Rev 3	1/Month Deleted Rev 3	Monthly Deleted Rev 3

e. Product Verification

5.1.1 MPCV Aerosciences Project Integration Deleted Rev 3

i. Integrated Master Milestone Schedule for CAP tasks Deleted Rev 3

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is

accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate. Deleted Rev 3
ii. CAP Project Management Plan (PMP) & WBS Document Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Deleted Rev 3
iii. TCSR Budget Package Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Deleted Rev 3
iv. OPSR Data Package Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Deleted Rev 3
v. VSPA Schedule Package Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Deleted Rev 3

5.2 MPCV Aeroscience Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering products in aerodynamics analysis; aerothermodynamics analysis; Computational Fluid Dynamics (CFD) modeling and analysis; radiation modeling and analysis. Tasks include development of analysis methods, tool development, and application of these methods and tools.

5.2.1 Aerosciences Project Database and Databook

Project Code:

The Contractor shall develop data tables, application program interface (API), and documentation for the MPCV spacecraft aerosciences database encompassing all nominal and abort configurations. The database shall cover subsonic, supersonic, hypersonic and free molecular flow regimes. The database shall be developed using inputs from CFD analysis, wind tunnel test data, and other ground based testing. The MPCV aerosciences API will be written to provide force and moment coefficients to various spacecraft flight simulation tools through simple subroutine or function calls and be designed for easy integration into the simulations. The database shall also include convective heating rates, radiative heating rates, and radiation equilibrium surface temperatures. Documentation products include a MPCV Aerodynamics and Aerothermodynamics Design Data book, API implementation and usage information, and a Database substantiation report.

5.2.2 Aeroscience Analysis

Project Code:

The contractor shall provide aerodynamic and aerothermodynamic assessments of candidate MPCV configurations for the flight corridors provided. This shall include analysis of Wind tunnel (WT) test results for the candidate configurations. Analysis shall also be required to support database population. In addition, CFD cases are required in the analysis of transition from laminar to turbulent flow.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EG-WI-00015	Advanced Studies Process for EG3/Applied Aerosciences and CFD Branch Work Instruction	D

EG-WI-00353	Aeroscience Process for Supporting Flight Design	C
NPR 7150.2	NASA Software Engineering Requirements	Basic 09-04
SO-999-M-JSC-004 Deleted R4	System Security Plan for the Aeroscience and Flight Mechanics Division	Rev C 06-30-2011
SO-9999-M-JSC-3173 SPEG0002 Added R4	System Security Plan for the Aeroscience and Flight Mechanics Division	3/23/2015

c. Required DRDs

5.2.1 Aerosciences Project Database and Databook		
DRD #	DRD Title	Quantity/Frequency
SW-04 Updated Rev 3	Software Code	3

5.2.2 Aeroscience Analysis		
DRD #	DRD Title	Quantity/Frequency
FROM:		
TD-08	Engineering Analysis	9
TO:		
TD-08 Updated R4	Engineering Analysis	13

d. Products

5.2.1 Aerosciences Project Database and Databook		
Product(s)	Quantity	Delivery Date
Aerosciences Data Tables	5	8/15/13 Aerodynamic DB Version 0.8, 8/15/13 Aerothermal DB v0.94 (CM), 1/31/14 Aerothermal DB v.94 (LAV), , 9/15/14 Aerodynamic DB Version 0.85, 8/15/14 Aerothermal DB v0.95
Substantiation Report Draft	4	8/15/13 Aerodynamic DB Version 0.8, 8/15/13 Aerothermal DB v0.94 (CM), 1/31/14 Aerothermal DB v.94 (LAV), 8/15/14 Aerothermal DB v0.95
Aerodynamic API Code Release , Documentation & Test Case Report	1	8/15/13 Aerodynamic DB Version 0.8
Aerosciences Data Tables	2	3/15/15 Aerodynamic DB Version 0.90, 9/1/15 Aerothermal DB v0.96
Substantiation Report Draft	4	12/15/14 Aerodynamic DB Version 0.85, 5/1/15 Aerodynamic DB v0.90 (CM), 1/15/15 Aerothermal DB v.94 (LAV), 9/30/15 Aerothermal DB v0.96
Aerodynamic API Code Release , Documentation & Test Case Report	2	10/15/14 Aerodynamic DB Version 0.85, 3/15/15 Aerodynamic DB Version 0.90
FROM:		
Aerodynamic API Code Release , Documentation & Test Case Report	2	10/15/14 Aerodynamic DB Version 0.85, 3/15/15 Aerodynamic DB Version 0.90
TO:		
Aerosciences Data Tables Updated R4	3 Updated R4	12/15/15 Aerodynamic DB Version 0.91, 1/31/16 Aerothermal DB v0.97, 4/15/16 FY16 Aerodynamic DB 0.92
FROM:		
Aerodynamic API Code Release , Documentation & Test Case Report	2	10/15/14 Aerodynamic DB Version 0.85, 3/15/15 Aerodynamic DB Version 0.90
TO:		

Substantiation Report Draft Updated R4	3 Updated R4	FY16 12/15/15 Aerodynamic DB Version 0.91, 1/31/16 Aerothermal DB v0.97, 4/15/16 Aerodynamic DB 0.92
Aerodynamic API Code Release , Documentation & Test Case Report Added R4	2 Added R4	FY16 12/15/15 Aerodynamic DB Version 0.91, 4/15/16 Aerodynamic DB 0.92

5.2.2 Aeroscience Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
FROM:		
Aeroscience Analysis Summary Report	9 Qrtly	Qrtly
TO:		
Aeroscience Analysis Summary Report	9 Updated R4	Qrtly
FY16 Aeroscience Analysis Summary Report Added R4	4 Added R4	Qrtly

e. **Product Verification**

5.2.1 Aerosciences Project Database and Databook
i. Aerosciences Data Tables
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
ii. Substantiation Report Draft
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
iii. Aerodynamic API Code Release , Documentation & Test Case Report
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
iv. Aerosciences Data Tables
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
v. Substantiation Report Draft
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
vi. Aerodynamic API Code Release , Documentation & Test Case Report
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
vii. Aerosciences Data Tables
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
viii. Substantiation Report Draft
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
ix. Aerodynamic API Code Release , Documentation & Test Case Report Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
Added R4

5.2.2 Aerospace Analysis

i. Aerospace Analysis Summary Report

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

ii. FY16 Aerospace Analysis Summary Report

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
Added R4

5.3 MPCV GN&C Project Integration

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide project integration services to the Orion MPCV GN&C Mode Teams specific tasks and products identified in section 5.4 below.

5.3.1 MPCV GN&C Project Integration

Project Code:

The Contractor shall provide project integration services to the Orion MPCV GN&C Mode Teams including integration and coordination of GN&C Mode Team specific tasks and products identified in section 5.4 below.

b. Applicable Documents

Document Number	Document Name	Rev.
EG-WI-00181	Flight Control Design and Analysis Process	C

c. Required DRDs

5.3.1 MPCV GN&C Project Integration		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	Monthly

d. Products

5.3.1 MPCV GN&C Project Integration		
Product(s)	Quantity	Delivery Date
Mode Team Windchill website updates	1/week	Weekly Per GN&C schedule
Consolidated GN&C Mode Team Design Technical Document Services Deleted Rev 2	2/month Deleted Rev 2	Bi-Monthly Per GN&C schedule Deleted Rev 2
GN&C Mode Team Schedule Deleted Rev 3	1/month Deleted Rev 3	Monthly Per GN&C schedule Deleted Rev 3

Project Action Item List Deleted Rev 3	1/week Deleted Rev 3	Weekly Per GN&C schedule Deleted Rev 3
Loads and Dynamics Team Schedule Deleted Rev 3	2/month Deleted Rev 3	Bi-Monthly Per GN&C schedule Deleted Rev 3
Integrated Aborts Team Schedule Deleted Rev 3	1/month Deleted Rev 3	Monthly Per GN&C schedule Deleted Rev 3
Houston Orion Test Hardware (HOTH) Display Deleted Rev 2	1 Deleted Rev 2	Per GN&C schedule Deleted Rev 2
TCSR Budget Package Added Rev 2	1/month Added Rev 2	Monthly Per GN&C schedule
MPCV VSPA Heads Up (HUD) Data Package Added Rev 3	1/month Added Rev 3	Monthly Per GN&C schedule
GN&C PPBE Budgeting Package Added Rev 3	1 Added Rev 3	March 2015
FY17 GN&C PPBE Budgeting Package Added R4	1 Added R4	March 2016

e. Product Verification

5.3.1 MPCV GN&C Project Integration
i. Mode Team Windchill website updates
- Deliverables shall be delivered to MPCV GNC Mode Team Windchill website. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
ii. Consolidated GN&C Mode Team Design Technical Document Services Deleted Rev 2
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
iii. GN&C Mode Team Schedule Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
iv. Project Action Item List Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
v. Loads and Dynamics Team Schedule Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
vi. Integrated Aborts Team Schedule Deleted Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
vii. Houston Orion Test Hardware (HOTH) Display Deleted Rev 2
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
viii. TCSR Budget Package Added Rev 2
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is

accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 2
ix. MPCV VSPA Heads Up (HUD) Data Package Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
x. GN&C PPBE Budgeting Package Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xi. FY17 GN&C PPBE Budgeting Package Added R4
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added R4

5.4 MPCV GN&C Systems Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services to the Orion Multi-Purpose Crew Vehicle (MPCV) GN&C Mode Teams including simulation-based analysis of Orion GN&C systems functional performance, and analysis of the integrated GN&C capability required prior to full-scale development of Orion system elements.

5.4.1 MPCV GN&C Systems Analysis Updated R4

Project Code:

FROM:

The contractor shall provide engineering services to the Orion Multi-Purpose Crew Vehicle (MPCV) GN&C Mode Teams including simulation-based analysis of Orion GN&C systems functional performance, and analysis of the integrated GN&C capability required prior to full-scale development of Orion system elements. The analysis of guidance and trajectory performance for Orion shall be provided including testing and validation of various flight software releases using the ANTARES/RAMSES-A and ANTARES/Prototype simulations. The contractor shall develop, maintain, and implement the engineering math models and simulation tools required for this analysis effort. Engineering services shall include:

- The design, development, and analysis of Orion GN&C systems, methodologies, and algorithms.
- Execution of trade studies and performance assessments required to support the definition of the Orion GN&C system.
- GNC Integration and Test (I&T) efforts including functional, system, verification validation and flight tests. (ITL-integrated test lab)
- Provide technical documentation of GN&C analysis and requirements definition.
- Develop, maintain and implement math models into the ANTARES simulation. Provide Clear Case configuration management of integrated ANTARES and RAMSES baseline releases.

TO:

The contractor shall provide engineering services to the Orion Multi-Purpose Crew Vehicle (MPCV) GN&C Mode Teams including simulation-based analysis of Orion GN&C systems functional performance, and analysis of the integrated GN&C capability required prior to full-scale development of Orion system elements. The analysis of guidance and trajectory performance for Orion shall be provided including testing and validation of various flight software releases using the ANTARES/RAMSES-A and ANTARES/Prototype

simulations. The contractor shall develop, maintain, and implement the engineering math models and simulation tools required for this analysis effort. Engineering services shall include:

- The design, development, and analysis of Orion GN&C systems, methodologies, and algorithms.
- Execution of trade studies and performance assessments required to support the definition of the Orion GN&C system.
- GNC Integration and Test (I&T) efforts including functional, system, verification validation and flight tests. (ITL-integrated test lab)
- Provide technical documentation of GN&C analysis and requirements definition.
- Develop, maintain and implement math models into the ANTARES simulation. Provide Clear Case configuration management of integrated ANTARES and RAMSES baseline releases.
- Support of AA-2 development activities including: GN&C software integration with CSR, AA-2 lab development and test execution, and AA-2 specific simulation development.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CEV-T-031210 Added Rev 3	CEV Subsystem Requirements Specification, Crew Module and Service Module/ Spacecraft Adapter - Guidance, Navigation & Control (GN&C)	6-25-2014
CEV-T-031210 Deleted Rev 3	CEV Subsystem Requirements Specification, Crew Module and Service Module/ Spacecraft Adapter - Guidance, Navigation & Control (GN&C)	5/31/2011 (Rev 5)
CEV-T-078 Deleted Rev 3	Project Orion GN&C Design and Data Book Volume V - Entry, Descent, and Landing	2/16/2009
CEV-T-078 Volumes 1-9 Added Rev 3	Guidance Navigation & Control Data Book	7/11/2014
EG-WI-00177	Integrated Guidance, Navigation, and Control IGN&C Work Instructions	C
EG-WI-00181	Flight Control Design and Analysis Process	C
SO-999-M-JSC-0047 Deleted R4	System Security Plan for the Aeroscience and Flight Mechanics Division	07-01-2013
SO-999-M-JSC-0047 Deleted Rev 3	System Security Plan for the Aeroscience and Flight Mechanics Division	Rev 3 06-30-2011
SO-9999-M-JSC-3173 SPEG0002 Added R4	System Security Plan for the Aeroscience and Flight Mechanics Division	3/23/2015

c. Required DRDs

5.4.1 MPCV GN&C Systems Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
FROM:		
SW-04	Software Code	9/Per GN&C Schedule
TO:		
SW-04 Updated R4	Software Code	15/Per GN&C Schedule
FROM:		
TD-08	Engineering Analysis	12/Per GN&C Schedule
TO:		
TD-08 Updated R4	Engineering Analysis	17/Per GN&C Schedule
TD-11 Updated Rev 3	Test Report	4/Per GN&C Schedule

d. Products

5.4.1 MPCV GN&C Systems Analysis		
Product(s)	Quantity	Delivery Date
ANTARES Simulation Baseline Release	5	6/30/13, 8/31/13, 9/30/13, 3/31/14, 9/30/14
Engineering Analysis Quarterly Summary Report	6	7/31/13, 9/30/13, 12/31/13, 3/31/14, 6/30/14, 9/30/14
Simulation Tool Development Quarterly Summary Report	4	7/31/13, 9/30/13, 3/31/14, 9/30/14
CM GN&C-Propulsion Phasing Test Report	1	Test complete + one month, Per GN&C Schedules
CM GN&C-Comm & Tracking Phasing Test Report	1	Test complete + one month, Per GN&C Schedules
CM S-Band Latency Measurement Test Report	1	Test complete + one month, Per GN&C Schedules
T-078 GN&C Databook updates	1	9/30/14
EM-1 GN&C Prototype Code	1	4/15/14
EM-1 Test Definition Plan Deleted Rev 1	1 Deleted Rev 1	3/31/14 Deleted Rev 1
EFT-1 independent verification by analysis (iVAC) artifacts and reports	1	9/30/13
EFT-1 independent certification by analysis (iCERT) artifacts and reports Added Rev 2	1 Added Rev 2	9/30/14
ANTARES Simulation Baseline Release Added Rev 3	5 Added Rev 3	6/30/13, 8/31/13, 9/30/13, 3/31/14, 9/30/14,
Engineering Analysis Quarterly Summary Report Added Rev 3	4 Added Rev 3	Quarterly + 2 weeks
Simulation Tool Development Quarterly Summary Report Added Rev 3	4 Added Rev 3	Quarterly + 2 weeks
Preliminary CM Pendulum Mode Modeling and Analysis Added Rev 3	1 Added Rev 3	January 2015
MPCV EFT-1 Post-flight Report Added Rev 3	1 Added Rev 3	Launch + 3 months
ANTARES EM-1 CDR Model Validation Added Rev 3	1 Added Rev 3	EM-1 CDR - 4 months
MPCV CDR Entry Analysis Report Deleted R4	1 Deleted R4	EM-1 CDR - 2 months Deleted R4
MPCV CDR Navigation Analysis Report Added Rev 3	1 Added Rev 3	EM-1 CDR - 2 months
ANTARES Simulation Baseline Release Added Rev 3	3 Added Rev 3	EM-1 CDR - 11 months, EM-1 CDR - 8 months, EM-1 CDR - 3 months
ANTARES Simulation Baseline Release Added R4	4 Added R4	FY16 Quarterly per GN&C Integrated Schedule
Engineering Analysis Quarterly Summary Report Added R4	4 Added R4	FY16 Quarterly + 2 weeks
Simulation Tool Development Quarterly Summary Report Added R4	4 Added R4	FY16 Quarterly + 2 weeks
MPCV Post-EM1 CDR GN&C Analysis Report Added R4	1 Added R4	FY16 EM-1 CDR + 3 months

T-078 GN&C Databook Post CDR Update Added R4	1 Added R4	FY16 EM-1 CDR + 6 months
CSU Inspection & Unit Test Reports Added R4	2 Added R4	FY16 Biannually per GN&C Integrated schedule
AA-2 GN&C Developmental Summary Report Added R4	2 Added R4	FY16 Biannually per GN&C Integrated schedule

e. Product Verification

5.4.1 MPCV GN&C Systems Analysis		
i. ANTARES Simulation Baseline Release		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
ii. Engineering Analysis Quarterly Summary Report		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
iii. Simulation Tool Development Quarterly Summary Report		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
iv. CM GN&C-Propulsion Phasing Test Report		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
v. CM GN&C-Comm & Tracking Phasing Test Report		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
vi. CM S-Band Latency Measurement Test Report		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
vii. T-078 GN&C Databook updates		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
viii. EM-1 GN&C Prototype Code		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
ix. EM-1 Test Definition Plan Deleted Rev 1		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
x. EFT-1 independent verification by analysis (iVAC) artifacts and reports		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate		
xi. EFT-1 independent certification by analysis (iCERT) artifacts and reports Added Rev 2		
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 2		
xii. ANTARES Simulation Baseline Release Added Rev 3		

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xiii. Engineering Analysis Quarterly Summary Report Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xiv. Simulation Tool Development Quarterly Summary Report Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xv. Preliminary CM Pendulum Mode Modeling and Analysis Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xvi. MPCV EFT-1 Post-flight Report Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xvii. ANTARES EM-1 CDR Model Validation Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xviii. MPCV CDR Entry Analysis Report Deleted R4
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate
xix. MPCV CDR Navigation Analysis Report Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xx. ANTARES Simulation Baseline Release Added Rev 3
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added Rev 3
xxi. ANTARES Simulation Baseline Release Added R4
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added R4
xxii. Engineering Analysis Quarterly Summary Report Added R4
- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate Added R4

xxiii. Simulation Tool Development Quarterly Summary Report

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

Added R4

xxiv. MPCV Post-EM1 CDR GN&C Analysis Report

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

Added R4

xxv. T-078 GN&C Databook Post CDR Update

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

Added R4

xxvi. CSU Inspection & Unit Test Reports

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

Added R4

xxvii. AA-2 GN&C Developmental Summary Report

Added R4

- Deliverables shall be delivered to DDMS and Flight Sciences laboratory Server or EG AFMD SharePoint Site. Deliverables shall be reviewed for technical content by the NASA TM. When the deliverable is accepted, it will be approved by the EG TM and reported to the EG TMR or EG TMR alternate

Added R4

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 9
Task Order Number: NNJ13HC85T TO#29	Revision Number: 3	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2013 & 2014	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Cold Stowage Systems Development, Operations, and Sustaining Engineering

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5 of the PWS. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order #29 Estimated Cost and Fee			
Summary	Previous Value	This Action	Current Value
Total Direct Labor Hrs	(b)	(4)	
Total Direct Labor Cost			
Subcontractor			
Material			
Travel			
NLR Miscellaneous			
Burden on Non-Labor			
Cost			
Fee			
SOW 1.0			
TOTAL	\$6,159,186	\$225,370	\$6,384,556

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.04.09 10:52:04 -05'00'</small> Signature: _____ Date: 4/9/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ13HC85T-TO29 REV 3

Originator: SHARON CAMPANA (EC7) (281) 244-5508 TMR: MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

Add hardware deliverables (Mini Coldbags, -32 C Icebricks, Double Coldbags, +4 Ice Bricks and mesh bags) changed Spx flights from 3 to 4, changed Orbital flights from 2 to 1.

1. FROM Title of Effort: Cold Stowage Systems Development, Operations, and Sustaining Engineering **Updated Rev 2**

1. Title of Effort: FY15/14 Cold Stowage Systems Development, Operations, and Sustaining Engineering

2. Date of Request: 03/25/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. **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

f. **2.2.4 Training**

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

g. **2.3 Analysis and Assessment**

h. **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.

i.

4. Period of Performance Updated Rev 2

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

5. Product Requirements

5.1 Cold Stowage Mission Integration and Operations Updated Rev 1

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall participate as the hardware developer and demonstrate hardware functionality at cargo reviews and hardware verification reviews. Contractor shall provide temperature controlled transportation of experiments during all phases of transportation (i.e. landing to JSC). Contractor shall perform Integrated Safety Assessments and submit to Payload Safety Review Panel (PSRP) for approval as required.

The contractor shall provide launch and landing activities for temperature conditioned payloads on Space X vehicle. The activities will include launch site preparations at KSC, and landing recovery in California. There will be limited facilities available for Cold Stowage at the landing location, so the samples shall be returned via a NASA provided charter flight or equivalent. It is estimated that 2 Glacier and/or Polars and up to 7 Double Coldbags with Ice Bricks will be flown on ascent and descent of each Space X flight.

The contractor shall perform stowage planning and analysis, conduct thermal analysis, develop and conduct console tools and training, participate in increment and flight simulations, and provide console staffing for real-time engineering assessments, operation, and problem resolution. Contractor shall provide the capability to perform real-time operations off-site, provide inputs and support real time operations data products, and participate in crew training. Contractor shall provide configuration management of sample locations and configurations within Cold Stowage facilities on orbit.

Fed Ex White Glove or equivalent service will be used when shipping Glacier Systems.

Note, unless otherwise noted, reorganization of requirements between 5.1 and 5.2 is effective 10/1. This is due to a shuffling of responsibilities between ISS customers. Updated Rev 1

5.1.1 Cold Stowage Mission Integration Updated REV 3

Project Code: 00010

1. Support late load/early retrieval and post flight processing of Cold Stowage Facility Payloads for up to 4 Space-X flights per year. Post flight processing includes de-integration of the Coldbags, Glaciers and other Cold Stowage hardware in California.
2. Provide Integrated Safety Memos as required.
3. Support pre flight processing of late load Cold bags/Ice Bricks for up to 1 flight per year on Orbital. All hardware handovers to occur at Wallops.
4. Conduct thermal performance and fit check test for experiments requiring Cold Stowage Facility Payloads. Not to exceed more than 10 days of testing per Payload.
5. Conduct Increment Feasibility Assessments to include review and input to Payload Cold Stowage Forms and Payload Integration Agreements (PIAs) as required.
6. Provide inputs/support to ISS Program boards and panels.
7. Develop and maintain a secure Cold Stowage database with the minimum input/output data consisting of the following: input: CS forms and generic flight asset data. Output: reports based on CS forms input data, i.e.: ascent, descent, flight, orientation, initial configuration plan and initial population of PTP table.(effective immediately)
8. Develop a Power Payload Transfer Box to allow for transportation of powered payload lockers (effective immediately)
9. Develop and maintain a battery system to provide power capable of powering any powered locker returning from ISS or powered ground support equipment (effective immediately).
10. Maintain Real Time Configuration Plan for MELFI/Glacier/Coldbag/Ice Brick/Polar.
11. Provide up to 1 stop light charts monthly.
12. Conduct annual Test Readiness Review and provide general Lab Management for the Cold Stowage Lab in B7, Room 2004 and 2007. This includes inventory management, calibration tracking, and maintenance of lab equipment required to support transport, storage, and testing of conditioned science. MELFI equipment will be maintained under WBS 5.2.2.
13. Attend and present Cold Stowage topics at the POIWG a maximum of twice per year.

5.1.2 Real Time Operations Updated Rev 2

Project Code: 00010

For the Glacier, MELFI, Polar (starting after SpX-5), Coldbag/Ice Bricks, and unique Cold Stowage Flight Support equipment, the;

1. Contractor shall participate in Cold Stowage Planning meetings, review, and provide inputs to CEFs (Change Evaluation Forms), Payload Tactical Plans (PTP), OCRs (Operational Change Requests), ECRs (Engineering Change Requests), and Crew Procedures and operations products as required.

2. Provide capability and support Real Time Console Operations for MELFI, Glacier, and Polar, including operations planning and associated data products (Crew Procedures, URC inputs, PDL inputs, CSF). This includes maintaining the TeleScience Support Center (TSC) in an offsite location.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
JSC 65305	Cold Stowage Laboratory (CCSL) Standard Operating Procedure Manual	D
JSC 65381	CSSL Bloodborne Pathogens Exposure Control Plan	D
JSC 65404	Generic Ground Processing and Handling Requirements and Constraints for Cold Stowage	E
SSP 52000-PDS	Payload Data Set Blank Book	G
SSP 57070	Cold Stowage Interface Requirements Documents	C
SSP 57289	Interface Control Document for Coldbag Assembly	A
SSP 57935	Interface Control Document for Icepac Assembly	A
STB-HA-271	Hazard Analysis	H

c. **Required DRDs**

5.1.1 Cold Stowage Mission Integration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.2 Real Time Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.1.1 Cold Stowage Mission Integration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
PRR (formerly 1027) Deleted Rev 1	Max 3 per launch	A/R
Predelivery Test Deleted Rev 1	Max 3 per launch	A/R
Launch Processing TPS Updated REV 3	Max 3 per launch	A/R
Landing Processing TPS Updated REV 3	Max 1 per launch	A/R
Generic Ground Processing and Handling Requirements and Constraints for Cold Stowage Deleted Rev 1	Max 3 revisions	A/R
Verification of Compliance Deleted Rev 1	Max 3 per launch	A/R
CoFR Endorsements (MELFI, Coldbag, Ice Bricks, TSC) Deleted Rev 1	Max 3 per launch	A/R
Series Reflight Assessments and Integration Memos Deleted Rev 1	Max 3 per launch	A/R
LRODS Deleted Rev 1	Max 3 revisions	A/R
Powered Payload Transfer Box (PPTB) Updated REV 3	Max 3 assemblies	11/1/13
Battery System to power lockers and/or GSE Updated REV 3	Max 8 battery boxes, Max 5 Breakout Boxes	11/1/13
Integrated Safety Memos Updated REV 3	Max 3 per launch	A/R

Generic Ground Processing and Handling Requirements and Constraints for Cold Stowage Updated REV 3	Max 3 revisions	A/R
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5.1.2 Real Time Operations		
Product(s)	Quantity	Delivery Date
OCR	A/R	A/R

e. **Product Verification**

5.1.1 Cold Stowage Mission Integration
i. PRR (formerly 1027) Deleted Rev 1
- Submittal through POWRS Deleted Rev 1
ii. Predelivery Test Deleted Rev 1
- Closure in QARC Deleted Rev 1
iii. Launch Processing TPS
- Closure in QARC
iv. Landing Processing TPS
- Closure in QARC
v. Generic Ground Processing and Handling Requirements and Constraints for Cold Stowage Deleted Rev 1
- EC Branch review of deliverable Deleted Rev 1
vi. Verification of Compliance Deleted Rev 1
- Submittal to VERITAS Deleted Rev 1
vii. CoFR Endorsements (MELFI, Coldbag, Ice Bricks, TSC) Deleted Rev 1
- EC Branch review of deliverable Deleted Rev 1
viii. Series Reflight Assessments and Integration Memos Deleted Rev 1
- EC Branch review of deliverable Deleted Rev 1
ix. LRODS Deleted Rev 1
- EC Branch review of deliverable Deleted Rev 1
x. Powered Payload Transfer Box (PPTB)
- EC Branch review of deliverable
xi. Battery System to power lockers and/or GSE
- EC Branch review of deliverable
xii. Integrated Safety Memos
- EC Branch review of deliverable
xiii. Generic Ground Processing and Handling Requirements and Constraints for Cold Stowage
- EC Branch review of deliverable

5.1.2 Real Time Operations
i. OCR
- MSFC POIC System

5.2 Flight Hardware Production and Sustaining **Updated REV 3**

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide support and products associated with flight deliveries for Cold Stowage hardware. Activities and products shall include but are not limited to: configuration of flight items, conducting required pre-flight acceptance tests, performing post flight inspections as well as providing certification necessary for CoFR, verification activities for flight including Certificate of Compliance, reflight verification, RCARs, and MRCARs. Contractor shall prepare and submit forms required for launch on Russian, HTV, ATV, and COTS vehicles. Cold stowage shall plan to support a maximum of 1 Progress flights, 3 SpaceX flights, and 2 other vehicle flights per FY. Contractor shall track limited life items and refurbish cold stowage hardware as necessary to maintain sufficient inventory.

Individual item quantities and product deliverable dates and tasks, including process tailoring, shall be defined via Project Directives (PD) based on flight requirements, vehicle schedule, and environments. All PD's are to be approved by the EC7 Branch Management (or equivalent) and the JETS COR.

Post hardware delivery, the contractor shall support anomaly resolution, act as an interface to the MER PIRATe, and act as liaison for sustaining engineering of MELFI with ESA. **Updated REV 3**

5.2.1 Flight Hardware Production **Updated REV 3**

Project Code: 00010

1. Fabricate hardware per CR 013661, build +22°C Ice Bricks and +27°C Ice Bricks (effective immediately)
2. Fabricate hardware per CR 013774, build New Double Cold Bags (effective immediately)
3. Fabricate hardware per CR 013827, build +4°C Ice Bricks (effective immediately)
4. Fabricate hardware per CR 014094, build 75 ea +12°C, +17 °C, and +25 °C Ice Bricks (effective immediately)
5. Fabricate hardware 10 Mini Coldbags SEG39136378-303, and 75 -32 Ice Bricks SEG33121016-309
6. Fabricate hardware per CR 014392, build 54 +4 Ice Bricks SEG33121016-301, 100 mesh bags SEG33121012-301 (FY15), and 3 Double Coldbags SEG39136374-303 (FY16). *Note FY16 work is not part of this revision and is planned to be added later.*

5.2.2 Cold Stowage Hardware Development/Sustaining Engineering **Updated Rev 2**

Project Code: 2C004 and 00010

1. Provide engineering services for MELFI and Glacier anomaly resolution. This includes analyzing flight data, conducting test with the MELFI Engineering Qualification Model (EQM), and Glacier Qualification Unit in the Cold Stowage Lab, supporting meetings associated with the anomaly, including but not limited to FITs, MART/ART. Polar shall be included in these tasks starting with SpX-6 launch.
2. Act as liaison between the MELFI and Glacier Operations Team and the MER PIRATe. Polar shall be included in these tasks starting with SpX-6 launch.
3. Act as liaison between NASA and ESA in regards to MELFI Sustaining Engineering
4. Update and Maintain MELFI Log Books
5. Maintain MELFI Equipment in the Cold Stowage Lab. This includes the Laboratory Ground Model (LGM), MELFI EQM and ancillary equipment including vacuum and water pumps, STEP and other IT equipment necessary to operate the EQM. Training model in B5 to be maintained by OZ.
6. Provide export documentation as required to ship MELFI hardware to OEM.
7. Maintain Glacier equipment in the Cold Stowage Lab. This includes the Glacier qual model and ancillary equipment including the GSE support cart and other equipment necessary to operate the Qual model.
8. Perform engineering testing remotely in the Payload Rack Checkout Unit (PRCU) for verification of future EXPRESS Rack Glacier operations on ISS.
9. Maintain supply of desiccant and mesh bags on ISS
10. Provide Reflight Safety Data Packages as required.
11. Conduct required PDA/PIA of Cold Stowage Facility Payloads for flight delivery. This includes up to 3 SpaceX flights per year and up to 2 other visiting vehicle flights per year. This also includes obtaining PRR (formerly 1027).
12. Provide necessary verification forms such as Certificate of Compliance, CoFR, LROD, RCAR, and/or ERCAR.
13. Support Public Relation events as needed. Support includes but is not limited to procurement of material and/or goods in support of the event; i.e., ice cream, patches, etc.
14. Provide Electrical Engineering inputs and design recommendations for Polar, to include, but not limited to transient current reduction, and steady state ripple reduction.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011

SSP 50476 Added Rev 2	Joint Implementation Plan for MELFI	B
SSP 57212	MELFI Hardware Interface Control Document	D
SSP 57289 Added Rev 2	ICD for Coldbag	A
SSP 57935 Added Rev 2	ICD for Ice Brick Assembly	A

c. **Required DRDs**

5.2.1 Flight Hardware Production		
DRD #	DRD Title	Quantity/Frequency
None		NA

5.2.2 Cold Stowage Hardware Development/Sustaining Engineering		
DRD #	DRD Title	Quantity/Frequency
None		NA

d. **Products**

5.2.1 Flight Hardware Production		
Product(s)	Quantity	Delivery Date
Fabrication and delivery of +22Å°C Ice Bricks and +27Å°C Ice Bricks Updated REV 3	Per CR 013661	Per CR 013661
Fabrication and delivery of New Double Cold Bags Updated REV 3	Per CR 013774	Per CR 013774
Fabrication and delivery of +4Å°C Ice Bricks Updated REV 3	Per CR 013827	Per CR 013827
Fabrication and delivery of +12Å°C, +17Å°C, +25Å°C Ice Bricks Updated REV 3	CR 014094	CR 014094
Fabrication and delivery of 54 +4 Ice Bricks and 100 mesh bags Updated REV 3	CR 014392	CR 014392
Fabrication and delivery of 10 Mini Coldbags, and 75 -32 Ice Bricks Updated REV 3	various	5/2015

5.2.2 Cold Stowage Hardware Development/Sustaining Engineering		
Product(s)	Quantity	Delivery Date
MELFI Log Books Updated REV 3	3 per year	A/R
PRR (formerly 1027) Updated REV 3	Max 3 per launch	A/R
Predelivery Test Updated REV 3	Max 3 per launch	A/R
Verification of Compliance Updated REV 3	Max 3 per launch	A/R
CoFR Endorsements (MELFI, Coldbag, Ice Bricks, TSC) Updated REV 3	Max 3 per launch	A/R
Series Reflight Assessments Updated REV 3	Max 3 per launch	A/R
Launch Return and On-Orbit Data Set (LRODS) Updated REV 3	Max 3 per launch	A/R
Revise Cold Stowage Passive Hardware Requirements Document Updated REV 3	1	A/R
Joint Implementation Plan for Minus Eighty Laboratory Freezer for ISS Added Rev 2	1	A/R

e. **Product Verification**

5.2.1 Flight Hardware Production

i. Fabrication and delivery of +22Â°C Ice Bricks and +27Â°C Ice Bricks
- DD250
ii. Fabrication and delivery of New Double Cold Bags
- DD250
iii. Fabrication and delivery of +4Â°C Ice Bricks
- DD250
iv. Fabrication and delivery of +12Â°C, +17Â°C, +25Â°C Ice Bricks
- DD250
v. Fabrication and delivery of 54 +4 Ice Bricks and 100 mesh bags
- DD250
vi. Fabrication and delivery of 10 Mini Coldbags, and 75 -32 Ice Bricks
- DD250

5.2.2 Cold Stowage Hardware Development/Sustaining Engineering
i. MELFI Log Books
- EC Branch review of deliverable
ii. PRR (formerly 1027)
- Submittal via POWRS
iii. Predelivery Test
- Closure per QARC
iv. Verification of Compliance
- Submittal via VERITAS
v. CoFR Endorsements (MELFI, Coldbag, Ice Bricks, TSC)
- EC Branch review of deliverable
vi. Series Reflight Assessments
- EC Branch review of deliverable
vii. Launch Return and On-Orbit Data Set (LRODS)
- EC Branch review of deliverable
viii. Revise Cold Stowage Passive Hardware Requirements Document
- EC Branch review of deliverable
ix. Joint Implementation Plan for Minus Eighty Laboratory Freezer for ISS
- EDMS Added Rev 2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ13HC87T TO#31	Revision Number: 4	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2013/2014/2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: EVA & IVA GFE Tools & Equipment & Habitability Systems Projects

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Estimated Cost and Fee			
Summary	Previous Value	This Action	Current Value
Direct Labor Hrs	(b)	(4)	
Direct Labor Cost			
Subcontract			
Material			
Travel			
NLR Misc.			
Burden on Non-Labor			
Total Non-Labor			
Cost			
Fee			
SOW 1.0			
TOTAL	\$4,183,529	\$214,282	\$4,397,811

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD
Date: 2015.06.02 16:42:06 -0500

Signature: _____ Date: **6/2/15**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ13HC87T-TO31 REV 4

Originator: CURTIS NEWMAN (EC7) (281) 483-9062 TMR: MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

Revision 4 adds 2 EVA projects in FY'15 for a total of 5 in FY15, and a total of 9 overall.

1. FROM Title of Effort: EVA & IVA GFE Tools & Equipment & Habitability Systems Projects **Updated Rev 2**

1. Title of Effort: FY15/14 EVA & IVA GFE Tools & Equipment & Habitability Systems Projects

2. Date of Request: 05/18/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. **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

f. **2.2.4 Training**

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

g. **2.3 Analysis and Assessment**

h. **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.

i.

4. Period of Performance Updated Rev 2

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

5. Product Requirements

5.1 EVA GFE Tools and Equipment Engineering Projects Updated REV 4

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform highly-specialized engineering and technical services to accomplish the programmatic objectives of the NASA/JSC Crew and Thermal Systems Division for ISS and Advanced NASA Programs. Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

Revision 1 reduces the number of EVA GFE Hardware tasks from 5 to 4 for FY'14.

Revision 2: The contractor shall perform 3 additional EVA GFE Hardware projects in FY15. This increases the contract total from 4 to 7 projects.

Revision 4: The contractor shall perform 2 additional EVA GFE Hardware projects, for a total of 5 in FY15. This increases the contract total from 7 to 9 projects. Updated REV 4

5.1.1 EVA GFE Hardware Projects Updated Rev 2

Project Code: Multiple

The contractor shall provide engineering, design, analysis, fabrication, assembly, test and delivery of unique space flight hardware associated with extravehicular activity such as the 7/16" Hex Driver and EHIP Battery Power Adapter. Typical activities include but are not limited to requirements development, design, manufacturing/fabrication, certification, and acceptance activities.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
EA-WI-023	Project Management of GFE Flight Projects	G
JSC-26626	EVA Generic Design Requirements Document	A

c. Required DRDs

5.1.1 EVA GFE Hardware Projects		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-05	Certification and Acceptance Requirements Document (CARD)	as required per PD
RV-08	Engineering Drawings and Model Files	as required per PD
TD-03	Flight Product Critical Design Review (CDR) Data Package	as required per PD
TD-04	Acceptance Data Package (ADP)	as required per PD
TD-06	Certification Data Package	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-16	Space Station Hardware Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)	as required per PD
TD-19	Space Station Hazard Reports (HRs)	as required per PD

TD-19	Risk Assessment Executive Summary Report	as required per PD
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d. **Products**

5.1.1 EVA GFE Hardware Projects		
Product(s)	Quantity	Delivery Date
EVA Hardware Projects Updated REV 4	9	per PD

e. **Product Verification**

5.1.1 EVA GFE Hardware Projects		
i. EVA Hardware Projects		
- Completed upon verification and acceptance by the EC7 Branch Chief or designee		

5.2 EVA Development & Verification Testing Updated Rev 2

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform highly-specialized engineering and technical services to accomplish the programmatic objectives of NASA/JSC Crew and Thermal Systems Division for Shuttle, ISS, and Advanced NASA Programs. Project Directives will be used define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

Revision 2: The contractor shall perform 4 additional EDVT projects in FY15. This increases the contract total from 3 to 7 projects. Updated Rev 2

5.2.1 EVA Development & Verification Testing

Project Code: Multiple

Contractor shall perform all aspects relating to the conducting of the ISS EVA development testing including test planning, test objective development, test performance and post test data documentation and reporting. Develop test plans for verifying EVA translation and worksite analyses and conduct tests using JSC facilities such as the Neutral Buoyancy Lab, air bearing floor, vacuum chambers, and glove boxes. Design and fabricate mockups and models of hardware needed to conduct tests. The contractor shall also provide unique test hardware inclusive of design, fabrication, assembly and integration, coordination and performance of test readiness reviews and the preparation of hazard reports and analysis.

b. **Applicable Documents**

Document Number	Document Name	Rev.
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
AOD 33899	JSC Reduced Gravity Program User's Guide	D
DX-007	DX Safety Review/Test Readiness Review Process	C
DX-POL-002	Neutral Buoyancy Laboratory Standard Operating Plan	D
DX-SLP-014	NBL Mockup and Training Hardware Requirements	B
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	A
SSP 50005	Flight Crew Integration Standard (NASA-STD-3000/T)	E

c. **Required DRDs**

5.2.1 EVA Development & Verification Testing		
DRD #	DRD Title	Quantity/Frequency

RV-08	Engineering Drawings and Model Files	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-11	Test Report	as required per PD

d. **Products**

5.2.1 EVA Development & Verification Testing		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
EVA Development & Verification Testing Projects	7	per PD

e. **Product Verification**

5.2.1 EVA Development & Verification Testing	
i. EVA Development & Verification Testing Projects	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	

5.3 IVA FCE GFE Tools and Equipment Engineering Projects Updated Rev 2

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform highly-specialized engineering and technical services to accomplish the programmatic objectives of the NASA/JSC Crew and Thermal Systems Division for ISS and Advanced NASA Programs.
Project Directives will be used define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

Revision 1 reduces the number of IVA FCE GFE Hardware tasks from 3 to 0 for FY'14. Updated Rev 2

5.3.1 IVA FCE GFE Hardware Projects

Project Code: Multiple

The contractor shall provide engineering, design, analysis, fabrication, assembly, test and delivery of unique space flight hardware associated with IVA FCE. Typical activities include but are not limited to requirements development, design, manufacturing/fabrication, certification, and acceptance activities.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
EA-WI-016	Off-the-Shelf Hardware Utilization in Flight Hardware	Baseline
EA-WI-023	Project Management of GFE Flight Projects	G
SSP-50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	C

c. **Required DRDs**

5.3.1 IVA FCE GFE Hardware Projects

DRD #	DRD Title	Quantity/Frequency
RV-03	Project Technical Requirements Specification (PTRS)	as required per PD
RV-04	Project Requirements and Verification Documentation (PRVD)	as required per PD
RV-08	Engineering Drawings and Model Files	as required per PD
TD-03	Flight Product Critical Design Review (CDR) Data Package	as required per PD
TD-04	Acceptance Data Package (ADP)	as required per PD
TD-06	Certification Data Package	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-16	Space Station Hardware Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)	as required per PD
TD-19	Space Station Hazard Reports (HRs)	as required per PD
TD-19	Risk Assessment Executive Summary Report	as required per PD

d. **Products**

5.3.1 IVA FCE GFE Hardware Projects		
Product(s)	Quantity	Delivery Date
IVA FCE Projects	0	per PD

e. **Product Verification**

5.3.1 IVA FCE GFE Hardware Projects
i. IVA FCE Projects
- Completed upon verification and acceptance by the EC7 Branch Chief or designee

5.4 Habitability Systems Engineering Projects Updated Rev 3

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform highly-specialized engineering and technical services to accomplish the programmatic objectives of the NASA/JSC Crew and Thermal Systems Division for ISS and Advanced NASA Programs. Project Directives will be used define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

Revision 1 adds the PWD new build volume selector switch modifications.

Revision 2: The contractor shall perform additional FY14 tasks including PWD ORU Filter Assembly and Cleaning Procedure update, perform an investigation on the ORU Filter S/N 1006 returned from orbit, and transfer hardware to building 421, as part of FY14 Sustaining tasks, and perform additional PWD Qualification testing as part of FY14 PWD New Build tasks. The contractor shall conduct FY15 activities for PWD including delivering 2 PWD ORU Filter Assemblies, performing sustaining engineering tasks, and completing PWD New Build Certification tasks.

Revision 3: The contractor shall perform additional FY15 tasks including PWD disinfection, cracked knob evaluation, ORU Filter life extension investigation, FIAR/TPS/DR activities, ORU Filter procedure revision, PWD cart maintenance and upgrades, spare parts inventory and transfer to bond, and sustaining engineering/anomaly resolution activities. All activities and due dates will be documented on the FY15 sustaining engineering PD. Updated Rev 3

5.4.1 Habitability Systems Hardware Projects Updated Rev 3

Project Code: Multiple

The contractor shall provide engineering, design, analysis, fabrication, assembly, test and delivery of unique space flight hardware associated with Habitability Systems, including but not limited to the Potable Water Dispenser (PWD). Activities include manufacturing, testing, certification, and acceptance of the redesigned PWD, redesign retro fit kits for the on-orbit PWD and the ground trainer, ORU Filter manufacturing and testing and delivery, and overall sustaining engineering activities.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
EA-WI-016	Off-the-Shelf Hardware Utilization in Flight Hardware	Baseline
EA-WI-023	Project Management of GFE Flight Projects	G
SSP-50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	C

c. Required DRDs

5.4.1 Habitability Systems Hardware Projects		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-03	Project Technical Requirements Specification (PTRS)	as required per PD
RV-04	Project Requirements and Verification Documentation (PRVD)	as required per PD
RV-08	Engineering Drawings and Model Files	as required per PD
TD-03	Flight Product Critical Design Review (CDR) Data Package	as required per PD
TD-04	Acceptance Data Package (ADP)	as required per PD
TD-06	Certification Data Package	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-16	Space Station Hardware Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)	as required per PD
TD-19	Space Station Hazard Reports (HRs)	as required per PD
TD-19	Risk Assessment Executive Summary Report	as required per PD

d. Products

5.4.1 Habitability Systems Hardware Projects		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
PWD (new build with upgrades)	1	per PD
PWD redesign retro fit kit (flight)	1	per PD
PWD redesign retro fit kit (trainer)	1	per PD
PWD Sustaining Engineering (FY 13)	1	per PD
PWD Sustaining Engineering (FY 14)	1	per PD

PWD ORU Filter	4	per PD
PWD new build volume selector switch modifications Added Rev 1	1	per PD
PWD Sustaining Engineering (FY15) Added Rev 2	1	per PD

e. Product Verification

5.4.1 Habitability Systems Hardware Projects
i. PWD (new build with upgrades)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
ii. PWD redesign retro fit kit (flight)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
iii. PWD redesign retro fit kit (trainer)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
iv. PWD Sustaining Engineering (FY 13)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
v. PWD Sustaining Engineering (FY 14)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
vi. PWD ORU Filter
- Completed upon verification and acceptance by the EC7 Branch Chief or designee
vii. PWD new build volume selector switch modifications
- Completed upon verification and acceptance by the EC7 Branch Chief or designee Added Rev 1
viii. PWD Sustaining Engineering (FY15)
- Completed upon verification and acceptance by the EC7 Branch Chief or designee Added Rev 2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ13HD26T TO#69	Revision Number: Rev 1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3 of Performance Work Statement	Fiscal Year(s): 2013, 2014 & 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ARES Astromaterials Curation

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4 of the Performance Work Statement (PWS)

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5 of the PWS. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Authorization – Rev 1			
	Previous Value	This Action (Rev 1)	Current Value (Rev 1)
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
Total	\$4,326,906	\$3,635,079	\$7,961,985

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

Signature:  Date: **3/27/2014**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ13HD26T-TO69 REV 1

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (KX) (281) 244-8848

Revision Summary:

This revision is to:

1)Extend the existing scope of work defined in KT-AC-01 rev A RES Astromaterials Curation Work Plan through September 27, 2015. Services are delivered via quarterly acceptance/delivery letter.

2)Increase the informatics database and web development deliverables defined in KT-AC-01 rev A, section 3.2 and table 7.1.

1. Title of Effort: ARES Astromaterials Curation

2. Date of Request: 02/20/2014

3. Statement of Work Task Description

a. **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.

b. **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

c. **2.2.4 Training**

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

d. **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.

e. **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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance Updated REV 1

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/27/2015.

5. Product Requirements

5.1 Astromaterials Curation

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide specialized science, engineering, and technical products for the Astromaterials Acquisition and Curation Office as detailed in the specific product and service requirements and deliverables defined in the Astromaterials Curation Work Plan, KT-AC-001:
- Readiness and Functionality (2.0)
 - Capabilities (3.0)
 - Curation Products and Services (4.0)
 - o New/Returned Sample Processing and Inventories
 - Lunar Sample Collections
 - Meteorite Collection
 - Genesis Solar Wind Collection
 - Stardust Collections
 - Cosmic Dust Collection
 - Hayabusa Collections
 - Space Exposed Hardware
 - o Data Center and Informatics
 - Advanced Curation Communications, Education and Outreach (5.0)
 - Future Mission Planning (6.0)
 - Product Deliverables and Verification (7.0)

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process. No flight products are required.

5.1.1 Astromaterials Curation Products

Project Code:

Specific product and service requirements and deliverables are defined in the Astromaterials Curation Work Plan, KT-AC-001

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-002	ARES Infrastructure Requirements	Rev 6, 12-12-2011
KA-INF-001	ARES Infrastructure Maintenance and Operations	Original, 4/15/2013
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 2/1/2011
KT-001	Astromaterials Acquisition and Curation Office Configuration Management	Rev 1, 11/01/2010
KT-AC-001 Added REV 1	Astromaterials Curation Work Plan	Rev A, 03/07/2014
KT-WI-001	Process for Astromaterials Curation	Rev 3.1, 05/05/2012
NPD 7100.1E	Curation of Extraterrestrial Materials	02/11/2003

c. Required DRDs

5.1.1 Astromaterials Curation Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter

d. Products

5.1.1 Astromaterials Curation Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report per TD-12	1/Quarter	Quarterly

e. Product Verification

5.1.1 Astromaterials Curation Products
. Delivery Acceptance Report per TD-12
- NASA TM and TMR/alternate approval of Delivery Acceptance Report

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ13HD32T TO#75	Revision Number: Rev 1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3 of Performance Work Statement	Fiscal Year(s): 2013 & 2014	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Chris Gaspard Tel No.: 281-483-0034 E-mail: cgaspard@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ARES Remote Sensing Operations and Science

Task Order Contract Type: Cost Plus Award Fee – Completion Form

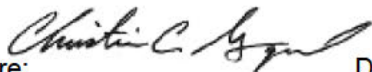
Period of Performance: See Item 4 of the Performance Work Statement (PWS)

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5 of the PWS. Detailed task descriptions are included in the following pages.

Task Order Authorization			
	Previous Value	This Action	Current Value
Total Cost	(b) (4)		
Fee			
SOW 1.0			
TOTAL	\$1,602,347	\$1,124,083	\$2,726,430

This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard  Signature: _____ Date: 4/22/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ13HD50T-TO75 REV 1

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (KA) (281) 244-8848

Revision Summary:

The purpose of the revision is as follows:

1. Add the development of an Earth Science Data Integration Tool (Remote Sensing Operations & Science Plan, Sections 3.0, 7.0)
2. Add Mission Operation Camera Technology, Section 3.0
3. Add domestic and international travel to include Technical Interchange Meetings with ISS payload partners, European Space Agency, ISS Research and Development Conference, and Roscosmos (Russian Federal Space Agency), as well as Education and Public Outreach events (Sections 4.1, 4.3, 5.2)
4. Updates to the topical organization and definition of Remote Sensing Operations & Science Plan, primarily Section 4.0 Products and Services, to include realignment with a new sub-section, 4.3 ISS Remote Sensing Team Interface.
5. To extend the period of performance to September 30, 2015

1. Title of Effort: ARES Remote Sensing Operations and Science

2. Date of Request: 04/03/2014

3. Statement of Work Task Description

a. **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.

b. **2.2.4 Training**

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

c. **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.

d. **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.

e. **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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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.

k.

4. Period of Performance Updated REV 1

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

5. Product Requirements

5.1 ARES Remote Sensing Operations & Science Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Earth Science and Remote Sensing services in accordance with the KX-RS-001 ARES Remote Sensing Operations & Science Plan. Deliverable Products are listed in section 7.0 of KX-RS-001. No flight hardware or software services are provided by this Task Order.

5.1.1 Remote Sensing Operations & Science Services and Products Updated REV 1

Project Code:

The contractor will perform the services described in KX-RS-001:

2.0 Readiness

- 2.1 Management
- 2.2 Facility Readiness
- 2.3 Document and Data Readiness
- 2.4 Organizational Readiness

3.0 Capabilities

4.0 Products and Services

- 4.1 ISS Program Science Office Support
- 4.2 Crew Earth Observations
- 4.3 ISS Remote Sensing Team Interface
- 4.4 Regional Remote Sensing

5.0 Communications and Outreach

- 5.1 External Communications
- 5.2 Public Outreach

6.0 Development

7.0 Product Deliverables and Verification

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-002	ARES Infrastructure Services Requirements	Rev 6, 12/12/2011
KA-INF-001	ARES Infrastructure Maintenance and Operations	Original, 4/15/2013
KA-WI-001	ARES Master Work Instruction	Rev 5 / 06-12
KA-WI-002	ARES Configuration Management	Rev 3 / 03-12
KA-WI-003	ARES Management or Research Proposals	Rev 3, 02/01/2011
KX-001	Office for Human Exploration Science Configuration Management Process	Rev 4.1 / 03-11
KX-RS-001 Added REV 1	Remote Sensing Operations & Science Plan	Rev 1, 4/2/2014

c. Required DRDs

5.1.1 Remote Sensing Operations & Science Services and Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

TD-12	Delivery Acceptance Report	1/Quarterly/Quarterly
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d. **Products**

5.1.1 Remote Sensing Operations & Science Services and Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products identified in KX-RS-001	1/Quarter	Quarterly

e. **Product Verification**

5.1.1 Remote Sensing Operations & Science Services and Products		
. Delivery Acceptance Report (per DRD TD-12) on products identified in KX-RS-001		
- NASA TM and TMR approval of Delivery Acceptance Report		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ13HD33T TO#76	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2013, 2014 & 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ARES Infrastructure Maintenance and Operations

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b) (4)		
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$9,759,720	(\$156,401)	\$9,603,319

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

**CHRISTIAN
GASPARD**

Signature: _____ Date: **5/21/15**
Contracting Officer

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA,
ou=People, 0.9.2342.19200300.100.1.1=cgaspard,
cn=CHRISTIAN GASPARD
Date: 2015.05.21 14:49:08 -05'00'

JSC Engineering, Technology and Science Contract

NNJ13HD33T-TO76 REV 2

Originator: SUSAN RUNCO (KX) (281) 244-8848 TMR: SUSAN RUNCO (XI) (281) 244-8848

Revision Summary:

The ARES Infrastructure and Maintenance work plan, XI-INF-001, is revised to reflect the de-scoped requirements as follows: The contractor shall decrease facility maintenance and operations services in the following areas; (1) decrease electro-mechanical technical services due to a reduction in research operations; (2) decrease the comprehensive facility engineering services due to a reduction in research operations and related facility services, (3) reduce administrative services due to reduced research staff; and (4) reduce the software licenses and renewals, and maintenance contracts due to the implementation of the NASA Enterprise License Management process and decrease in research operations. Increases in scope include admin services and travel associated with Education & Outreach, and travel for training associated with the Ion Chromatograph.

1. FROM Title of Effort: ARES Infrastructure Maintenance and Operations **Updated REV 2**

1. Title of Effort: FY15/14 ARES Infrastructure Maintenance and Operations

2. Date of Request: 05/07/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. **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.

g. **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.

h. **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.

i. **2.6 Special Projects**

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

4. Period of Performance Updated Rev 1

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/01/2013 and ends 09/30/2015.

5. Product Requirements

5.1 ARES Infrastructure Maintenance and Operations Updated REV 2

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide ARES Infrastructure Maintenance and Operations services as defined in the ARES Infrastructure Maintenance and Operations Plan, XI-INF-001, outlined in section 5.1.1. Updated REV 2

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services Updated REV 2

Project Code:

The contractor shall provide ARES Infrastructure Maintenance and Operations products and services as defined in the ARES Infrastructure Maintenance and Operations Plan, XI-INF-001, outlined in the sections below.

- 1.0 Introduction
- 2.0 Facility and Organizational Readiness
- 3.0 Capabilities and Systems Development
- 4.0 Products and Services
 - 4.1 Facility Management
 - 4.2 Facility Engineering
 - 4.3 Technical Services
 - 4.4 Safety and Occupational Health
 - 4.5 Environmental Services
 - 4.6 Scientific Instrument Service Contracts
 - 4.7 IT Services

- 4.8 ARES Processes and Document Management
- 5.0 External Communications and Public Outreach
- 6.0 Business Development & Special Projects
- 7.0 Product Deliverables and Verification

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process. No flight products are required.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 02/01/2011
XI-INF-001 Added REV 2	ARES Infrastructure Maintenance and Operations Plan	Original, 05/04/2015

c. Required DRDs

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products identified in XI-INF-001 Updated REV 2	1/Quarter	Quarterly

e. Product Verification

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services	
i. Delivery Acceptance Report (per DRD TD-12) on products identified in XI-INF-001	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 27
Task Order Number: NNJ15HA28T TO# 110		Revision Number: 5		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ES Structural Engineering Services

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,782,673	-\$30,244	\$3,752,428

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Rochelle N. Overstreet	
Name: _____		Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.08.20 11:10:04 -05'00'	
Signature: _____ Date: _____		Signature: _____ Date: 8/20/15 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA28T-TO110 R5

Originator: SHIRLEY HOLLAND-HUNT (ES18) **TMR:** SHIRLEY HOLLAND-HUNT (ES) (281) 483-3254

Revision Summary:

CLIN 5.1 The contractor shall reduce the hours of Engineering Services for Orion Mech system assessments

CLIN 6.2 The contractor shall reduce the work cost authorization of Engineering Services for Orion Loads & Dynamics CLIN to reflect savings or under run

CLIN 6.3 The contractor shall reduce the hours of Engineering Services for Technology development

CLIN 3.1 The contractor shall reduce the hours of Engineering Services for ES3 Thermal design Branch Services

CLIN 2.1 The contractor shall increase the hours of Engineering Services for Orion CSM

CLIN 2.2 The contractor shall increase the hours of Engineering Services for PSRP/GCAR review

CLIN 2.4 The contractor shall increase the hours of Engineering Services for Structural Tech development

1. Title of Effort: FY15 ES Structural Engineering Services (LOE)

2. Date of Request: 08/10/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. **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.

f. **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

g. **2.2.4 Training**

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

h. **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.

i. **2.3 Analysis and Assessment**

j. **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.

k. **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.

l. **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.

m. 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.

n. 2.4 Facilities

o. 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.

p. 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.

q. 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.

r. 2.5 Research and Development

s. 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, Descent, 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.

t. 2.6 Special Projects

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

u.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 ES18 Managment Integration Office Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall (INACTIVE)

5.1.1 INACTIVE)

Project Code:

See PD for all charge code and reporting requests

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirement for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

- c. **Required DRDs**

5.1.1 INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

- d. **Products**

5.1.1 INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

- e. **Product Verification**

5.1.1 INACTIVE)	
i. LOE	
- LOE	

5.2 ES2 Structural Branch Services Updated Rev 4

Requirement - In compliance with the above identified SOW(s) the contractor shall provide

Review of structural engineering estimates
Review of performance of trade studies
Review of performance of structural engineering assessments and analysis
Safety assessments
Development of anomaly resolution recommendations
Participation in GFE project technical reviews
Travel to support Orion PDRs and TIMs
Structural design services including outer mold line definition, structural layout, and subsystem/payload placement for advanced vehicle studies

Related to:

Spacecraft payloads
ISS, Orion, GFE projects
Technology Development projects

Representative of:

Engineering requirements analysis reports for ISS Program projects
Orion Project Stress Analysis Summary reports
GFE Technology Development projects

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.2.1 Orion CSM

Project Code:

See PD for all charge code and reporting requests

5.2.2 PSRP/GCAR Review

Project Code:

See PD for all charge code and reporting requests

5.2.3 GFE Core Team

Project Code:

See PD for all charge code and reporting requests

5.2.4 Structural Technologies Development Added Rev 4

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34241)JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware	Baseline
NSTS 08307	Criteria for Pre-Loaded Bolts	Rev A
NSTS 13830	Payload Safety Review and Data Submittal Requirements for Payloads Using the Shuttle and ISS	Rev C, Change 4 01-02
NSTS 14046	Payload Verification Requirements	Rev E, Change 3 08-02
NSTS 1700.7B ISS	Safety Policy and Requirements for Payloads Using the ISS	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. Required DRDs

5.2.1 Orion CSM		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.2 PSRP/GCAR Review		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.3 GFE Core Team		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.4 Structural Technologies Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 4		LOE

d. Products

5.2.1 Orion CSM			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

5.2.2 PSRP/GCAR Review			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

5.2.3 GFE Core Team			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

5.2.4 Structural Technologies Development			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE Added Rev 4	LOE Added Rev 4	LOE	

e. Product Verification

5.2.1 Orion CSM	
i. LOE	
- LOE	

5.2.2 PSRP/GCAR Review	
i. LOE	

- LOE

5.2.3 GFE Core Team
i. LOE
- LOE

5.2.4 Structural Technologies Development
i. LOE Added Rev 4
- LOE Added Rev 4

5.3 Thermal Design Branch Services Updated Rev 3

Requirement - In compliance with the above identified SOW(s) the contractor shall provide

Thermal Analysis Support and Reports
System management activities
Travel to support System management activities

Related to:
International Space Station Program
Orion MPCV Program
Commercial Crew Integrated Capability (CCiCap) Program

Representative of:
On-orbit thermal analyses
Entry thermal analysis
Thermal test simulation

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES3 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.3.1 ES3 Thermal Design Branch Services

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	Current

c. Required DRDs

5.3.1 ES3 Thermal Design Branch Services		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.3.1 ES3 Thermal Design Branch Services		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.3.1 ES3 Thermal Design Branch Services	
i. LOE	
- LOE	

5.4 ES4 Materials and Processes Branch Services (INACTIVE)

a. Requirement - In compliance with the above identified SOW(s) the contractor shall provide

Assessments

Support for technology development projects for fracture and materials

Support for technology development projects for fracture mechanics

Prepare releases of the fracture mechanics software NASGRO, including but not limited to alpha, beta, and production releases, with maintenance and user support as required

Develop new features in NASGRO.

Attend two annual program meetings and shall prepare and deliver presentations at those two annual meetings.

Related to:

ISS Program

Orion Program

Technology Development projects

Representative of:

Life cycle reviews

Safety Data Package Reviews

Problem Resolutions

Certifications

Hardware design support

Oversight activities

OCCPs

Payload TRR Reviews

Hardware inspections

Drawing reviews

NDE development tasks

In accordance with:

SOP-001.31

SOP-001.32

Under the governance of:

The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.4.2 ISS EVA Materials/Fracture (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.4.3 ISS Materials/Fracture Control (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.4.4 NASGRO (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.4.5 Ellington Aircraft (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.4.6 NDE Projects (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
AOD 33890	WB-57 Users Guide	Baseline/Feb 2002
EA-WI-025	GFE Flight Project Software and Firmware Development	Rev A 11-01
JSC 22267	Fatigue Crack Growth Computer Program NASGRO V 3.0	A
JSC 25863	Fracture Control Plan for JSC Spaceflight Hardware	B/April 2009
JSC 27301	Materials Control Plan for JSC Flight Hardware	F/August 2009
MIL-HDBK-6870A	Inspection Program Requirements Nondestructive for Aircraft and Missile Materials and Parts	Current
MSFC-HDBK-527/JSC 09604	Materials Selection List for Space Hardware Systems	F/09-88
NASA-STD-5003	Fracture Control Requirements for Payloads Using the Space Shuttle	10-96
NASA-STD-5009	Nondestructive Evaluation Requirements for Fracture Control Programs	Current
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware	Baseline/Jan 2008
NASA-STD-6016	Standard Materials and Processes Requirements for Spacecraft	Baseline/July 2008

NASA/SP-2007-6105	NASA Systems Engineering Handbook	1/12-07
NSTS 14046	Payload Verification Requirements	Rev E Change 3 08-02
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System	Change 13 08-02
NSTS 1700.7B ISS Addendum	Safety Policy and Requirements for Payloads Using the International Space Station	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-007.5	Materials and Processes Drawing Approval	D/July 2009
SOP-007.6	Materials and Fracture Control Certification	C/July 2009
SOP-009.98	Preparation of an Operation & Configuration Control Plan (OCCP) for Category B Pressure Vessels/Systems (PV/S)	Baseline/Jan 2010
SSP 30233	Space Station Requirements for Materials and Processes	G/November 2004
SSP 30558	Fracture Control Requirements for Space Station	Rev C 11-01
SSP 52005	ISS Payload Flight Equipment Requirements for Safety Critical Structures	C/December 2002

c. Required DRDs

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.4 NASGRO (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.5 Ellington Aircraft (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.6 NDE Projects (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.4 NASGRO (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.5 Ellington Aircraft (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.6 NDE Projects (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
i. LOE		
- LOE		

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
i. LOE		
- LOE		

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
i. LOE		
- LOE		

5.4.4 NASGRO (INACTIVE)		
i. LOE		
- LOE		

5.4.5 Ellington Aircraft (INACTIVE)		
i. LOE		
- LOE		

5.4.6 NDE Projects (INACTIVE)		
--------------------------------------	--	--

i. LOE
- LOE

5.5 ES5 Mechanical Design and Analysis Branch Services Updated Rev 3

Requirement - In compliance with the above identified SOW(s) the contractor shall provide
Mechanical system safety assessments
Design and analysis of structures and mechanisms
Design, analysis, testing, planning, components, prototypes, training, and technical review for the
development mechanical system technologies and projects
Engineering Services for technical lab tasks

Related to:
ISS Program
Orion Program
Technology Development projects

Representative of:
PSRP and SRP document package reviews representative of those for flight safety reviews of spacecraft
systems, payloads, and experiments
Orion mechanism motion and separation analyses
Half-year design activity for a prototype mechanism or concept development planned and delivered

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES5 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board
(CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.5.1 Orion Mechanical System Assessments

Project Code:

See PD for all charge code and reporting requests

5.5.2 Mechanical System Safety Reviews

Project Code:

See PD for all charge code and reporting requests

5.5.3 Mechanical Technology Development

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
MA2-00-057	Mechanical System Safety	Sept 2000
NASA-STD-5017	Design & Development Requirements for Mechanisms	current

NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements	Rev B
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP 30599	Safety Review Process International Space Station	current
SSP 50021	ISS Safety Requirements Documents	current

c. Required DRDs

5.5.1 Orion Mechanical System Assessments		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.5.2 Mechanical System Safety Reviews		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.5.3 Mechanical Technology Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.5.1 Orion Mechanical System Assessments			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

5.5.2 Mechanical System Safety Reviews			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

5.5.3 Mechanical Technology Development			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
LOE	LOE	LOE	

e. Product Verification

5.5.1 Orion Mechanical System Assessments	
i. LOE	
- LOE	

5.5.2 Mechanical System Safety Reviews	
i. LOE	
- LOE	

5.5.3 Mechanical Technology Development	
i. LOE	
- LOE	

5.6 Loads and Dynamics Branch Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide loads and dynamics engineering and testing of aerospace systems (i.e. launch vehicle, spacecraft, payloads, GFE, and extraterrestrial vehicles)

Related to:

ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:

Linear and non-linear analyses
Assessments
Model development
Prototype model development
Mission flight rules
Missions support
Software tool development
Test support
Processes

In accordance with:

SOP-001.31
SOP-001.32

Under the governance of:

The ES6 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.6.1 Extraction and Berthing Integration

Project Code:

See PD for all charge code and reporting requests

5.6.2 Orion Loads & Dynamics Updated Rev 3

Project Code:

See PD for all charge code and reporting requests

5.6.3 Technology Development Updated Rev 3

Project Code:

See PD for all charge code and reporting requests

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current

SOP-001.32	Operating Plan for Structural Engineering	Current
SSP-41000	International Space Station System Specification	Current
SSP-50808	ISS to COTS IRD	Current

c. Required DRDs

5.6.1 Extraction and Berthing Integration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.6.2 Orion Loads & Dynamics		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.6.3 Technology Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.6.1 Extraction and Berthing Integration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.6.2 Orion Loads & Dynamics		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.6.3 Technology Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.6.1 Extraction and Berthing Integration	
i. LOE	
- LOE	

5.6.2 Orion Loads & Dynamics	
i. LOE	
- LOE	

5.6.3 Technology Development	
i. LOE	
- LOE	

5.7 ES Static and Dynamic Test Facility (SDTF) (INACTIVE)

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide
- Test execution
 - Day-to-day maintenance and operations
 - Lab upgrades
 - Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:

- ISS Program
- Orion Program
- SLS Program
- Commercial Crew Program
- GFE
- Technology Development projects
- Space Act Agreements

Representative of:

- Static Testing
- Dynamic Testing
- Fracture Testing

In accordance with:

- SOP-001.24
- SOP-001.31
- SOP-001.32

Under the governance of:

The ES2 Branch Chief, ES6 Branch Chief and/or SDTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

- The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

- The contractor shall ensure laboratory and support team availability

Standard of excellence: Contractor support team availability of >97%

Minimum Requirement: Contractor support team availability of >95%

- The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

- The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.7.1 ISS Testing (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.7.2 Other Testing (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.7.3 Fracture Testing (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34417)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.7.1 ISS Testing (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.7.2 Other Testing (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.7.3 Fracture Testing (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.7.1 ISS Testing (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.7.2 Other Testing (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.7.3 Fracture Testing (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.7.1 ISS Testing (INACTIVE)	
i. LOE	
- LOE	

5.7.2 Other Testing (INACTIVE)	
i. LOE	

- LOE

5.7.3 Fracture Testing (INACTIVE)

i. LOE

- LOE

5.8 ES Radiant Heat Test Facility (INACTIVE)

a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide

Test execution
Day-to-day maintenance and operations
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Radiant Heat Testing

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The RHTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
Standard of excellence: 50% of excess capacity utilized
Minimum Requirement: > 35% of excess capacity utilized

5.8.1 ES Radiant Heat Test Facility (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline

SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.8.1 ES Radiant Heat Test Facility (INACTIVE)		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.8.1 ES Radiant Heat Test Facility (INACTIVE)		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.8.1 ES Radiant Heat Test Facility (INACTIVE)	
i. LOE	
- LOE	

5.9 Materials and Evaluation Laboratory (INACTIVE)

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide
Test execution
Day-to-day maintenance and operations
Lab upgrades and Welding
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
ISS Program
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Material Analysis Request

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The MEL Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by

external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)	
i. LOE	
- LOE	

5.10 ES Additive Manufacturing Lab (AML) Updated Rev 1

Requirement - In compliance with the above identified SOW(s) the contractor shall provide

Part Fabrication

Day-to-day maintenance and operations

Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate/Divisions.

Related to:

ISS Program

Orion Program

CC Program

Technology Development projects

Space Act Agreements

Representative of:
Plastic Parts and Plastic Scale Models

In accordance with:

SOP-001.24

SOP-001.31

SOP-001.32

Under the governance of:

The AML Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Lab availability of >97%

Minimum Requirement: Lab availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE) Updated Rev 3

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Most current
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 4200.1	Management of Controlled Equipment	Most current
NPR 4200.2	Equipment Management Manual for Property Custodian	Most current

c. Required DRDs

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)
i. LOE
- LOE

5.11 ES Manufacturing Services Updated Rev 1

Requirement - In compliance with the above identified SOW(s) the contractor shall provide:

Machining and fabrication
Cleaning
Welding

Related to:
ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements
Spacecraft payloads

Representative of:
Fabrication, cleaning and welding services including a broad scope of functions from providing rapid turnaround of simple parts and modifications to hardware, to the development of products, prototypes and space flight hardware.

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products received

5.11.1 Management and Administration Updated Rev 1

Project Code:

See PD for all charge code and reporting requests

5.11.2 Maintenance and Repair Updated Rev 3

Project Code:

See PD for all charge code and reporting requests

5.11.3 Capability Assurance Updated Rev 3

Project Code:

See PD for all charge code and reporting requests

5.11.4 EA (Internal) Customers Added Rev 1

Project Code:

See PD for all charge code and reporting requests

5.11.5 Non-EA (External) Customers Added Rev 1
Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1281.8 Added Rev 1	Product Identification and Traceability	Change 3, Jan. 2010
JPR 1700.1 Added Rev 1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1 Added Rev 1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1 Added Rev 1	JSC Environmental Management System Manual	Mar. 2011
JPD1280.1A Added Rev 1	JSC QUALITY POLICY	Current
JPR 1280.2 Added Rev 1	JSC QUALITY MANUAL	Current
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-003.29 Added Rev 1	Material Handling Operations in Buildings 9S and 10	Current
SOP-005.21 Added Rev 1	Self-Verification Program	Current

c. Required DRDs

5.11.1 Management and Administration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 1		LOE

5.11.2 Maintenance and Repair		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 1		LOE

5.11.3 Capability Assurance		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 1		LOE

5.11.4 EA (Internal) Customers		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 1		LOE

5.11.5 Non-EA (External) Customers		
DRD #	DRD Title	Quantity/Frequency
None Added Rev 1		LOE

d. Products

5.11.1 Management and Administration		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

5.11.2 Maintenance and Repair		
Product(s)	Quantity	Delivery Date
LOE Added Rev 1	LOE Added Rev 1	LOE

5.11.3 Capability Assurance		
Product(s)	Quantity	Delivery Date
LOE Added Rev 1	LOE Added Rev 1	LOE

5.11.4 EA (Internal) Customers		
Product(s)	Quantity	Delivery Date
LOE Added Rev 1	LOE Added Rev 1	LOE

5.11.5 Non-EA (External) Customers		
Product(s)	Quantity	Delivery Date
LOE Added Rev 1	LOE Added Rev 1	LOE

e. Product Verification

5.11.1 Management and Administration		
i. LOE		
- LOE		

5.11.2 Maintenance and Repair		
i. LOE Added Rev 1		
- LOE Added Rev 1		

5.11.3 Capability Assurance		
i. LOE Added Rev 1		

- LOE Added Rev 1

5.11.4 EA (Internal) Customers

i. LOE Added Rev 1

- LOE Added Rev 1

5.11.5 Non-EA (External) Customers

i. LOE Added Rev 1

- LOE Added Rev 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA27T TO# 119	Revision Number: Rev 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EA5 Maintenance & Operations/Engineering Directorate Facility Maintenance and Operations Integration

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,173,513	\$(112,843)	\$1,060,670

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.21 15:59:53 -0500</small> Signature: _____ Date: <u>5/21/15</u> Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA27T-TO119 REV 1

Originator: JEFFERSON DUTTON (EA211) (281) 483-2841 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

Revision Summary:

Remove B36 Fabrication Support from TO. This effort is being transferred to ES TO110.

1. Title of Effort: FY15 EA5 Maintenance & Operations/Engineering Directorate Facility Maintenance and Operations Integration FY15 (TO20)

2. Date of Request: 10/23/2014

3. Statement of Work Task Description

a. 2.4 Facilities

b. 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.

c. 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.

d. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 General Facility M&O Requirements Updated REV 1

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall i) provide day-to-day maintenance and operations activities common to all test facilities, systems and laboratories in the EA5

Project Management and Integration Office, in accordance with the EA5 Facility Utilization Summary, attached as a supporting document. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with requirements of this task order.

Standard maintenance & operations tasks that span the EA5 Office facilities, laboratories and systems are included but not limited to the list below.

1. Perform preventative, routine and reparative maintenance of facility equipment.
2. Provide and maintain a personnel certification and training program.
3. Perform work document initiation, review, coordination, in-process control, and close-out actions (Includes WAD coordination for the EA Directorate Office).
4. Provide storage of and ready access to work documents/records.
5. Identify and maintain a list of equipment that needs to be replaced.
6. Maintain property accounts.
7. Provide cost estimates for services and functions provided.
8. Perform and maintain configuration management (CM) of facility baseline documentation for all facility-related assets.
9. Propose revisions to standard operating procedures and documentation to ensure they accurately reflect processes and identify those that could be rescinded.
10. Maintain laboratory equipment and systems.
11. Maintain pressure systems, including pressure testing of hardware, and ensure up to date certification of active pressure systems.
12. Inspect Lifting Devices and Equipment (LDEM), ensure appropriate certifications prior to use, and execute non-critical rigging and lifts.
13. Plan and schedule all M&O activities to minimize impacts to product-related TO activities.
14. Administer service contracts for equipment.
15. Ensure all Inspection, Testing and Measurement Equipment (IMTE) is within calibration during data measurement.
16. Perform periodic functional tests and operational readiness of equipment and facility systems.
17. Operate database and/or website that tracks maintenance items and property.

ii) In compliance with the above identified SOW(s) the contractor shall perform common health, safety & environmental (HSE) related requirements for the EA5 laboratories and facilities in accordance with JPR 1700.1 and EA-WI-024. Standard health, safety and environmental tasks that span the division's facilities, laboratories and systems are included but not limited to the list below.

1. Conduct periodic safety and compliance inspections and meetings. Track and close findings identified;
2. Provide, service, maintain, and repair all PPE associated with M&O of facilities and systems;
3. Conduct facility safety reviews;
4. Conduct emergency drills for OSHA and test operations;
5. Perform testing of all emergency and facility safety systems.
6. Maintain an inventory of hazardous chemicals.
7. Perform, maintain environmental compliance.

iii) IT maintenance and operation requirements are not applicable for this task order. **Updated REV 1**

5.1.1 Facility M&O Products

Project Code: Facility M&O products are made from Monthly Status and test reports

Facility M&O Products

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JWI 4200.1	Management of Controlled Equipment	Rev A, July 2013
n/a Added REV 1	EA5 Facility Utilization Summary	10/22/2014

NPR 4200.2	Equipment Management Manual for Property Custodian	Rev B Change 1, Sept. 2003
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c. Required DRDs

5.1.1 Facility M&O Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	1 per test; irregular frequency

d. Products

5.1.1 Facility M&O Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	1 per test	2 weeks after test completion

e. Product Verification

5.1.1 Facility M&O Products	
i. Monthly Status Report	
- The above stated product shall be verified through review at scheduled periodic status meetings with NASA EA5 personnel.	

5.2 EA Directorate Maintenance and Operations Integration

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide EA Directorate level integration in the areas of Maintenance, Pressure Systems, Facility Configuration Management Support, and Safety Support for Chief Engineer. The contractor shall provide integration for all facilities and test equipment for which the contractor is given the responsibility of performing maintenance in operations in a JETS TO.

The contractor shall provide:

Maintenance:

- Monthly Metric reporting
- Maximo administration (CMMS)
- Ladder Inspections Program
- Oversight of Fall Protection Program
- MSCL reduction reporting
- Weekly EA Safety Walk Throughs
- Manage SDRS Safety Discrepancy Tracking
- Special Studies or Safety Inspections
- Conduct Incident/Issue investigation and resolution
- Provide JETS related input to NASA/EA Directives
- Personnel certifications/training for M&R (i.e. CMRP, recurring annual)
- Oversight of maintenance sub-contracts (i.e. annual forklift maintenance and certifications)
- Facility related maintenance of a generalized nature (not Division specific) including but not limited to, preventive, reparative and predictive maintenance, calibration; as well as Health, Safety and Environmental actions

Pressure Systems Maintenance

- Monthly Metric reporting
- Monitor PSMD database to ensure systems are not used with past due inspections
- Pressure system inspection tracking, reminders, and metrics
- Compliance reviews (current goal is 10% of new/ modified/ reactivated/ inactivated systems)
- PSMD POC (Coordinate resolution of issues between PSMD and JETS)
- Provide JETS related input to NASA/EA Directives
- Conduct pressure system related Incident/Issue investigation and resolution
- Maintain training program to ensure continued education of the pressure system personnel
- General administration: PSP maintains license for PV Elite, an ASME code calculation software package, with cost of \$1296 per year. PSP is also responsible for printer maintenance, with estimated cost of \$1300 per 2 year for supplies
- Program Administration PSP documents including a plan, standard operating procedure, and 4 work instructions
- Pressure systems technical expert support to all JETS pressure systems personnel for design,

maintenance, and operation of pressure vessels and systems

Configuration Management Support

- Facility as built condition (drawings/reports) of current configuration, supporting audits and investigations
- Facility configuration requirement compliance assessments/reports for EA-WI-024, JPR 1700.1, and applicable industry standards (i.e. ASME, API, NFPA)
- CM Noncompliance action item closures
- Assist pressure systems engineer with data collection for evidence of pressure systems compliance with JPR 1710.13
- Training and monthly reporting (Administrative)

Directorate Facilities Strategic and Tactical Usage Planning

- Maintain EA Directorate Facility Master Plan (update twice per year)
- Develop and oversee completion of Division level strategic and tactical facility usage and move plans (8 per year)

[Note: Personnel moves will be implemented by a separate contractor]

5.2.1 EA Directorate M&O Products

Project Code:

EA Directorate M&O Products are Monthly Status Reports

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JPR 1710.13	Design Inspection, and Certification of Pressure Vessels and Pressurized Systems	Rev F, August 2012

c. Required DRDs

5.2.1 EA Directorate M&O Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

d. Products

5.2.1 EA Directorate M&O Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Report	12	Last working day of each month

e. Product Verification

5.2.1 EA Directorate M&O Products	
i. Monthly Report	
- The above stated product shall be verified by NASA personnel when compiling the information for the Quarterly Technical , Cost, Schedule Review (TCSR)	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA27T TO# 119	Revision Number: Rev 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EA5 Maintenance & Operations/Engineering Directorate Facility Maintenance and Operations Integration

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,173,513	\$(112,843)	\$1,060,670

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.21 15:59:53 -0500</small> Signature: _____ Date: <u>5/21/15</u> Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA27T-TO119 REV 1

Originator: JEFFERSON DUTTON (EA211) (281) 483-2841 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

Revision Summary:

Remove B36 Fabrication Support from TO. This effort is being transferred to ES TO110.

1. Title of Effort: FY15 EA5 Maintenance & Operations/Engineering Directorate Facility Maintenance and Operations Integration FY15 (TO20)

2. Date of Request: 10/23/2014

3. Statement of Work Task Description

a. 2.4 Facilities

b. 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.

c. 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.

d. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 General Facility M&O Requirements Updated REV 1

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall i) provide day-to-day maintenance and operations activities common to all test facilities, systems and laboratories in the EA5

Project Management and Integration Office, in accordance with the EA5 Facility Utilization Summary, attached as a supporting document. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with requirements of this task order.

Standard maintenance & operations tasks that span the EA5 Office facilities, laboratories and systems are included but not limited to the list below.

1. Perform preventative, routine and reparative maintenance of facility equipment.
2. Provide and maintain a personnel certification and training program.
3. Perform work document initiation, review, coordination, in-process control, and close-out actions (Includes WAD coordination for the EA Directorate Office).
4. Provide storage of and ready access to work documents/records.
5. Identify and maintain a list of equipment that needs to be replaced.
6. Maintain property accounts.
7. Provide cost estimates for services and functions provided.
8. Perform and maintain configuration management (CM) of facility baseline documentation for all facility-related assets.
9. Propose revisions to standard operating procedures and documentation to ensure they accurately reflect processes and identify those that could be rescinded.
10. Maintain laboratory equipment and systems.
11. Maintain pressure systems, including pressure testing of hardware, and ensure up to date certification of active pressure systems.
12. Inspect Lifting Devices and Equipment (LDEM), ensure appropriate certifications prior to use, and execute non-critical rigging and lifts.
13. Plan and schedule all M&O activities to minimize impacts to product-related TO activities.
14. Administer service contracts for equipment.
15. Ensure all Inspection, Testing and Measurement Equipment (IMTE) is within calibration during data measurement.
16. Perform periodic functional tests and operational readiness of equipment and facility systems.
17. Operate database and/or website that tracks maintenance items and property.

ii) In compliance with the above identified SOW(s) the contractor shall perform common health, safety & environmental (HSE) related requirements for the EA5 laboratories and facilities in accordance with JPR 1700.1 and EA-WI-024. Standard health, safety and environmental tasks that span the division's facilities, laboratories and systems are included but not limited to the list below.

1. Conduct periodic safety and compliance inspections and meetings. Track and close findings identified;
2. Provide, service, maintain, and repair all PPE associated with M&O of facilities and systems;
3. Conduct facility safety reviews;
4. Conduct emergency drills for OSHA and test operations;
5. Perform testing of all emergency and facility safety systems.
6. Maintain an inventory of hazardous chemicals.
7. Perform, maintain environmental compliance.

iii) IT maintenance and operation requirements are not applicable for this task order. **Updated REV 1**

5.1.1 Facility M&O Products

Project Code: Facility M&O products are made from Monthly Status and test reports

Facility M&O Products

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JWI 4200.1	Management of Controlled Equipment	Rev A, July 2013
n/a Added REV 1	EA5 Facility Utilization Summary	10/22/2014

NPR 4200.2	Equipment Management Manual for Property Custodian	Rev B Change 1, Sept. 2003
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c. Required DRDs

5.1.1 Facility M&O Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	1 per test; irregular frequency

d. Products

5.1.1 Facility M&O Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	1 per test	2 weeks after test completion

e. Product Verification

5.1.1 Facility M&O Products	
i. Monthly Status Report	
- The above stated product shall be verified through review at scheduled periodic status meetings with NASA EA5 personnel.	

5.2 EA Directorate Maintenance and Operations Integration

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide EA Directorate level integration in the areas of Maintenance, Pressure Systems, Facility Configuration Management Support, and Safety Support for Chief Engineer.
The contractor shall provide integration for all facilities and test equipment for which the contractor is given the responsibility of performing maintenance in operations in a JETS TO.

The contractor shall provide:

Maintenance:

- Monthly Metric reporting
- Maximo administration (CMMS)
- Ladder Inspections Program
- Oversight of Fall Protection Program
- MSCL reduction reporting
- Weekly EA Safety Walk Throughs
- Manage SDRS Safety Discrepancy Tracking
- Special Studies or Safety Inspections
- Conduct Incident/Issue investigation and resolution
- Provide JETS related input to NASA/EA Directives
- Personnel certifications/training for M&R (i.e. CMRP, recurring annual)
- Oversight of maintenance sub-contracts (i.e. annual forklift maintenance and certifications)
- Facility related maintenance of a generalized nature (not Division specific) including but not limited to, preventive, reparative and predictive maintenance, calibration; as well as Health, Safety and Environmental actions

Pressure Systems Maintenance

- Monthly Metric reporting
- Monitor PSMD database to ensure systems are not used with past due inspections
- Pressure system inspection tracking, reminders, and metrics
- Compliance reviews (current goal is 10% of new/ modified/ reactivated/ inactivated systems)
- PSMD POC (Coordinate resolution of issues between PSMD and JETS)
- Provide JETS related input to NASA/EA Directives
- Conduct pressure system related Incident/Issue investigation and resolution
- Maintain training program to ensure continued education of the pressure system personnel
- General administration: PSP maintains license for PV Elite, an ASME code calculation software package, with cost of \$1296 per year. PSP is also responsible for printer maintenance, with estimated cost of \$1300 per 2 year for supplies
- Program Administration PSP documents including a plan, standard operating procedure, and 4 work instructions
- Pressure systems technical expert support to all JETS pressure systems personnel for design,

maintenance, and operation of pressure vessels and systems

Configuration Management Support

- Facility as built condition (drawings/reports) of current configuration, supporting audits and investigations
- Facility configuration requirement compliance assessments/reports for EA-WI-024, JPR 1700.1, and applicable industry standards (i.e. ASME, API, NFPA)
- CM Noncompliance action item closures

- Assist pressure systems engineer with data collection for evidence of pressure systems compliance with JPR 1710.13

- Training and monthly reporting (Administrative)

Directorate Facilities Strategic and Tactical Usage Planning

- Maintain EA Directorate Facility Master Plan (update twice per year)

- Develop and oversee completion of Division level strategic and tactical facility usage and move plans (8 per year)

[Note: Personnel moves will be implemented by a separate contractor]

5.2.1 EA Directorate M&O Products

Project Code:

EA Directorate M&O Products are Monthly Status Reports

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JPR 1710.13	Design Inspection, and Certification of Pressure Vessels and Pressurized Systems	Rev F, August 2012

c. Required DRDs

5.2.1 EA Directorate M&O Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

d. Products

5.2.1 EA Directorate M&O Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Report	12	Last working day of each month

e. Product Verification

5.2.1 EA Directorate M&O Products	
i. Monthly Report	
- The above stated product shall be verified by NASA personnel when compiling the information for the Quarterly Technical , Cost, Schedule Review (TCSR)	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA01T-TO# 121	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ARES Advanced Exploration Science (TO71)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose:

In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$962,297	\$962,297

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.1.9200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.17 13:21:20 -05'00'</small> Signature: _____ Date: 9/17/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA01T-TO121

Originator: LISA FLETCHER (KA) (281) 483-2630 **TMR:** SUSAN RUNCO (KA) (281) 244-8848

1. Title of Effort: FY15 ARES Advanced Exploration Science (TO71)

2. Date of Request: 08/05/2014

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m. **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.

n. **2.6 Special Projects**

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

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Advanced Exploration Science

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide specialized science, engineering, and technical products for ARES Advanced Exploration Science as detailed in Section 5.1.1 and in accordance with referenced documents, controlled per ARES Configuration Control Process. The contractor shall provide scientific assessments of future missions, spacecraft and payload instruments, landing sites, and surface operations; provide scientific assessments and recommendations for samples and processes used in exploration, including simulants, lunar dust, and analog field sites; provide laboratory and field testing and assessment of science instruments under mission relevant conditions; provide basic and applied research in the geological and planetary sciences by preparing samples, acquiring data, providing databases, evaluating findings, and providing materials for abstracts, presentations, peer-review publications, and research proposals, and provide technical management to include overall cost and resource management, schedules, implementation of safety policies, and coordination with the NASA technical personnel. No flight products are required.

5.1.1 Advanced Exploration Science Services

Project Code:

The contractor will perform the services listed in the ARES Advanced Exploration Science Plan (KX-AEG-001):

Introduction – Section 1.0

Readiness – Section 2.0

Mission Operations Capability – Section 3.0

Products and Services – Section 4.0

- Mission Science, Development, and Operations – Section 4.1
- Scientific Analysis, Instrument and Technology Development – Section 4.2
- Field Science, Operations, and Training – Section 4.3

External Communications and Public Outreach – Section 5.0

Evolution and Business Development – Section 6.0

Product Deliverables and Verification – Section 7.0

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-002	ARES Infrastructure Requirements	Rev 6, 12-12-2011
KA-AEG-001	ARES Advanced Exploration Group (AEG) Work Plan	Rev 1, 6/10/2014
KA-INF-001	ARES Infrastructure Maintenance and Operations	Original, 4/15/2013
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 2/1/2011

c. Required DRDs

5.1.1 Advanced Exploration Science Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter

d. Products

5.1.1 Advanced Exploration Science Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products identified in KA-AEG-001	1/Quarter	Quarterly

e. Product Verification

5.1.1 Advanced Exploration Science Services		
i. Delivery Acceptance Report (per DRD TD-12) on products identified in KA-AEG-001		
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA24T TO# 122	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ARES Orbital Debris

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,486,699	\$3,486,699

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard christian.c.gaspard@nasa.gov Digitally signed by christian.c.gaspard@nasa.gov DN: cn=christian.c.gaspard@nasa.gov Date: 2014.09.29 13:15:40 -05'00' Signature: _____ Date: 9/29/2014 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA24T-TO122

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (KA) (281) 244-8848

1. Title of Effort: FY15 ARES Orbital Debris (TO72)

2. Date of Request: 09/05/2014

3. Statement of Work Task Description

a. 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.

b. 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

c. 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.

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Orbital Debris Research

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform orbital debris research and provide related documents in accordance with the requirements stated in the ARES Orbital Debris Research & Science Operations Plan(KX-OD-004) and in accordance with applicable documents - controlled per ARES Configuration Control Process. Deliverable products are listed in the Specific Product Requirements section of KX-OD-004. No flight products are provided by this Task Order

5.1.1 Orbital Debris Research Products and Services

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide specialized science, engineering, and technical products for the Orbital Debris Project Office as detailed in the specific product

and service requirements and deliverables defined in the Orbital Debris Research and Science Operations Plan, KX-OD-004:

- Readiness (2.0)
- Capabilities and System Development (3.0)
- Products and Services (4.0)
 - Research and Development (4.1)
 - Orbital Debris Modeling and Analytical Tools (4.2)
 - Measurement Products (4.3)
 - Operational Products (4.4)
- External Communications (5.0)
- Evolution and Business Development (6.0)
- Product Deliverables and Verification (7.0)

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-INF-001	ARES Infrastructure Maintenance and Operations	Original, 4/12/2013
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 2/1/2011
KX-OD-004	ARES Orbital Debris Research & Science Operations Plan	Rev B, 9/3/2014
NPR 8621.1	NASA Procedure Requirements for Mishap Reporting, Investigating, and Record Keeping	Rev B Ch6; 10/24/11

c. Required DRDs

5.1.1 Orbital Debris Research Products and Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Orbital Debris Research Products and Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report as defined by KX-OD-004	1/Quarter	Quarterly

e. Product Verification

5.1.1 Orbital Debris Research Products and Services	
i. Delivery Acceptance Report as defined by KX-OD-004	
- NASA approval by TM and TMR/Alternate of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA11T TO# 123	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ARES Hypervelocity Impact Technology & Risk Assessment

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,282,480	\$2,282,480

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0 9 2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.15 14:21:16 -0500</small> Signature: _____ Date: <u>9/15/14</u> Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA11T-TO123

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (KA) (281) 244-8848

1. Title of Effort: FY15 ARES Hypervelocity Impact Technology & Risk Assessment (TO73)

2. Date of Request: 08/20/2014

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. 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.

h. 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.

i. 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.

j. 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.

k. 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.

l. 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.

m. 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.

n. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Hypervelocity Impact Research

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide hypervelocity impact test and risk analyses, and provide related documents in accordance with the requirements stated in the ARES Hypervelocity Impact Technology (HVIT) Group Work Plan (KX-HVIT-001) and in accordance with applicable documents - controlled per ARES Configuration Control Process. Deliverable products are listed in the Specific Product Requirements section. No flight products are provided by this Delivery Order.

5.1.1 Hypervelocity Impact Research Products

Project Code:

Hypervelocity Products consist of:

Hypervelocity Impact Administrative Products: The contractor shall develop and maintain HVIT impact database and web sites, and provide HVIT status reports per KX-HVIT-001.

Orion Multi-Purpose Crew Vehicle (MPCV) Products: The contractor shall provide Orion MPCV MMOD risk assessments and test/analysis reports per KX-HVIT-001.

ISS Products: The contractor shall provide ISS MMOD risk assessments and test/analysis reports per KX-HVIT-001.

Other Products: The contractor shall provide MMOD risk assessments and test/analysis reports, conduct shielding research, and provide additional hypervelocity impact products for other spacecraft per KX-HVIT-001.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
HITF-KX-002	ARES BUMPER Configuration Management Plan Hypervelocity Impact Technology Facility (HITF)	Rev B, 11/2009
HITF-KX-003	ARES BUMPER Micro-Meteoroid and Orbital Debris (MMOD) Risk Assessment Process Hypervelocity Impact Technology Facility (HITF)	Rev A, 1.2008
KA-INF-001	ARES Infrastructure Maintenance and Operations	Rev 1, 6/1/2014
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 02/01/2011
KX-HVIT-001	ARES Hypervelocity Impact Technology Group Work Plan	Rev A, 7/31/2014
NPR 8621.1	NASA Procedure Requirements for Mishap Reporting, Investigating, and Record Keeping	Rev B Ch 7; 7/15/2013

c. Required DRDs

5.1.1 Hypervelocity Impact Research Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Hypervelocity Impact Research Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products identified in KX-HVIT-001	1/Quarter	Quarterly

e. Product Verification

5.1.1 Hypervelocity Impact Research Products	
i. Delivery Acceptance Report (per DRD TD-12) on products identified in KX-HVIT-001	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ14HA41T TO# 124	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ARES Image Science and Analysis (TO74)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose:

In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,607,406	\$2,607,406

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.15 16:25:18 -05'00'</small> Signature: _____ Date: 9/15/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ14HA41T-TO124

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (KA) (281) 244-8848

1. Title of Effort: FY15 ARES Image Science and Analysis (TO74)

2. Date of Request: 08/05/2014

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Image Science and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide image science and analysis as identified in Section 5.1.1 and in accordance with referenced documents, controlled per ARES Configuration Control Process. The contractor shall provide engineering image analysis services for the International Space Station (ISS), Orion, Commercial Crew and Cargo Program Office (C3PO) programs and other external customers. No flight products will be required. Materials used for conducting image science and analysis as identified under KA-002 shall be authorized in accordance with KA-WI-001 ARES Master Work Instruction.

5.1.1 Image Science and Analysis Services

Project Code:

Perform image science and analysis services as outlined in the categories listed in the following sections of the document KX-IA-002 Image Science and Analysis Group Work Plan:

Readiness - Section 2.0

Capabilities and Systems Developments - Section 3.0

Products and Services - Section 4.0

- International Space Station - Section 4.1
- Commercial Space Flight - Section 4.2
- Orion Multi-Purpose Crew Vehicle - Section 4.3
- Commercial Development through SAAs - Section 4.4

External Communications - Section 5.0

Evolution and Business Development - Section 6.0

Product Deliverables and Verification - Section 7.0

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-002	ARES Infrastructure Services Requirements	Rev 5, 12/12/2011
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KX-001	Office for Human Exploration Science Configuration Management Process	03/24/11
KX-IA-001	JSC Image Science and Analysis Facilities CoFR Plan	04/02/2013
KX-IA-002	Image Science and Analysis Group Work Plan	04/02/2013
NPR 8621.1	NASA Procedure Requirements for Mishap Reporting, Investigating, and Record Keeping	Rev B Ch6; 10/24/11
SPKA0005	Information Technology Security Plan Image Science and Analysis Laboratory Astromaterials Research and Exploration Science (ARES)	1/25/2013

c. Required DRDs

5.1.1 Image Science and Analysis Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. **Products**

5.1.1 Image Science and Analysis Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery/Acceptance Report (per DRD TD-12) on products identified in KX-IA-002	1/Quarter	Quarterly

e. **Product Verification**

5.1.1 Image Science and Analysis Services	
. Delivery/Acceptance Report (per DRD TD-12) on products identified in KX-IA-002	
- NASA TM and TMR approval of Delivery/Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 15
Task Order Number: NNJ15HA05T TO# 125		Revision Number: 1		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EA4 - Technical Integration Office Support (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$5,660,521	\$157,045	\$5,817,566

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name:		CHRISTIAN GASPARD	
Signature: _____ Date: _____		Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.04.28 15:16:27 -05'00'	
Signature: _____ Date: _____		Signature: _____ Date: 4/28/2015 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA05T-TO125 REV 1

Originator: LARRY MOON (EA41) (281) 483-8178 **TMR:** LARRY MOON (EA4) (281) 483-8178

Revision Summary:

This TO revision will increase the required hours for FY15 to subtask 5.2.5 EA4 International Docking System Standard Technical Integration to accommodate additional hours required to support technical integration of the second Commercial Crew Program Capability provider. The contractor shall submit a proposed adjustment in resources required to satisfy this change.

1. Title of Effort: FY15 EA4 - Technical Integration Office Support (TO11) (LOE)

2. Date of Request: 04/16/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. **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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 ISS OB System Management

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services as they relate to ISS System Management. System Management is defined as technical oversight/insight of the design, development, test, certification, verification, sustaining engineering, real time on-orbit system performance assessments (US and International element interfaces), problem resolution, requirements change initiation/evaluation, visiting vehicle integrated reviews, and payload assessments and integration with the system.

5.1.1 Active Thermal Control System

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.1.2 Environmental Control and Life Support System

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.1.3 Flight Crew Systems

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.1.4 Structures and Mechanisms System

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.1.5 Passive Thermal Control System

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.1.6 Crew Health Care System - Counter Measures System

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.1.1 Active Thermal Control System		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.2 Environmental Control and Life Support System		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.3 Flight Crew Systems		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.4 Structures and Mechanisms System		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.5 Passive Thermal Control System		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.6 Crew Health Care System - Counter Measures System		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.1.1 Active Thermal Control System		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.2 Environmental Control and Life Support System		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.3 Flight Crew Systems		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.4 Structures and Mechanisms System		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.5 Passive Thermal Control System		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.6 Crew Health Care System - Counter Measures System		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.1.1 Active Thermal Control System		
i. LOE		
- LOE		

5.1.2 Environmental Control and Life Support System		
i. LOE		
- LOE		

5.1.3 Flight Crew Systems		
i. LOE		
- LOE		

5.1.4 Structures and Mechanisms System		
i. LOE		
- LOE		

5.1.5 Passive Thermal Control System		
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i. LOE
- LOE

5.1.6 Crew Health Care System - Counter Measures System
i. LOE
- LOE

5.2 Technical Integration Office/EA4 Technical Integration

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services for technical integration as they relate to the ISS Chief Engineers Office (perform technical integration of ISS Change Request (CR)/Flight Rule CR evaluations, EA Flight Readiness Assessments, CR directive action closures, schedules, and real-time anomaly resolution); Engineering Visualization support to the JSC Concept Analysis Team; Avionics Software Change and Schedule Review; MPCV Chief Engineers Office, Commercial Crew Chief Engineers Office, and the Systems Engineering Management Office; ISS Safety Review Panel (SRP)/Payload SRP; and the ISS International Docking System Standard(IDSS).

5.2.1 ISS System Management Technical Integration and Coordination

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.2 Engineering Visualization (follow-on to TO-92)

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.3 Avionics Software Change and Schedule Review Panel Technical Integration

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.4 Safety Review Panel/Payload Safety Review Panel Subject Matter Expert Technical Integration

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.5 EA4 International Docking System Standard Technical Integration

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.6 EA4 ISS/OB Cargo packing foam analysis tool

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.2.7 International Docking System Standard Technical Integration - support to CCtCap Added REV

1

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001

Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.2.1 ISS System Management Technical Integration and Coordination		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.2.2 Engineering Visualization (follow-on to TO-92)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.2.3 Avionics Software Change and Schedule Review Panel Technical Integration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-02	Regular Status Report/Summary Review	LOE
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5.2.4 Safety Review Panel/Payload Safety Review Panel Subject Matter Expert Technical Integration

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.2.5 EA4 International Docking System Standard Technical Integration

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.2.6 EA4 ISS/OB Cargo packing foam analysis tool

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.2.7 International Docking System Standard Technical Integration - support to CCtCap

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Added REV 1	Regular Status Report/Summary Review	LOE

d. Products

5.2.1 ISS System Management Technical Integration and Coordination

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.2.2 Engineering Visualization (follow-on to TO-92)

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.2.3 Avionics Software Change and Schedule Review Panel Technical Integration

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.2.4 Safety Review Panel/Payload Safety Review Panel Subject Matter Expert Technical Integration

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.2.5 EA4 International Docking System Standard Technical Integration

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.2.6 EA4 ISS/OB Cargo packing foam analysis tool

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
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LOE	LOE	LOE
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5.2.7 International Docking System Standard Technical Integration - support to CCtCap		
Product(s)	Quantity	Delivery Date
LOE Added REV 1	LOE	LOE

e. **Product Verification**

5.2.1 ISS System Management Technical Integration and Coordination
i. LOE
- LOE

5.2.2 Engineering Visualization (follow-on to TO-92)
i. LOE
- LOE

5.2.3 Avionics Software Change and Schedule Review Panel Technical Integration
i. LOE
- LOE

5.2.4 Safety Review Panel/Payload Safety Review Panel Subject Matter Expert Technical Integration
i. LOE
- LOE

5.2.5 EA4 International Docking System Standard Technical Integration
i. LOE
- LOE

5.2.6 EA4 ISS/OB Cargo packing foam analysis tool
i. LOE
- LOE

5.2.7 International Docking System Standard Technical Integration - support to CCtCap
i. LOE
- LOE Added REV 1

5.3 OZ/ISS Research Integration Office

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services as they relate to the ISS Research Integration Office Program Integration. The contractor shall provide engineering services for High Definition Earth Viewing (HDEV) System Program Interface Requirements Notice (PIRN) integration.

5.3.1 HDEV System Program Integration

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001
Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.3.1 HDEV System Program Integration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.3.1 HDEV System Program Integration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.3.1 HDEV System Program Integration	
i. LOE	
- LOE	

5.4 AB/JSC Office of Chief Technologist Technology Integration and Management

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services as they relate to technology strategy development and portfolio management, technical integration, and technology communication.

5.4.1 Technology Development, Portfolio Manangement, Technical Integration, and Technology Communication

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integraton Office Requirements Document # RD-EA4-2010-0001
Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.4.1 Technology Development, Portfolio Management, Technical Integration, and Technology Communication		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.4.1 Technology Development, Portfolio Management, Technical Integration, and Technology Communication		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.4.1 Technology Development, Portfolio Management, Technical Integration, and Technology Communication	
i. LOE	
- LOE	

5.5 ISS OD System Management

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services as they relate to ISS System Management. System Management is defined as technical oversight/insight of the design, development, test, certification, verification, sustaining engineering, real time on-orbit system performance assessments (US and International element interfaces), problem resolution, requirements change initiation/evaluation, visiting vehicle integrated reviews, and payload assessments and integration with the system.

5.5.1 Guidance Navigation & Control

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integration Office Requirements Document # RD-EA4-2010-0001
Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

5.5.2 Communications & Tracking

Project Code: this is a level of effort task

Example tasks can be found in the Technical Integration Office Requirements Document # RD-EA4-2010-0001
Version: Rev. F

(see attached spreadsheet for SLC's and labor hours, etc. required)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.5.1 Guidance Navigation & Control		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.5.2 Communications & Tracking		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.5.1 Guidance Navigation & Control			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOE		LOE	LOE

5.5.2 Communications & Tracking			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOE		LOE	LOE

e. Product Verification

5.5.1 Guidance Navigation & Control	
i. LOE	
- LOE	

5.5.2 Communications & Tracking	
i. LOE	
- LOE	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ14HA43T TO# 126	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 DDMS and MCAD Services (TO80 & TO42 5.5)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose:

In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$545,541	\$545,541

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=PIV,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD
Date: 2014.08.20 09:54:46 -05'00'

Signature: _____ Date: **08/20/2014**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ14HA43T-TO126

Originator: PAUL COLLIER (EA4) (281) 483-8127 **TMR:** JEFFERSON DUTTON (EA5) (281) 483-2841

1. Title of Effort: FY15 DDMS and MCAD Services (TO80 & TO42 5.5)

2. Date of Request: 07/25/2014

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 DDMS Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall assist NASA with the definition, creation, and release of a model-based engineering release process;

assist NASA in support of projects with the use of non-Pro/E CAD platforms;

provide user adoption and training support;

provide DDMS project management through project planning, execution, monitoring, control, and outreach to the user community.

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.1.1 DDMS

Project Code:

The contractor shall:

* Develop Plans and Solution Architecture to move JSC Engineering toward Model-based Release, including MCAD and ECAD (Solution Architect)

* Assists JSC Engineering and external orgs with the proper use of DDMS, specifically focused on engineering best practices (Solution Architect & PM)

* Assists NASA PM/JSC PLM Lead with visionary and roadmap tasks for Product Lifecycle Management (PLM) and DDMS (PM)

* Assures DDMS User Registration and NAMS processes are working and assists users into DDMS (Solution Architect and/or PM)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
EA-WI-023	Project Management of GFE Flight Projects	D
na	Design and Data Management System (DDMS) Statement of Work	Attached

c. Required DRDs

5.1.1 DDMS		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1 per month (TCSR Status)

d. Products

5.1.1 DDMS		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	12	1 per month (TCSR Status)
Preliminary/Draft Architecture Document for Model-based Release	1	June 2015
Preliminary/Draft Deployment Strategy for Model-based Release	1	June 2015

e. **Product Verification**

5.1.1 DDMS
i. Status Reports and Summaries
- Delivered to and verified by the Branch Chief
ii. Preliminary/Draft Architecture Document for Model-based Release
- Delivered to and verified by the Branch Chief
iii. Preliminary/Draft Deployment Strategy for Model-based Release
- Delivered to and verified by the Branch Chief

5.2 Mechanical Computer Aided Design (MCAD)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services for MCAD tools used for hardware development by the Johnson Space Center Engineering Directorate.

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.2.1 MCAD

Project Code:

The contractor shall provide MCAD tools engineering services associated with the development of mechanical hardware in accordance with the Applicable Documents Listing.

The contractor shall provide engineering services to perform the following tasks for all Space Programs supported at the Johnson Space Center:

- * Establish and develop MCAD Best Practices and present to CAE Team
- * Help remedy MCAD related issues experienced by the JSC Engineering Community and NASA PM approved external users
- * Assist JSC Engineers and NASA PM approved external users with MCAD tool usage
- * Assist NASA PM with license recommendations during license renewals
- * Identify need for additional MCAD licenses and/or deletions of licenses no longer needed
- * Assist DDMS Solution Architect with Model-promotion and release solution development (Model-based Release)
- * Initiate and organize vendor-supplied training for MCAD tools; assists NASA HR in training planning
- * Participate in the CAE Team meetings
- * **Travel (one domestic trip) may be required to enhance MCAD Tool Products currently used or planned for use at JSC. The purpose for travel would include tool training and/or MCAD related conferences.**
- * **Materials purchases will be required for MCAD Services with prior NASA approval.**

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
------------------------	----------------------	-------------

EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of GFE Flight Projects	

c. Required DRDs

5.2.1 MCAD		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1 per month (TCSR Status)

d. Products

5.2.1 MCAD		
Product(s)	Quantity	Delivery Date
Status Reports and Summaries	12	1 per month (TCSR status)
License Renewal and Purchasing Plan	4	Quarterly

e. Product Verification

5.2.1 MCAD	
i. Status Reports and Summaries	
- Delivered to and verified by the Branch Chief.	
ii. License Renewal and Purchasing Plan	
- Delivered to and verified by the Branch Chief.	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 9
Task Order Number: NNJ15HD43T TO# 127		Revision Number: Rev 3		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: GFE Design & Sustaining Engineering

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,843,212	\$164,684	\$2,007,896

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name: _____		Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.03.26 11:31:47 -05'00'	
Signature: _____ Date: _____		Signature: _____ Date: 3/26/2015 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA43T-TO127 REV 3

Originator: KEITH GRIMM (EV171) (281) 483-1532 **TMR:** DARILYN PEDDIE (EV) (281) 483-8279

Revision Summary:

Extend Date of Clin 4

Update requirements documents on Clin 1 and Clin 2.

1. Title of Effort: FY15 GFE Design & Sustaining Engineering (TO21 Partial)

2. Date of Request: 03/09/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 EHDV-External High Definition Video

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to the EHDV-External High Definition Video task.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.1.1 EHDV-External High Definition Video

Project Code:

The contractor shall provide services and products in accordance with for tasks listed in EV-112, External High Definition Camera (Ext HD Camera Engineering Products for the International Space Station Program.

The contractor shall provide Weekly Activity Reports (WARs) based on the contractor format.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
EA-WE-023	Project Management of GFE Flight Projects	G
EV-112 Added REV 3	External High Definition Camera (Ext HD Camera Engineering Products for the International Space Station Program	A
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	change 5
SSP 30243	Space Station Requirements for Electromagnetic Compatibility	G
SSP 30309	Safety Analysis and Risk Assessment Requirements	E
SSP 30559	Structural Design and Verification Requirements	C
SSP 30599	ISS Safety Review Process	A
SSP 41172	Qualification and Acceptance Environmental Test Requirements	AA
SSP 50021	International Space Station Program Safety Requirements Document	Basic
SSP 50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	B
SSP 50955	Project Technical Requirements Specification for the ISS External HD Camera	Basic

c. Required DRDs

5.1.1 EHDV-External High Definition Video		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/Monthly

d. Products

5.1.1 EHDV-External High Definition Video		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Report	1	Monthly

e. Product Verification

5.1.1 EHDV-External High Definition Video	
i. Status Report	
- Project verification occurs when product is accepted by Project Manager	

5.2 ISS GFE Sustaining

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform sustaining engineering and new development / certification as applicable related to ISS GFE Sustaining.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web pag

5.2.1 ISS GFE Sustaining

Project Code: Multiple

The contractor shall provide services and products for tasks listed in JSC 63968 Avionic Systems Division Approved Sustaining Engineering Projects Listing Sections 4, 5, and 6 in accordance with JSC 63950 Avionic Systems Division GFE Sustaining Engineering Requirements.

The contractor shall provide lab management services for the Sustaining Engineering Lab.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ANSI/ESD S20.20-2007	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	Mar. 2007
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
SSP 30695	Acceptance Data Package (ADP) Requirements Specification	Rev. C, Aug. 2010
EA-WI-023	Project Management of GFE Flight Projects	G
EA-WI-025	GFE Flight Project Software and Firmware Development	C
EV-100	Avionic Systems Division GFE Sustaining Engineering Requirements for EVA	Baseline
JSC 26549	Manual for the Control of Program Stock (Receiving, Handling, Storage, Packaging, Preservation, and Delivery of Controlled Flight, Non-Flight, and Ground Support Equipment	C
JSC 63950	Avionic Systems Division GFE Sustaining Engineering Requirements for ISS	G
JSC 63968 Added REV 3	Avionic Systems Division Approved Sustaining Engineering Projects Listing	F
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	change 5
SSP 30243	Space Station Requirements for Electromagnetic Compatibility	G
SSP 30309	Safety Analysis and Risk Assessment Requirements	E
SSP 30559	Structural Design and Verification Requirements	C
SSP 30599	ISS Safety Review Process	A
SSP 41172	Qualification and Acceptance Environmental Test Requirements	AA
SSP 50021	International Space Station Program Safety Requirements Document	Basic
SSP 50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	B

- c. **Required DRDs**

5.2.1 ISS GFE Sustaining		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	1/monthly
RV-02	Regular Status Report/Summary Review	1/monthly

d. **Products**

5.2.1 ISS GFE Sustaining		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Integrated Microsoft Schedule	1	Montly
Regular Status Report/ Monthly Review	1	Montly

e. **Product Verification**

5.2.1 ISS GFE Sustaining	
i. Integrated Microsoft Schedule	
- Product verification will be obtained via Sustaining Engineering concurrence per JSC 63950	
ii. Regular Status Report/ Monthly Review	
- Product verification will be obtained via Sustaining Engineering concurrence per JSC 63950	

5.3 EVA Sustaining Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to the EVA Sustaining Engineering task.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.3.1 EVA Sustaining Engineering

Project Code:

The contractor shall provide services and products for tasks listed in JSC 63968, Avionic Systems Division Approved Sustaining Engineering Projects Listing Sections 4, 5, and 6 in accordance with EV-100 Avionic Systems Division Government Furnished Equipment (GFE) Sustaining Engineering Requirements for Extravehicular Activity (EVA).

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ANSI/ESD S20.20-2007	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	Mar. 2007
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirments for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
SSP 30695	Acceptance Data Package (ADP) Requirements Specification	Rev. C, Aug. 2010

EA-WI-023	Project Management of GFE Flight Projects	G
EA-WI-025	GFE Flight Project Software and Firmware Development	C
EV-100 Added REV 3	Avionic Systems Division GFE Sustaining Engineering Requirements for EVA	A
JSC 26549	Manual for the Control of Program Stock (Receiving, Handling, Storage, Packaging, Preservation, and Delivery of Controlled Flight, Non-Flight, and Ground Support Equipment	C
JSC 63950	Avionic Systems Division GFE Sustaining Engineering Requirements for ISS	G
JSC 63968 Added REV 3	Avionic Systems Division Approved Sustaining Engineering Projects Listing	F
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	change 5
SSP 30243	Space Station Requirements for Electromagnetic Compatibility	G
SSP 30309	Safety Analysis and Risk Assessment Requirements	E
SSP 30559	Structural Design and Verification Requirements	C
SSP 30599	ISS Safety Review Process	A
SSP 41172	Qualification and Acceptance Environmental Test Requirements	AA
SSP 50021	ISS Pressurized Volume Hardware Common Interface Requirements Document	Basic
SSP 50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	B

c. **Required DRDs**

5.3.1 EVA Sustaining Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	1/Monthly
RV-02	Regular Status Report/Summary Review	1/Monthly

d. **Products**

5.3.1 EVA Sustaining Engineering		
Product(s)	Quantity	Delivery Date
Integrated Microsoft Schedule	1	Monthly
Regular Status Report/Monthly Review	1	Monthly

e. **Product Verification**

5.3.1 EVA Sustaining Engineering	
i. Integrated Microsoft Schedule	
- Product verification will be obtained via Sustaining Engineering CCB concurrence per EV-100	
ii. Regular Status Report/Monthly Review	
- Product verification will be obtained via Sustaining Engineering CCB concurrence per EV-100	

5.4 MPCV Avionics

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to MPCV Avionics.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.4.1 MPCV Avionics

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide engineering services in support of the MPCV Command and Data handling (C&DH) System Management (SM). The SM function, as specified in CxP-72088, CEV Systems Engineering Management Plan (SEMP), is the single point of contact for oversight and management of the development of a specific system. The C&DH system includes the Vehicle Management Computer, Power Data Unit, Instrumentation and Orion Data Network. The Contractor shall provide the function of the PDU Subsystem Manager and Developmental Flight instrumentation engineering. These functions shall cover the entire life cycle including feasibility assessments, project definition, requirements, design, production, certification and operations. The Contractor shall participate in the development of the CEV System Requirements Document, CEV to other element Interface Requirements Documents (IRDs) and Interface Control document (ICDS), the CEV avionic architecture definition, and related trade studies. In addition, this function monitors development, schedules and risk, and participates in programmatic support activities such as Requirements Assessment Cycle (RAC), Design Analysis Cycle (DAC), mode teams and other system integration activities and forums. The Contractor shall work with an integrated team of stakeholder disciplines throughout the system development lifecycle involved in the oversight of the contractors' activities. The stakeholder disciplines include flight operations, ground operations, flight crew office, and Safety and Mission Assurance (SMA).

The Contractor shall provide engineering analysis of review documents and presentations and present recommended RIDs at the subsystem design reviews {Project Technical Reviews (PTR), PDRs, CDRs} and spacecraft design reviews (PTR, PDRs, CDRs).

The Contractor shall provide engineering services for the MPCV C&DH SM, MPCV flight computer subsystem management, MPCV Power Data Unit Subsystem management, MPCV instrumentation subsystem management and MPCV Communication & Tracking (C&T) systems engineering and analysis.

The Contractor shall:

1. Provide analysis of system and subsystem requirements as pertaining to the areas above.
2. Provide analysis of the requirement maturation process
3. Assess MPCV documents with consideration to these areas. Generate and work RIDs if required.
4. Perform trade studies.(1-3 per year)
5. Provide analysis of information provided all meetings, i.e. team technical interface meetings (TIM)
6. Prepare and present briefings.

The Contractor shall provide resources to evaluate COTS instrumentation systems for potential space flight applications. This will include but may not be limited to market research, trade studies, procurement, hardware setup and operation, and technical evaluation in a development lab environment.

5.4.2 MOCV Avionic Test Lab Support Updated REV 3

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide engineering services to the Orion Test Labs for integration and test engineering, including end-to-end spacecraft to ground communications testing (such as E2E-03 ISP). Specific tasks include test planning, scheduling, procedure development, Test Readiness Review preparation, dry-run/clean-run/run-for-record test execution, anomaly tracking and resolution, and configuration management. Activities include integration of technical changes to the Avionics & Software Integration and Development Test Plan and coordination of technical review's with subject matter experts and stakeholders.

The contractor shall provide expertise with Automation Framework, a tool set for procedure writing, editing, lab configuration, issue tracking and resolution, scheduling, and data analysis on the Orion Test lab rigs. The task includes providing support to the Integrated Sync Point leadership as a team member, sub task lead. Specific duties include: lead for writing, editing, tracking, configuring and managing the procedures, documents and any necessary documentation in relation to supporting ISPs and lab Standard Operations. Duties in addition to technical writing include out briefing at meetings, test support in the lab, and hardware integration testing. In preparation for testing in the labs, the contractor shall coordinate meetings with members from the external and internal teams to learn their technical role to include in any needed joint procedures. The contractor shall provide support in capturing issues, and coordinating resolutions with all stakeholders. The contractor shall provide test engineering in Orion Test Labs as needed; to include lab testing, tracking issues, and coordinating resolutions. Team member duties include; briefing, giving status, offering advice on path forward for procedure development,

along with new duties of loading software to the lab, and capturing lab updates and changes in Detailed Work Instructions.

Revision 2 extends the period of performance for this task from March 31, 2015 to May 31, 2015

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CEV RFP	Statement of Work, Attachment J-1	CCO 124, 2010
CxP-72088	CREW ELPLORATION VEHICLE(CEV) SYSTEMS ENGINEERING MANAGMENT PLAN (SEMP)	C
DRD CEV-B-003	CEV Integreated Master Schedule (IMS) included in CEV Cost Perofrmance Report	Baseline
MPCV 72000	CEV Systems Requirements Document	Baseline

c. Required DRDs

5.4.1 MPCV Avionics		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/Monthly
TD-08	Engineering Analysis	1/Monthly

5.4.2 MOCV Avionic Test Lab Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/Monthly

d. Products

5.4.1 MPCV Avionics		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Engineering assessment/RID package, with technical review 1 week prior to life cycle reviews Updated REV 3	1 set per lifecycle review	per CEV Integrated Master Schedule, DRD CEV-B-003
Activity report Updated REV 3	1	Monthly
Change Request (CR) evaluation form Updated REV 3	1	per CR delivery date
Regular Status Report / Monthly Review Updated REV 3	1	Monthly

5.4.2 MOCV Avionic Test Lab Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Activity Report	1	Monthly
Regular Status Report/Monthly Review	1	Monthly

e. Product Verification

5.4.1 MPCV Avionics	
i. Engineering assessment/RID package, with technical review 1 week prior to life cycle reviews	
- - Branch review and acceptance	

ii. Activity report
- - Branch review and acceptance
iii. Change Request (CR) evaluation form
- - Branch review and acceptance
iv. Regular Status Report / Monthly Review
- - Branch review and acceptance

5.4.2 MOCV Avionic Test Lab Support
i. Activity Report
- Branch review and acceptance
ii. Regular Status Report/Monthly Review
- Branch review and acceptance

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 9
Task Order Number: NNJ15HA07T TO# 128	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EV Specialty Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,776,290	\$1,776,290

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=ccgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.11 14:44:02 -05'00'</small> Signature: _____ Date: 09/11/2014 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA07T-TO128

Originator: SAMANTHA MCDONALD (EV171) (281) 244-5877

TMR: CORDELIA FOSTER (EV) (281) 483-5265

1. Title of Effort: FY15 EV Specialty Engineering Services (TO42)

2. Date of Request: 08/05/2014

3. Statement of Work Task Description

a. 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.

b. 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 V bration -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 Distr bution 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 Distr bution -Failure modes -Toxicity Screening by analytical means -Off-gassing -Wet Chemistry -Metallurgy

c. 2.2.4 Training

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

d. 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.

e. 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.

f. **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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Electromagnetic Compatibility Test and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide planning, management, and implementation activities to assure electromagnetic compatibility for various programs, projects, government furnished equipment (GFE), contractor furnished equipment (CFE), and commercial off-the-shelf (COTS) hardware by test and analysis.

Planning shall include preparing for test readiness reviews (TRRs) and the evaluation of EMI test procedures.

The contractor shall provide electromagnetic environmental effects (E3) systems engineering and analysis for various programs, projects, and elements. Analysis shall include design and development review activities including analysis of both new and modified designs. The contractor shall prepare reports in memorandum form that includes a description of the hardware or design reviewed, a description of the analyses performed, and a detailed explanation of all recommendations that includes the likely consequences if the recommendations are not implemented.

The contractor shall evaluate change requests, change request evaluation reports, and EMI test evaluation reports.

The contractor shall provide electromagnetic compatibility technical expertise regarding electrical bonding, EMI, EMC, lightning, magnetic fields, and related topics.

The contractor shall provide services for floating potential studies, including mitigation measures, and prepare assessment reports.

The contractor shall plan, design, and perform EMI tests for a variety of programs, projects, and elements including GFE, CFE, and COTS.

Procure materials and/or equipment as required for EMI testing and analyses with prior NASA approval.

The contractor shall prepare recommended changes or updates to program and project level requirements documents.

The contractor shall provide the necessary services to maintain the test facility including technician support for setup and maintenance items as needed.

The contractor shall provide briefings at technical interchange meetings and shall observe or perform testing at other facilities. Travel may be required for the contractor to perform specification development and participate in design reviews at vendor facilities.

NASA will provide all in-line quality staffing and support.

All products and deliverables will go into DDMS.

Note: RV-02 will be met by submitting technical cost and schedule review (TCSR) charts in a NASA approved format.

5.1.1 E3 Test Data Package

Project Code:

For each test, the contractor shall supply a Test Data Package containing at a minimum:

1. Copies of the data obtained during the test including a comparison of data to specification requirements in graph and table formats, pass or fail status of the equipment under test (if applicable), laboratory ambient measurement data (if applicable), and copies of all related documentation such as TRR proceedings, hazard analyses, pre-test checklists, etc.
2. Lists of equipment utilized during the test including calibration due dates.
3. Photographs of the test setups.
4. Remarks.

5.1.2 Engineering Analyses

Project Code:

For each analysis, the contractor shall supply a report that includes:

1. A description of the hardware or design reviewed.
2. A description of the analyses performed.
3. A detailed explanation of all recommendations made including the likely consequences if the recommendations are not implemented.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
ATV-ESA-RQ-014	ATV EMC and Power Quality Requirements	Rev Basic 3/1999
CEV-T-025000	CEV Electromagnetic Compatibility Control and Verification Document	5/2010
COL-ESA-RQ-014	Columbus EMC and Power Quality Requirements	Rev E 12/2001
EV-021	Procedures for Client Use of Avionic Systems Division Laboratories	Rev I 1/2012
JF-41	EMC Engineering Work Order	3/2011
JSC 27773	Avionic Systems Division General Operating Procedures	Rev H 5/2012
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	Change 5 8/2009
MIL-STD-461E	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment	Rev E 8/1999
MIL-STD-461F	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment	Rev F 12/2007
MPCV 70080	Cross-Program Electromagnetic Environmental Effects (E3) Requirements Document	Rev Basic 9/2013
RE3-82-14110	Operator Certification Procedure for Hewlett Packard Model 8582A Automatic Spectrum Analyzer System	1/1998
SSP 30237	Space Station Electromagnetic Emissions and Susceptibility Requirements	Rev R 1/2007
SSP 30238	Space Station Electromagnetic Techniques	Rev E 7/2002
SSP 30240	Space Station Grounding Requirements	Rev H 1/2010
SSP 30242	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility	RevK 1/2010
SSP 30243	Space Station Requirements for Electromagnetic Compatibility	Rev N 1/2010

SSP 30245	Space Station Electrical Bonding Requirements	Rev P 1/2010
SSP 50094	NASA/RSA Joint Specification Standards Document for the ISS Russian Segment	Rev A 3/2000
SSP 52000-IDD-ERP	Expedite the Processing of Experiments to Space Station (EXPRESS) Rack Payloads Interface Definition Document	Rev M 7/2013
SSP 57000	Pressurized Payloads Interface Requirements Document	Rev N 8/2013

c. Required DRDs

5.1.1 E3 Test Data Package		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1/month
TD-11	Test Report	1/test

5.1.2 Engineering Analyses		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1/month
TD-08	Engineering Analysis	1/analysis

d. Products

5.1.1 E3 Test Data Package		
Product(s)	Quantity	Delivery Date
E3 Test Data Package	1/Test	Within 5 days of test completion
Status Reports and Summaries	1/month	15th of the month

5.1.2 Engineering Analyses		
Product(s)	Quantity	Delivery Date
Engineering Analysis Reports	1/Analysis	Within 5 days of analysis completion
Status Reports and Summaries	1/month	15th of the month

e. Product Verification

5.1.1 E3 Test Data Package	
i. E3 Test Data Package	
- Test data packages will be reviewed and approved by the JSC E3 team lead or their designee	
ii. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	

5.1.2 Engineering Analyses	
i. Engineering Analysis Reports	
- Engineering analyses will be reviewed and approved by the JSC E3 team lead or their designee	
ii. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	

5.2 EEE Parts

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide EEE parts analysis and engineering services for flight hardware development in accordance with EEE Parts CCB procedures. The quantities per Program are interchangeable and managed by the EEE Parts CCB.

The contractor shall provide engineering services to perform the following tasks:

- * Develop and implement JSC EEE parts processes and procedures
- * Prepare and present materials for PDR, CDR, and FCA/PCA as required
- * Prepare memorandums or reports for EEE parts risk/screening/test/inspection recommendations
- * Technical consultation for onsite activities including Center EEE parts, working group, NEPAG/NEPP, data reviews, and weekly CCB reviews
- * Participate on committees that review and revise connector specifications
- * Travel may be required for project technical interchange meeting and audits.
- * Provide materials as required for EEE parts testing with prior NASA approval

All product deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.2.1 EEE Parts

Project Code:

The contractor shall provide EEE parts engineering services associated with the development of hardware in accordance with the applicable documents listing.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 61360	Engineering Directorate Certified Parts Approval Process	Rev. A, July 1998
JSC 49697	EV5 Implementation of the Johnson Space Center (JSC) EEE Parts Approval Process	Rev Basic 5/1993
JSC 61365	Component Engineers Handbook	Rev Basic 9/1996
MIL-HDBK-0217	Reliability Prediction of Electronic Equipment	Rev F 12/1991

c. Required DRDs

5.2.1 EEE Parts		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-15	Electrical, Electronic, and Electromechanical (EEE) Parts List and Analysis Report	1/review

d. Products

5.2.1 EEE Parts		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	1/month	15th of the month
EEE parts analysis and report	1/review	Preliminary report due 4 weeks prior to PDR. Final report due 4 weeks prior to project CDR

e. Product Verification

5.2.1 EEE Parts	
i. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their	

designee
ii. EEE parts analysis and report
- All EEE parts products are delivered to and verified by the EEE Parts CCB or their designee

5.3 Radiation

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide radiation analysis and test support services for hardware development and assessments. Testing may be proton testing or heavy ion testing depending on the Program/Project needs.

The contractor shall provide engineering services to perform the following tasks:

- * Perform MTBF predication and radiation susceptibility assessments
- * Travel is required for radiation testing.

All product deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.3.1 Radiation

Project Code:

The contractor shall provide radiation engineering services associated with the development of hardware in accordance with the applicable documents listing. All resulting analyses and test data will be made available to the EV5 EEE Parts CCB as needed as part of developing hardware in accordance with the applicable documents listing.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 61360	Engineering Directorate Certified Parts Approval Process	Rev. A, July 1998
JSC 49697	EV5 Implementation of the Johnson Space Center (JSC) EEE Parts Approval Process	Rev Basic 5/1993
JSC 61365	Component Engineers Handbook	Rev A 7/1998
MIL-HDBK-0217	Reliability Prediction of Electronic Equipment	Rev F 12/1991

c. Required DRDs

5.3.1 Radiation		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-11	Test Report	1/test

d. Products

5.3.1 Radiation		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	1/month	15th of the month
Radiation Test Report	1/test	2 weeks after completion date

e. Product Verification

5.3.1 Radiation

i. Status Reports and Summaries
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee
ii. Radiation Test Report
- All radiation products are delivered to and verified by the EEE Parts CCB or their designee

5.4 Electronic Computer Aided Design (ECAD)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services for ECAD tools used for hardware development by the Johnson Space Center Engineering Directorate.

The contractor shall provide engineering services to perform the following tasks for all Programs supported at the Johnson Space Center:

- * Coordinate purchasing of annual license renewals
- * Identify need for additional licenses as necessary
- * Identify ECAD tools no longer needed/used
- * Present tool licensing needs to EV5 management and NASA ECAD lead
- * Establish a database interface process to DDM for finalized designs
- * Initiate and organize vendor supplied training for ECAD tools
- * Participate in ECAD tools team meetings
- * Assist members in ECAD tool usage
- * Travel may be required to enhance ECAD tool products currently used or planned for use at JSC. The purpose for travel would include tool training and/or ECAD related conferences.
- * Materials purchases will be required for ECAD services with prior NASA approval

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.4.1 ECAD

Project Code:

The contractor shall provide ECAD tools engineering services associated with the development of electronic hardware in accordance with the applicable document listing.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
IPC-2221	Generic Standard on Printed Board Design	Rev A, May 2003
IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards	Feb. 1998
IPC-6011	Generic Performance Specification for Printed Boards	Jul. 1996
IPC-6012	Qualification and Performance Specification for Rigid Printed Boards	Rev C, Apr. 2010
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs

5.4.1 ECAD		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	1/quarter
RV-02	Regular Status Report/Summary Review	1/month

d. Products

5.4.1 ECAD		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	1/month	15th of the month
License Renewal and Purchasing Plan	1/quarter	12/15,3/15,6/15,9/15
Project Schedule	1/quarter	12/15,3/15,6/15,9/15

e. Product Verification

5.4.1 ECAD
i. Status Reports and Summaries
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee
ii. License Renewal and Purchasing Plan
- License renewal and purchasing plans will be delivered to and approved by the EV5 branch chief or their designee
iii. Project Schedule
- Delivered and verified by the NASA ECAD lead or their designee

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ15HA36T TO# 129	Revision Number: 3	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Communications & Tracking (C&T) and Electromagnetics Systems Analysis and Spectrum Management

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,816,363	\$178,920	\$3,995,283

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.02 12:40:57 -05'00'</small> Signature: _____ Date: 7/2/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA36T-TO129 REV 3

Originator: DAVID LEE (EV611) (281) 483-5227 **TMR:** CYNTHIA ZAMORA (EV) (281) 483-0313

Revision Summary:

Add funding authority to procure expiring Software Licenses supporting spectrum analysis.

1. Title of Effort: FY15 Communications & Tracking (C&T) and Electromagnetics Systems Analysis and Spectrum Management (TO43 & TO44)

2. Date of Request: 06/08/2015

3. Statement of Work Task Description

a. 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.

b. 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 Failure Toxicity Screening by analytical means Off-gassing Wet Chemistry Metallurgy

c. 2.2.4 Training

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

d. 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.

e. 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.

f. **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.

g. **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.

h. **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.

i. **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.

j.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 ISS, Exploration and Commercial Programs and Institutional C&T Test and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform ISS, Exploration and Commercial Program and Institutional Communications & Tracking and avionics systems analysis tasks including system engineering of conceptual designs/development (including system upgrades), system requirements development & verification, compatibility assessment, interference analysis, communication performance evaluation (including computer simulations), and link analysis. The contractor shall also perform antenna analysis, coverage analysis, test planning and assessment, interface control document development/maintenance/update, anomaly resolution, mission definition and requirements development, and end-to-end communications link viability/security/availability evaluation. The contractor shall perform evaluation and processing of JSC Program/project frequency authorization requests and perform assessment of potential performance impacts to ISS RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall present in Technical Interchange Meetings (TIMs), including International travel, to disseminate analysis results. Contractor shall meet with NASA monthly to provide status and schedule for the project.

Note that "EV TO-129 Communications & Tracking (C&T) Systems Analysis and Spectrum Management, is referenced in the TO as "C&T Master Schedule". Link to current C&T Master Schedule is https://oasis.jsc.nasa.gov/orgs/EV/EV6/C_T_Analysis/master_schedules/default.aspx

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

All deliverable documents shall be stored in DDMS except for the Sensitive But Unclassified (SBU) reports. These reports are stored in a restricted SharePoint site, <https://oasis.jsc.nasa.gov/orgs/EV/EV6/Analysis/Shared%20Documents/Forms/Custom%20View.aspx>

5.1.1 C&T Analysis Updated REV 3

Project Code:

The contractor shall perform ISS Communications & Tracking and avionics systems analysis tasks including system engineering of conceptual designs/development (including system upgrades), system requirements development & verification, compatibility assessment, interference analysis, communication performance evaluation (including computer simulations), and link analysis. The contractor shall also perform antenna analysis, coverage analysis, test planning and assessment, interface control document development / maintenance / update, anomaly resolution, mission definition and requirements development, and end-to-end communications link viability/security/availability evaluation. The contractor shall perform evaluation and processing of JSC Program/project frequency authorization requests and perform assessment of potential performance impacts to ISS RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall present in Technical Interchange Meetings (TIMs), including International travel, to disseminate analysis results. Contractor shall meet with NASA monthly to provide status and schedule for the project.

The contractor shall develop models for lunar coverage analysis. The contractor shall provide technical assessment of Orion contractor analyses, simulations, proposed system architectures and designs. The contractor shall provide requirements development and verification for SRD, IRDs, ICDs and subsystem specifications. The contractor shall assess the Orion project reviews and provide comments and recommendations. The contractor shall upgrade CSSL models for Orion analysis and simulation. The contractor shall perform evaluation and processing of project frequency authorization requests and perform assessment of potential performance impacts to Orion RF systems due to external frequency requests and proposed modifications to radio regulations. Contractor shall provide NASA with monthly status and schedule for the project.

The contractor shall provide radio frequency compatibility/interference analyses, spectrum regulation compliance analyses and National Telecommunications & Information Administration (NTIA) spectrum certification data package preparation in support of the Space Launch System (SLS) Program. Specifically the contractor shall (1) provide technical analyses to determine performance integrity of each radio link on the SLS core stage and upper stage rockets during launch and ascent phases with Orion vehicle transmitting RF in the same frequency band, (2) provide power fluxed density and out-of-band/spurious emissions analysis based on the SLS design parameters to determine compliance to the NTIA spectrum utilization requirements, (3) develop data package in NTIA Spectrum Certification format and supplementary analysis reports for Stage 2 experimental license submittal. Contractor shall also document the SLS spectrum and channel selection in the Cross Program Spectrum & Channel Plan. Contractor may be required to travel to support reviews. Contractor shall meet with NASA monthly to provide status and schedule for the project.

The Contractor shall perform communications and tracking analyses to assess NASA program (including ISS, Orion, future exploration, and commercial), project, and Institutional communications and RF systems performance. These analyses shall include link margin analysis, coverage analysis, multi-path, RF hardware performance modeling (Matlab), KOZ analysis, RF masking analysis, and compatibility and interference analysis. The contractor shall develop models for surface coverage analysis. The contractor shall provide technical assessment of Programs, projects, and Institutional contractor analyses, simulations, proposed system architectures and designs. The contractor shall provide requirements development and verification for SRD, IRDs, ICDs and subsystem specifications. The contractor shall assess the Programs, projects, and Institutional reviews and provide comments and recommendations.

The contractor shall upgrade CSSL models for program, project, & institutional analysis and simulation needs as listed in the EV CSSL Product Requirement Document, EV-081. The contractor shall perform evaluation and processing of project frequency authorization requests and perform assessment of potential performance impacts to Program, project, and Institutional RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall provide IT maintenance for the EV6 laboratory facilities. The contractor shall provide financial budgeting report and tracking support for this task

Note that "EV CO-129 Communications & Tracking (C&T) Systems Analysis and Spectrum Management, is referenced in the TO as "C&T Master Schedule". Link to current C&T Master Schedule is https://oasis.jsc.nasa.gov/orgs/EV/EV6/C_T_Analysis/master_schedules/default.aspx

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EV-022	Radio Frequency Communications Electromagnetic Environmental Effects Analysis Work Instruction	H
EV-081 Added REV 3	EV CSSL Product Requirement Document	R

c. Required DRDs

5.1.1 C&T Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-08	Engineering Analysis	1/Analysis

d. Products

5.1.1 C&T Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Analysis reports	1/analysis	Per C&T master schedule
Regular Project status	1	monthly
CSSL Products Added REV 3	1/release	September 1, 2015

e. Product Verification

5.1.1 C&T Analysis	
i. Analysis reports	
- - Branch review upon delivery	
ii. Regular Project status	
- - Branch review upon delivery	
iii. CSSL Products	
- - Product acceptance and inspection by NASA Lab Monitor Added REV 3	

5.2 Wireless Systems, Standards, and Technology

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services to analyze wireless systems, standards, and technologies. Typical content includes study and recommendation of wireless standards for space and ground operations. Engineering services shall also include provisions for the development and maintenance of network protocols, software applications and demonstration of these applications and technologies.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

All deliverable documents shall be stored in DDMS.

5.2.1 Standards and systems development and evaluation

Project Code:

The contractor shall apply wireless and network engineering in the design, services, and implementation of multiple project areas. Technology areas shall include at a minimum Radio Frequency Identification and Detection (RFID), JSC Wireless Analog System (JAWS), and Delay / Disruption Tolerant Network (DTN). They shall demonstrate, modify and maintain the existing wireless test beds, and implement experimental network for Intra-Agency communications.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011

c. Required DRDs

5.2.1 Standards and systems development and evaluation		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	2/year

d. Products

5.2.1 Standards and systems development and evaluation		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Summary Review	2/year	March 31 and August 30

e. Product Verification

5.2.1 Standards and systems development and evaluation	
i. Summary Review	
- - Branch review	

5.3 RFID Testing and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide testing, analysis and algorithm development services in support of Radio Frequency Identification (RFID) system development. The contractor shall provide development services including evaluation of RFID antennas, RFID tags, system and component level testing and analysis in the anechoic chamber, RFID ALM Test-bed, and other JSC analogs.

5.3.1 Test and Analysis Engineering Services

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide test and analysis engineering services for electromagnetic and thermal systems. Typical test systems include antenna and RF measurements and thermal chambers. Analysis includes computational electromagnetic simulation and associated post-processing.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

All deliverable documents shall be stored in DDMS.

5.3.2 Complex Event Processing System and Algorithm Development

Project Code:

In compliance with the above-identified SOW(s) the contractor shall provide Complex Event Processing (CEP) related engineering services. Typical activities related to CEP engineering services are developing statistical, machine-learning, or deterministic models that are used to create contextual information that help identify meaningful events for a complex event processing system; performing low-level embedded device and application specific programming for filtering RFID event streams from RFID readers; developing new or extending existing complex event processing software; integrating both low-level RFID event streams and higher-level event streams (outputs of statistical, machine-learning, or deterministic models) with complex event processing software; and developing user interfaces or visualizations for displaying the results from the complex event processing system and its related models. Additionally, network architecture, network construction, and network troubleshooting services are necessary to support the collection of RFID event streams from networked RFID readers to the CEP system.

5.3.3 Model and Assembly of prototypes

Project Code:

In compliance with the above-identified SOW(s) the contractor shall provide board and box assembly and cable fabrication in support of RFID System development.

5.3.4 Embedded Systems Development Deleted Rev 2

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
ANSI/IEEE Std 149-1979	IEEE Std. Test Procedures for Antenna Testing	R2008

c. Required DRDs

5.3.1 Test and Analysis Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	2/year

5.3.2 Complex Event Processing System and Algorithm Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
SW-04	Software Code	1/software release

5.3.3 Model and Assembly of prototypes		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	2/year

5.3.4 Embedded Systems Development Deleted Rev 2		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

d. Products

5.3.1 Test and Analysis Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Data Package	1/test	within 3 days of test completion

5.3.2 Complex Event Processing System and Algorithm Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Software Code	1/software release	as required by project plan

5.3.3 Model and Assembly of prototypes		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Summary review	2	March 31 and Aug 30

5.3.4 Embedded Systems Development Deleted Rev 2		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>

e. Product Verification

5.3.1 Test and Analysis Engineering Services		
i. Data Package		
- NASA technical expert will review test data package to verify quality and completeness.		

5.3.2 Complex Event Processing System and Algorithm Development		
i. Software Code		
- NASA technical expert will review		

5.3.3 Model and Assembly of prototypes		
i. Summary review		
- NASA technical experts will review summary report.		

5.3.4 Embedded Systems Development Deleted Rev 2		
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HD47T TO# 130	Revision Number: Rev 5	Appropriation Data: Funded at Contract	
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841	
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: <u>NNJ13HA01C</u>	

Title: Avionics Systems Division Services

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$651,401	\$85,103	\$736,504

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 9.9.2342.19200300.1001.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.28 08:23:20 -05'00'</small> Signature: _____ Date: 7/21/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

Proposal-TO130 R5

Originator: CYNTHIA ZAMORA (EV171) (281) 483-0313 **TMR:** DARILYN PEDDIE (EV) (281) 483-8279

Revision Summary:

Add hours for EV3 software support and increase hours for Safety services for Personal CO2 Monitor Certification. Add hours for new task in support of EV2 Development Flight Instrumentation, including material for 3D printing. Add hours for developing proposal for AA2 support.

1. Title of Effort: FY15 Avionics Systems Division Services FY15 (TO68) (LOE)

2. Date of Request: 07/08/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Estimating Services Updated R5

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide estimating services for project and Division derived work.

Rev 5: The contractor shall provide support for developing the proposal for Ascent Abort 2 (AA2) support requirements. Updated R5

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.2 Project Derived Support Updated R5

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide academia services and engineering services for short turn-around requests and requirements development of new products within the Division that specifically support project specific derived objectives and goals.

Rev 4 adds hours to CLIN 2 for the following: 1)Develop safety documentation and certification package for the Personal CO2 Monitor Project, 2)Extend HERA support to end of FY, 3)Allow overtime for EV2 Software Support, and 4)EV2 Instrumentation support.

Rev 5: The contractor shall provide additional support for Safety services for certification of the Personal CO2 Monitor hardware. (EV3)

Rev 5: The contractor shall provide support for the Development Flight Instrumentation effort (EV2). In addition, the contractor shall provide 3-D printing to support EV projects. Updated R5

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.3 Electronic Manufacturing

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technician services to fabricate, assemble and/or repair electronic hardware that may include, but is not limited to, printed circuit boards, cables, electronic assemblies, and subassemblies including all documentation steps and procedures. These tasks may be performed on flight or non-flight hardware. NASA shall provide all facilities for contractor use and in-line quality support as required.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

d. **Products**

e. **Product Verification**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ15HA09T TO# 131	Revision Number: Rev 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EV Admin, Maintenance & Operations

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$908,561	-\$78,430	\$830,131

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.29 12:58:20 -0500</small> Signature: _____ Date: 5/29/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA09T-TO131 REV 1

Originator: CORDELIA FOSTER (EV171) (281) 483-5265 **TMR:** CORDELIA FOSTER (EV) (281) 483-5265

Revision Summary:

To remove iPAS work that was identified as taking place on EG TO141 CLIN 4 GN&C Lab Sustaining & Maintenance.

1. Title of Effort: FY15 EV Admin, Maintenance & Operations (TO101)

2. Date of Request: 10/28/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 2.6 Special Projects

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

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 General Division Administration, Maintenance and Operations Requirements

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide day-to-day maintenance and operations activities common to all test facilities, systems and laboratories in the Avionic Systems Division, in accordance with requirements of the Avionic Systems Division Administration, Maintenance and Operations Requirements document, JSC-63524, and the Avionic Systems Division General Operating Procedures for Laboratories and Facilities Document, JSC-27773. A list of facilities under the purview of this division is in sections 5.1.1 through 5.1.7 of this task order. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with Avionic Systems Division General Operating Procedures for Laboratories and Facilities Document, JSC-27773. Implementation of savings for required consumables/products/services shall be pursued by utilizing economies of scale for similar requirements of other Directorate divisions.

Standard maintenance & operations tasks that span the division's facilities, laboratories and systems are in the list below.

1. Evaluate preventative and reparative maintenance of facility equipment in order to keep the facility open.
2. Provide and maintain a personnel certification and training program.
3. Perform work document initiation, review, coordination, in-process control, and close-out actions.
4. Provide storage of and ready access to work documents/records.
5. Identify and maintain a list of equipment that needs to be replaced.
6. Maintain property accounts.
7. Provide cost estimates for services and functions provided.
8. Propose revisions to standard operating procedures and documentation to ensure they accurately reflect processes and identify those that could be rescinded.
9. Plan and schedule M&O activities to minimize impacts to product-related TO activities.
10. Ensure Inspection, Testing and Measurement Equipment (IMTE) is within calibration during data measurement.
11. Operate database and/or website that tracks maintenance items and property.

ii) In compliance with the above identified SOW(s) the contractor shall perform common health, Safety & Environmental (HSE) related requirements for the Avionic Systems Division laboratories and facilities. HSE requirements for unique facilities and systems are specified in JSC -63524. Standard health, safety and environmental tasks that span the division's facilities, laboratories and systems are included but not limited to the list below in conjunction with NASA.

1. Conduct periodic safety and compliance inspections and meetings. Track and close findings identified;
2. Service, maintain, and repair all PPE associated with M&O of facilities and systems;
3. Conduct facility safety reviews;
4. Conduct emergency drills for OSHA and test operations;
5. Perform testing of all emergency and facility safety systems.
6. Maintain an inventory of hazardous chemicals.
7. Perform, maintain environmental compliance.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products are delivered into DDMS.

5.1.1 Division Administrative Services

Project Code:

Division administrative services tasks shall be performed as outlined in section 5.1 of this task order and per JSC-27773, Avionic Systems Division General Operating Procedures for Laboratories and Facilities, and JSC 63524, the Avionic Systems Division Administration, Maintenance and Operations Requirements document, sections 3.1 and 3.4. Assist with development of relationships with academia and industry for potential collaboration in accordance with the EV Domain Implementation Plans. Travel could be required for this activity.

5.1.2 Integrated Power Avionics & Software (iPAS) Deleted REV 1

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
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EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
JSC-27773	Avionic Systems Division General Operating Procedures for Laboratories and Facilities	H
JSC-63524	Avionic Systems Division Administration, Maintenance and Operations Requirements	E

c. Required DRDs

5.1.1 Division Administrative Services		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1 / Quarterly

5.1.2 Integrated Power Avionics & Software (iPAS) Deleted REV 1		
DRD #	DRD Title	Quantity/Frequency

d. Products

5.1.1 Division Administrative Services			
Product(s)		Quantity	Delivery Date
Regular Status Report / Review	Updated REV 1	1	Quarterly

5.1.2 Integrated Power Avionics & Software (iPAS) Deleted REV 1			
Product(s)		Quantity	Delivery Date

e. Product Verification

5.1.1 Division Administrative Services	
i. Regular Status Report / Review	
- i. Reviewed and approve via DDMS	

5.1.2 Integrated Power Avionics & Software (iPAS) Deleted REV 1	
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5.2 Property Administration

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall implement a Property Management Plan for the Avionic Systems Division (ASD) in accordance with JSC-63524 appendix B.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS

5.2.1 Property Administration
Project Code:

The contractor shall implement a Property Management Plan for the Avionic Systems Division (ASD) in accordance with JSC - 63254, section 3.2.2 and Appendix B. The contractor shall provide a property administrator and handle move coordinator activities for the division.

Each property administrator shall be responsible for identifying and tracking government property assigned to their area. Each administrator shall maintain property accountability records and conduct property inventories in compliance with established JSC policies and procedures. Property administrators shall be responsible for performing the following duties for all areas under their purview:

- Maintain capital equipment database.
- Control, monitor and approve capital equipment moves through issuance of NASA forms 892, 290 and N_Prop.
- Conduct periodic audits.
- Provide comprehensive monthly activity reports.
- Coordinate the disposition of items that are obsolete or excess.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NPR 4100.1	NASA Materials Inventory Management Manual	Rev. D, July 1999 Chg. 1, Mar. 2004 Revalidated Feb. 2006
NPR 4200.1	NASA Equipment Management Procedural Requirements	Rev. G, Mar. 2010
NPR 4300.1	NASA Personal Property Disposal Procedural Requirements	Rev. A, July 1999 Revalidated via Chg. 1, Feb. 2006

c. Required DRDs

5.2.1 Property Administration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1 / Quarterly

d. Products

5.2.1 Property Administration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Regular Status Report / Review	1	Quarterly

e. Product Verification

5.2.1 Property Administration	
i. Regular Status Report / Review	
- - Office Review and Approval	

5.3 Facility Management

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide facility manager(s) to buildings (see JSC-63524, Section 3.6 and Appendix B) within the Division to ensure proper coordination and safe conduct of all activities taking place in or around the assigned facility, such as testing, operations, construction, modification, repairs, or maintenance.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS.

5.3.1 Facility Management

Project Code:

The contractor shall provide facility manager(s) within the Division in accordance with JSC-63524, Section 3.6 and Appendix B to ensure proper coordination and safe conduct of all activities taking place in or around the assigned facility, such as testing, operations, construction, modification, repairs, or maintenance. The facility manager shall have the following responsibilities:

- Act as interface to ASD and Center Ops for all utility outages
- Monitor building construction, repair, modification and maintenance and keep the appropriate personnel apprised of any problems associated with such activities
- Prepare work requests and related documentation for facility changes and track to completion
- Provide resolution to ASD Safety discrepancies as reported in the JSC Hazard Abatement Tracking System
- Provide resolution for Close Calls and Mishap Reports
- Enter rooms/areas into the BITS database as they are inspected
- Attend all URRs and TRRs
- Provide comprehensive monthly activity reports
- Accompany Fire Techs on annual fire protection audits upon notification
- Accompany Contractor Safety Personnel on Contractor Safety Evaluation Audits upon notification
- Accompany Contractor Safety Personnel on Facility Condition Assessment Audits upon notification
- Coordinate preparations for VPP audit and attend OSHA VPP inspections upon notification
- Coordinate review for all documentation concerning Hurricane & Severe Weather Plans, Emergency Action Plans
- Coordinate environmental issues
- Coordinate Lock-out tag-outs (LOTO), Do not use, Hot Work, and Confined Space Entry as needed
- Attend annual Workplace Health Inspections upon notification
- FM serves as principle fire warden; maintains fire warden assistance list and coordinates with the assistants and Fire Protection Service (FPS) during actual alarms and drills
- Update the Evacuation Floor Plans as needed, and at a minimum every three years
- Ensure quarterly and annual inventories of hazardous materials are kept on schedule and flammable cabinets are in compliance for occupant safety
- Maintain records of fire alarms, fire drills, occupants attending alarms and drills, outages, and reports (environmental, occupational health, VPP, fire, etc)
- Attend Facility Manager and Fire Warden Training as well as other trainings associated with tasks or buildings
- Access to the labs and Dead Mode Alarm Testing
- Coordinate and prepare data for All-Hands Safety meetings

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-24	General Operating Procedures for EA Testing Facilities	B
JSC 27773	ASD General Operating for Laboratories and Facilities	H
JSC 63524	ASD Administration Maintenance & Operations Requirements	D
JWI 8831	Facility Manager Program Handbook	

c. Required DRDs

5.3.1 Facility Management		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1 / Quarterly

d. Products

5.3.1 Facility Management		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>

Regular Status Report / Review	1	Quarterly
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e. Product Verification

5.3.1 Facility Management
i. Regular Status Report / Review
- - Office Review and Approval

5.4 Safety, Occupational Health and Environmental Management

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall ensure the protection of ASD personnel, property, equipment and the environment through implementation of an effective Safety and Environmental Health Program.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS.

5.4.1 Safety, Occupational Health and Environmental Management

Project Code:

The contractor shall ensure the protection of ASD personnel, property, equipment and the environment through implementation of an effective Safety and Environmental Health Program.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011

c. Required DRDs

5.4.1 Safety, Occupational Health and Environmental Management		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1/ Quarterly

d. Products

5.4.1 Safety, Occupational Health and Environmental Management		
Product(s)	Quantity	Delivery Date
Regular Status Report / Review	1	Quarterly

e. Product Verification

5.4.1 Safety, Occupational Health and Environmental Management
i. Regular Status Report / Review
- - Reviewed and approved via DDMS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA17T TO# 132	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EV C&DH Instrumentation Systems

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$253,545	\$253,545

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard christian.c.gaspard@nasa.gov <small>Digitally signed by christian.c.gaspard@nasa.gov DN: cn=christian.c.gaspard@nasa.gov Date: 2014.09.29 09:51:36 -05'00'</small> Signature: _____ Date: 9/29/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA17T -TO132

Originator: TODD HONG (EV171) (281) 244-2451 **TMR:** CORDELIA FOSTER (EV) (281) 483-5265

1. Title of Effort: FY15 EV C&DH Instrumentation Systems (TO21 Partial)

2. Date of Request: 09/04/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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

e. 2.2.4 Training

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

f. **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.

g. **2.3 Analysis and Assessment**

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Wireless Instrumentation System (WIS) Engineering Products & Sustaining Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to the ISS Wireless Instrumentation System (WIS) Products and Sustaining Engineering.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering
Project Code: 2S701 & 00109

In compliance with the above identified SOW(s) the contractor shall provide WIS engineering products and sustaining engineering per EV-113.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
EV-113	Wireless Instrumentation Systems (WIS) Engineering Products and Sustaining Engineering	Basic

c. Required DRDs

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	1/Month
RV-02	Regular Status Report/Summary Review	1/Month

d. Products

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Integrated Microsoft Schedule	1	Monthly
Regular Status Report / Monthly Review	1	Monthly

e. Product Verification

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering	
i. Integrated Microsoft Schedule	
- Delivered in DDMS	
ii. Regular Status Report / Monthly Review	
- Delivered in DDMS	

5.2 BEAM Instrumentation Project

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall perform testing and certification for the International Space Station (ISS) Bigelow Expandable Activity Module (BEAM) instrumentation project.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.2.1 BEAM Instrumentation Project
Project Code: 1S901

The contractor shall provide services and products in accordance with for tasks listed in EV-107, Bigelow Expandable Activity Module (BEAM) Instrumentation Products for the International Space Station (ISS) Program.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JSC 28035	Program Problem Reporting and Corrective Action (PRACA) Requirements for Johnson Space Center (JSC) Government Furnished Equipment (GFE)	Rev. B, Dec. 2006
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
EV-107	Bigelow Expandable Activity Module (BEAM) Instrumentation Products for the International Space Station (ISS) Program	B

c. Required DRDs

5.2.1 BEAM Instrumentation Project		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	1/monthly
RV-02	Regular Status Report/Summary Review	1/monthly

d. Products

5.2.1 BEAM Instrumentation Project		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Project Schedule	1	monthly
Regular Status Report/Summary Review	1	monthly

e. Product Verification

5.2.1 BEAM Instrumentation Project	
i. Project Schedule	
- Delivered in DDMS	
ii. Regular Status Report/Summary Review	
- Delivered in DDMS	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 7
Task Order Number: NNJ15HA15T TO# 133		Revision Number: 2		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Advanced EMU Technology Development (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,205,926	\$121,791	\$3,327,717

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD
Date: 2015.07.14 15:41:03 -0500

Signature: _____ Date: **7/14/15**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA15T-TO133 REV 2

Originator: LIANA RODRIGGS (EC5) (281) 483-6632 **TMR:** MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

This revision adds hours to CLIN 5.3 for SWME flight experiment development. It removes unused hours from CLIN 5.4.3 and CLIN 5.6. It also increases the amount of non-labor dollars on CLIN 5.4.2 to allow increased purchasing of hardware for AEMU technology development and decreases the number of labor hours on CLIN 5.4.2.

1. Title of Effort: FY15 Advanced EMU Technology Development (TO102) (LOE)

2. Date of Request: 07/01/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Project Management Updated Rev 1

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide project management services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU systems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services include preparation and oversight of JETSPDs; regular reporting on technical, cost, and schedule performance; coordination of NASA technical meetings; preparation of project weekly status reports; management of project risks database; maintenance of project SharePoint site; and maintenance of project master schedule. Updated Rev 1

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

- d. **Products**

- e. **Product Verification**

5.2 Systems Engineering and Integration

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide systems engineering and integration services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU systems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services include preparation of project systems engineering documents such as operational concepts, environmental definitions, and interface controls; conducting or supporting systems engineering trade studies such as the life support umbilical trade and display and control module trade; and support hardware test preparations such as development of test plans for the Display and Control Unit test.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

- d. **Products**

e. **Product Verification**

5.3 Modified Advanced Crew Escape Suit (MACES) Updated REV 2

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide engineering and technical services to accomplish the research and development objectives needed to advance key technologies for MACES.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services include definition of MACES to Portable Life Support System (PLSS) interfaces, design of interface hardware, and related analyses.

Revision 2 update: The Contractor shall provide engineering and technical services for the development of the Suit Water Membrane Evaporator (SWME) flight experiment. In support of this task, the contractor shall procure pressure transducers. **Updated REV 2**

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.4 Advanced EMU Subsystems Updated REV 2

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide engineering and technical services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU subsystems.

The WBS for this activity shall be organized as follows:

4 AEMU Subsystems

4.1 PGS

4.2 PLSS AES

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. Content will be allocated to sub-CLINS by PD. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services under WBS 4.1 include identification and documentation of PLSS, PAS, vehicle and facility interfaces to the PGS; providing technical oversight of mockup development; developing and documenting procedures for the handling of controlled suit hardware; and leading or supporting test planning for suit testing such as CO₂ washout, human vacuum chamber, display and control module evaluations which may include preparation of test plan, test procedures, hazard analysis, and post-test reports.

Examples of services under WBS 4.2 include performing systems engineering and integration tasks such as tracking of mass and power and defining interfaces to other subsystems; performing thermal/fluids analyses such as defining thermal sink temperatures for possible suit destinations and evaluating the performance of PLSS thermal loop components; performing computational fluid dynamics modeling; performing analyses for sizing of the feedwater

supply assembly; updating the PLSS Thermal Desktop Model; planning for and analyzing results of Liquid Cooling and Ventilation Garment testing; fabrication of tubing, panels, and brackets for test system build-up; supporting development, assessment, and testing of LabVIEW modules for use in PLSS testing; support testing of PLSS 2.0 including test operation, trouble shooting, facility systems operation, and data acquisition support; design, build, and evaluate successive generations of Suit Water Membrane Evaporator hardware; perform test buildup and testing of the Rapid Cycle Amine and the Suited Manikin Test Apparatus; and assembly, maintenance, testing, servicing, and calibrating test rigs in support of Variable Oxygen Regulator testing.

Revision 2 deletes section 5.4.3 and removes all unused funding.

Revision 2 also adds: As part of the PLSS AES task, the contractor shall procure materials as needed. The Materials to procure include, but are not limited to pressure transducers, Suit Water Membrane Evaporator membrane material, component brackets, sensors, electrical connector, and machined components. **Updated REV 2**

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

5.5 Reserved

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Hold this CLIN in reserve until a later date.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

5.6 Safety and Mission Assurance (S&MA) Deleted REV 2

5.7 Education and Public Outreach

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide education and public outreach services to related to Advanced EMU subsystems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor

shall provide services related to AEMU education and outreach as assigned by Project Directives.

Examples of services include supporting the NASA Engineering Network knowledge capture (KC) effort by providing an administrator to stream KC events, prepare reports on KC efforts, and identify and secure technical expert speakers.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. **Required DRDs**

d. **Products**

e. **Product Verification**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 9
Task Order Number: NNJ15HA33T TO# 134		Revision Number: 4		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2016		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: EC Division Services

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,846,793	\$9,136	\$3,855,929

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rmovert
, cn=ROCHELLE OVERSTREET
Date: 2015.09.02 14:19:41 -05'00'

Signature: _____ Date: **9/2/2015**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA33T-TO134 R4

Originator: MARIE KOWAL (EC1) **TMR:** MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

Revision 4 adds new requirements (CLIN 5.7) for carbon dioxide removal SAA work.

1. Title of Effort: FY15 EC Division Services (TO41) (LOE)

2. Date of Request: 08/25/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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

d. 2.3 Analysis and Assessment

e. **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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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.

k.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Miscellaneous Engineering and Technical Services Updated Rev 3

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Crew and Thermal Systems Division (CTSD) in support of the various programs including ISS, AES/OCT, and Orion. These include short turnaround, ancillary tasks outside the original project scope.

Contractor is authorized to expend travel and material resources, within the authorized limits, and only as required to complete TMR assigned action items.

Revision 1 reduces the labor hours based on a reduction in the expected FY15 activity level.

Revision 3 adds labor hours based on new FY15 work including Orion ECLSS risk reduction, micro channel reactor, water quality monitor, and mTAMs thermal analysis. It also reduces travel.

5.1.1 Miscellaneous Engineering and Technical Services

Project Code:

See above: 5.1 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.1.1 Miscellaneous Engineering and Technical Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.1.1 Miscellaneous Engineering and Technical Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.1.1 Miscellaneous Engineering and Technical Services	
i. None	
- NA	

5.2 EC Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide technical services for the CTSD projects including but not limited to EVA and suit subsystem management, NGLS project management services, division project coordination and oversight, documentation support, graphics development, business development, and other tasks as assigned by the division chief. The WBS for this task shall be organized as follows:

- 2 EC Services
- 2.1 EVA/Suit SSM
- 2.2 Division Projects
- 2.3 NGLS Project Management

5.2.1 EC Services

Project Code:

See above: 5.2 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.2.1 EC Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.2.1 EC Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.2.1 EC Services	
. None	
- NA	

5.3 EC2 Services Updated Rev 3

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Design and Analysis Branch (EC2) for the CTSD Materials Development Lab and the CTSD Softgoods Laboratory. The contractor shall also provide engineering services for the development of preliminary designs to meet the objectives and requirements of CTSD projects, and provide analysis of Environmental Control and Life Support System (ECLSS), Active Thermal Control System (ATCS), and Extravehicular Activity (EVA) systems.

The WBS for this task shall be organized as follows:

- 3 EC2 Services
 - 3.1 Materials Lab
 - 3.2 Softgoods Lab
 - 3.3 Mechanical Systems Design
 - 3.4 Analytical Tools Development and Analysis

Revision 3 reduces softgoods and mechanical design engineering services.

5.3.1 EC2 Services

Project Code:

See above: 5.3 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.3.1 EC2 Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.3.1 EC2 Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.3.1 EC2 Services	
. None	
- NA	

5.4 Orion ECLSS Systems Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide systems engineering services for the Environmental Control and Life Support Systems (ECLSS) for Orion, including but not limited to the following: monitoring of technical status of development activities, testing, and operations planning; identifying and/or evaluating technical issues, changes, or concerns; analyzing technical information; formulating responses and presentations; and presenting to the appropriate boards, panels, or technical/status meetings.

5.4.1 Orion ECLSS Systems Engineering

Project Code:

See above: 5.4 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.4.1 Orion ECLSS Systems Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.4.1 Orion ECLSS Systems Engineering		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.4.1 Orion ECLSS Systems Engineering	
. None	
- NA	

5.5 EC6 lab and test support Updated Rev 2

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the development of Thermal Control Systems specifically in the areas of radiators, heat transport fluids, heat pumps, and evaporative heat. The contractor shall also provide engineering services for the development of the heat exchanger payload. The original revision contains labor for October through December 2014 and materials for the heat exchanger payload.

Revision 1 moves non-labor to labor due to shifting priorities of the heat exchanger payload.

Revision 2 adds engineering services for heat exchanger payload tasks.

5.5.1 EC6 lab and test support

Project Code:

See above: 5.5 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. **Required DRDs**

5.5.1 EC6 lab and test support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.5.1 EC6 lab and test support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.5.1 EC6 lab and test support	
. None	
- NA	

5.6 EC7 services Updated Rev 3

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering services for EC7 including technical representative services for EVA Bilateral and Shuttle Tools to resolve issues from the following: engineering review panels, test readiness boards, Crew Equipment Interface Test (CEIT) and Bench Reviews, hardware anomalies and resolution for flight and trainer hardware, PIRN/ICD resolution, management reviews, and DR/FIAR disposition/resolution. The contractor shall provide technician services for the EC7 lab including the assembly and test of R&D and flight hardware. The

contractor shall also provide engineering services for Habitation Engineering including the development of critical need habitation technologies.

The WBS of this task shall be organized as follows:

- 6 EC7 Services
- 6.1 EVA GFE Hardware SSM
- 6.2 EC7 Lab Services
- 6.3 Habitation Engineering

Revision 2 adds engineering services for the Acoustic Multi-purpose Crew Transfer Bag tasks under the Habitation Engineering WBS.

Revision 3 adds additional AMCTB softgoods design and fabrication services.

5.6.1 EC7 services

Project Code:

See above: 5.6 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.6.1 EC7 services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.6.1 EC7 services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.6.1 EC7 services	
. None	
- NA	

5.7 Carbon Dioxide Removal Space Act Agreement Services Added R4

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and air laboratory services for the Life Support Systems Branch/EC3 for the development of carbon dioxide removal technologies for Space Act Agreement work.

5.7.1 Carbon Dioxide Removal Space Act Agreement Services Added R4

Project Code:

See above 5.7 requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None Added R4	None	NA

c. Required DRDs

5.7.1 Carbon Dioxide Removal Space Act Agreement Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added R4		NA

d. Products

5.7.1 Carbon Dioxide Removal Space Act Agreement Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None Added R4	NA Added R4	NA

e. Product Verification

5.7.1 Carbon Dioxide Removal Space Act Agreement Services	
i. None Added R4	
- NA Added R4	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ14HA52T TO# 135	Revision Number: 1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ARES Astromaterials Research

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,759,710	-\$201,091	\$3,558,619

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=ccgaspard, cn=CHRISTIAN GASPARD Date: 2015.06.26 15:19:06 -05'00'</small> Signature: _____ Date: 6/26/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA13T-TO135 REV 1

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (XI) (281) 244-8848

Revision Summary:

The ARES Astromaterials Research Plan XI3-AR-001 has been updated to include the following descope for TO135: the contractor shall decrease the scientific research services, material, and travel for the Experimental Impact Laboratory, Light Element Analysis Lab, and Mars Research due to decreased NASA research grant funding. The contractor shall reduce research associated with certain unfunded grants and/or maintain minimal research services in these laboratories. Increases include adding material associated with Organic Geochemistry Research and travel associated with Isotope, Geochemistry, and Geochronology and Interplanetary Dust, Stardust, and Primitive Materials.

1. Title of Effort: FY15 ARES Astromaterials Research (TO70)

2. Date of Request: 06/04/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. **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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

I.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Astromaterials Research Updated REV 1

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform the research identified in Section 5.1.1 and in accordance with referenced documents, controlled per ARES Configuration Control Process. The contractor shall provide services and invitational travel for visiting scientists and researchers when so requested by ARES. The contractor shall enhance NASA ARES competitiveness and quality of science via external collaborations, writing proposals, and pursuing resources from other relevant entities. No flight products will be required. Materials used for completion of research as identified in XI3-AR-001 ARES Astromaterials Research Plan, shall be authorized by XI Project Directives approved by the XI TMR. Updated REV 1

5.1.1 Astromaterials Research Initiatives Updated REV 1

Project Code:

Perform the research outlined in the research plans listed in the following sections contained in document XI3-AR-001 ARES Astromaterials Research Plan. Maintenance and Operations for the Astromaterials Research facilities is defined in the ARES Infrastructure task order and in KA-INF-001 Rev1 ARES Infrastructure Maintenance and Operations Plan

Readiness (2.0), Capabilities and Systems Development (3.0), Research Areas (4.0), Organic Geochemistry (4.1), Experimental Petrology (4.2), Experimental Impact Research (4.3), Mars Research (4.4), Isotopes and Geochemistry (4.5), Interplanetary Dust, Stardust, & Primitive Materials (4.6), Lunar Research (4.7), Astromaterials Projects (4.8), External Communications (5.0), Research Development (6.0), Product Deliverables and Verification (7.0)

b. Applicable Documents

Document Number	Document Name	Rev.
JPR 1700.1 Added REV 1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1 Added REV 1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-INF-001	ARES Infrastructure Maintenance and Operations Plan	Rev 1, 6-1-2014
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KA-WI-003	ARES Management of Research Proposals	Rev 3, 2/1/2011
KR-001	Office of Astromaterials research Configuration Management Process	Rev2, 8/1/2011
XI3-AR-001 Added REV 1	ARES Astromaterials Research Plan	Orig, 5/18/2015

c. Required DRDs

5.1.1 Astromaterials Research Initiatives		
DRD #	DRD Title	Quantity/Frequency
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Astromaterials Research Initiatives		
Product(s)	Quantity	Delivery Date
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

e. Product Verification

5.1.1 Astromaterials Research Initiatives
i. Delivery Acceptance Report (per DRD TD-12)
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ14HA53T TO# 136	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: Joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Advanced Docking System (LOE) (TO27 and TO35 follow on)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
DLabor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,032,469	-\$9,617	\$2,022,851

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a contract modification to document the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.24 17:06:36 -05'00'</small> Signature: _____ Date: <u>7/24/15</u> Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ14HA53T-TO136 REV 2

Originator: RICHARD HARDY (EA329) (281) 244-1088 **TMR:** JEFFERSON DUTTON (EA5) (281) 483-2841

Revision Summary:

Revision adds CLIN 3 for the reimbursable SpaceX 6 DoF Docking System testing activities.

Note: The amount of labor hours are updated. Only future labor hours are included in the LOE sheet.

The material authorization is to remain the same from the TO revision in March. The material dollars do need to be moved from Clin2 to Clin 1.

1. Title of Effort: FY15 Advanced Docking System (TO27& TO35) (LOE)

2. Date of Request: 07/17/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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~~

d. **2.3 Analysis and Assessment**

e. **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.

f. **2.4 Facilities**

g. **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.

h.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Advanced Docking System (ADS) Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort (LOE) products and services as directed by the NASA Advanced Docking System (ADS) Project Manager in support of NDS dynamic modeling, NDS testing support and engineering analysis and support for the Six degree of Freedom Dynamic Test System (SDTS) facility tests and maintenance. The contractor shall also provide LOE products and services in support of the NASA Docking System Block 2 (NDSB2) study effort. The contractor shall provide support per the attached LOE spreadsheet of standard labor categories.

A limited amount of materials may be purchased up to the limit allowed in this TO, as approved by the NASA ADS Project Manager or Deputy Project Manager. The materials may include, but are not limited to, articles required for the maintenance and operation of the SDTS and SDTS test article hardware.

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility

Project Code:

NDS Dynamic Modeling and Testing support tasks to be performed include but are not limited to:

- Support development of the NASA Docking System (NDS) block 1 simplified dynamics model.
- Support the development of dynamic models that will provide an integrated performance analysis when different user(s) models are provided.
- Support the correlation of Docking System and SDTS facility test models.
- Support planning and the completion of SDTS testing activities.
- Support activities leading to a certified facility ready to support docking system qualification testing.

Engineering analysis and support for SDTS Facility tasks to be performed include but are not limited to:

- Structures and Mechanism design and drafting
- Structural analysis
- Fabrication and assembly of hardware and equipment for the SDTS Facility

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort**Project Code:**

Engineering analysis and support tasks to be performed include but are not limited to:

- Structures and Mechanism design and drafting
- Structural and Thermal analysis
- Fabrication and assembly NDSB2 Study Hardware

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test Added Rev 2**Project Code:**

- Support planning, execution and completion of the SpaceX Docking System SDTS test activities and reporting.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs**5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility**

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Added Rev 2	Regular Status Report/Summary Review	Monthly

d. Products**5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility**

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	1	Monthly

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	1	Monthly

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report Added Rev 2	1	Monthly

e. **Product Verification**

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility		
i. Monthly Status Report		
- As approved by ADS Project Manager or Deputy Project Manager		

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort		
i. Monthly Status Report		
- As approved by ADS Project Manager or Deputy Project Manager		

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test		
i. Monthly Status Report		
- As approved by ADS Project Manager or Deputy Project Manager Added Rev 2		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA04T TO# 137	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 CPAS Engineering Services (TO22) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$728,014	\$728,014

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=PIV, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.08.28 08:15:29 -0500</small> Signature: _____ Date: 08/28/2014 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA04T-TO137

Originator: MICHELE PARKER (EA321) (281) 483-4683 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

1. Title of Effort: FY15 CPAS Engineering Services (TO22) (LOE)

2. Date of Request: 08/07/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 2.3 Analysis and Assessment

d. 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.

e. 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.

f. 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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Consultation and Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide independent consultant services to the CPAS design team in review of the parachute and deployment system. The contractor shall provide design recommendations for the parachute and deployment system.

5.1.1 Engineering Services

Project Code: 00067

The contractor shall provide support in the following areas:

- Engineering drawings
- Stress analysis
- Stress analysis reports
- Parachute system test procedures
- Parachute analysis
- Schedule design reviews
- Teleconferences

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 64221	Implementation Plan for the Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS)	Latest Revision
JSC 66003	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Technical Guidance Document	Latest Revision
JSC 66004	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Management Integrated Product Team (IPT) Record (MIPTR)	Latest Revision

c. Required DRDs

5.1.1 Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Per JSC 64221

d. Products

5.1.1 Engineering Services

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

e. Product Verification

5.1.1 Engineering Services
i. LOE
- As approved by the CPAS Project Manager

5.2 Engineering Technical Services and Drafting

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide CPAS design, drafting and analysis services.

5.2.1 Engineering Technical Services and Drafting

Project Code: 00067

The contractor shall provide CPAS design, drafting and analysis services.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 64221	Implementation Plan for the Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS)	Latest Revision
JSC 66003	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Technical Guidance Document	Latest Revision
JSC 66004	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Management Integrated Product Team (IPT) Record (MIPTR)	Latest Revision

c. Required DRDs

5.2.1 Engineering Technical Services and Drafting		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Per JSC 64221

d. Products

5.2.1 Engineering Technical Services and Drafting		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

e. Product Verification

5.2.1 Engineering Technical Services and Drafting
i. LOE
- As approved by the CPAS Project Manager

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 3
Task Order Number: NNJ15HA02T TO# 138		Revision Number: 2		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Exploration Augmentation Module (EAM)/Orion Docking Hatch (TO117) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$231,504	\$34,429	\$265,933

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name:		CHRISTIAN GASPARD	
Signature: _____ Date: _____		Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.04.27 10:01:00 -0500	
Signature: _____ Date: _____		Signature: _____ Date: 4/27/2015 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA02T-TO138 REV 2

Originator: JAN YOKLEY (EA311) (281) 483-7581 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

Revision Summary:

This revision adds hours due to a slight under planning of hours for the task. The attached LOE spreadsheet for this revision covers additional hours only.

1. Title of Effort: FY15 Exploration Augmentation Module (EAM)/Orion Docking Hatch (TO117) (LOE)

2. Date of Request: 04/21/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Exploration Augmentation Module (EAM)/Orion Docking Hatch Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of the EAM/Orion Docking Hatch. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.1.1 Provide design, analysis, procurement, assembly and testing support for the EAM/Orion Docking Hatch

Project Code:

Provide design, stress/pressure/vibration/dynamics analyses, procurement, assembly, and testing of the full scale EAM/Orion Docking Hatch Leak/Pressure/Vacuum/Vibration Test Fixture.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the EAM/Orion Docking Hatch		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As needed

- d. **Products**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the EAM/Orion Docking Hatch		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

- e. **Product Verification**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the EAM/Orion Docking Hatch	
i. LOE	
- --As approved by the EAM/Orion Docking Hatch Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 3
Task Order Number: NNJ14HA56 TO# 139		Revision Number: 1		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Alpha Magnetic Spectrometer

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$663,079	\$202,842	\$865,922

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name: _____		CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.03.26 17:23:09 -05'00'</small>	
Signature: _____ Date: _____		Signature: _____ Date: 3/26/15 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ14HA56T-TO139 REV 1

Originator: JAN YOKLEY (EA311) (281) 483-7581 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

Revision Summary:

Revision 1 includes future hours only for FY15 starting in March. The purpose of revision 1 is to increase hours for on-orbit AMS pump troubleshooting and blanket installation. Increases travel for contractor since new civil service project manager cannot travel as much as previous project manager.

1. Title of Effort: FY15 Alpha Magnetic Spectrometer FY15 (TO19) (LOE)

2. Date of Request: 03/18/2015

3. Statement of Work Task Description

a. 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.

b. 2.3 Analysis and Assessment

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Products and services to support on-going mission support for Alpha Magnetic Spectrometer.

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide LOE products and services as directed by the NASA AMS Project Manager in support of ongoing on orbit operations of the Alpha Magnetic Spectrometer. Contractor shall provide support per the attached LOE spreadsheet.

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.

Project Code:

All necessary ISS data products shall be collected and delivered to AMS Collaboration in Geneva, Switzerland.

All necessary analysis reports shall be developed and delivered to ISS program and AMS Collaboration as required.

A limited amount of materials may be purchased up to the limit allowed in this TO, as approved by the NASA PM. The materials may include, but are not limited to, renewal of a Unigraphics software license.

Travel may be required to support the activities on this TO. The contract should expect trips to Geneva, Switzerland, Taiwan, and Huntsville, Alabama. Other trips may be required and must be approved by the NASA PM. For this TO, it is assumed for FY14, 3 one week trips to Geneva, 2 one week trips to Taiwan, and 2 one week trips to Huntsville.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1 per week

d. Products

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Weekly Operational Reports provided to AMS Collaboration	1 per week	1 per week
Trip Reports	7	1 week after return from travel

e. Product Verification

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.	
i. Weekly Operational Reports provided to AMS Collaboration	
- As approved by AMS PM	
ii. Trip Reports	
- As approved by AMS PM	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ14HA57T TO# 140	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 SOPD Support (TO79)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose:

In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages. This task order establishes a ceiling that the contractor may not exceed (except at its own risk) without the approval of the contracting officer.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,399,806	\$1,399,806

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD
Date: 2014.09.17 09:13:28 -05'00'

Signature: _____ Date: **9/17/14**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ14HA57T-TO140

Originator: JEFFERSON DUTTON (EA211) (281) 483-2841

TMR: JAN YOKLEY (AO) (281) 483-7581

1. Title of Effort: FY15 SOPD Support (TO79)

2. Date of Request: 08/06/2014

3. Statement of Work Task Description

a. 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.

b. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Engineering and Administrative Services in Support of the Strategic Opportunities & Partnership Development (SOPD) Office

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide technical services to the JSC SOPD office. This service shall include all work completed on-site in the SOPD office as well as work completed off-site, as requested by the Manager of the SOPD office. Work off-site may require travel to conferences, events, and other NASA facilities. The following requested structure shown below should be collected and cost shown on 533 on a single level.

Management of the JSC Intellectual Property and Patent License Agreements Processes

The contractor shall manage and coordinate all maintenance of paper files and use of electronic tools to complete these tasks. Specifically this requirement includes:

- * New Technology disclosure process (including technical assessment of potential new technologies)
- * New Technology Report training (including eNTRe)
- * New Technology Evaluation process including New Technology evaluation, evaluation recommendation meeting, agenda management and execution
- * NASA Tech Briefs process including publication process and JSC distribution
- * Software Usage Agreement (SUA) process management
- * IP Portfolio Management Meeting monthly reports
- * IP documentation, including paper files and Tech Finder/NTTS data management
- * License opportunity development
- * NTTS application specialist

Management of the JSC Partnerships and Agreements Processes

The contractor shall manage and coordinate all maintenance of paper files and use of electronic tools. Specifically, this requirement includes:

- * Partnership Agreement process management
- * SAAM system management
- * SAA coordinator and contact management
- * Partnership training including SAA and SAAM training
- * SAA Helpdesk/Consulting
- * Inventory of Partnership (dashboard) management - active and inactive

Management of the JSC SBIR/STTR and Crosscutting Services Processes

The contractor shall manage and coordinate all maintenance of paper files and use of electronic tools. Specifically, this requirement includes:

- * Support to SBIR/STTR program operations/functions
- * JSC SBIR/STTR Technology Infusion process
- * JSC contract closeout activities for JSC managed contracts
- * TTCO Service Center process management (Front Door, Document Availability Authorization, Technology Assistance Requests)
- * TTCO Standard Operating Procedure (SOP) document management
- * Conference engagement and networking support
- * Quality Management System (QMS) Metrics
- * Performance Management System process management, as a part of the Performance Management Report (PMR) process
- * Outreach to achieve TTCO licensing and partnership objectives
- * Ad Hoc reports

Management of the JSC Technology Transfer & Commercialization Office (TTCO) Communication Management

The contractor shall provide limited support to:

External Communication

- * Provide communication materials to the TTCO for communications with Headquarters, responding to actions, calls for stories, technology reviews, photography and exhibit support
- * Provide JSC TTCO presentation/reports to the Innovative Office (IO) Headquarters Office and to the Johnson Space Center Strategic Communications Panel.
- * Communicate with other directorates regarding technology development, infusion, inventors to improve our products and press releases
- * Coordinate information dissemination with partner organization communication representatives (SATOP, HTC, etc.)
- * Coordinate publicity opportunities (inventor luncheon, new technology) with JSC Legal and the newsroom organizations

Materials Production

- * Continue TTCO Web site strategy, by providing content and coordination of web design. This includes news articles, innovator profiles, business-relevant information and forms, and technology transfer representative contact information
- * Produce written materials, presentations, web site material, correspondence, executive communication, success stories, coordinate press releases, innovation and inventor features, opportunity sheets, fact sheets, etc.
- * Provide strategy, graphics, writing and coordination with exhibits for HQ conferences
- * Produce stories for agency publications (Innovation, Spin Off Magazine, etc.)

The contractor shall prepare, submit, and maintain a Management Plan. The Management Plan shall include provisions for implementing Performance Measurement System reports for NASA/JSC Senior Management, which will provide SOPD with metrics measuring a summary of planned versus actual accomplishments for each reporting cycle, Quality Management System reports for NASA/JSC Senior Management, which will provide SOPD with metrics measuring performance against JSC Center QMS metrics; and other quantitative metrics. The Management Plan shall include specific details on the data to be included within the product deliverables. The Management Plan will be maintained and updated to reflect the current status of the contractor's SOPD operations.

Records and documents resulting from the Intellectual Property and Patent License Agreements, Partnerships and Agreements, SBIR/STTR process and provide Crosscutting Services and Communications Management Process tasks shall be maintained and electronically stored in a secure common database available to NASA (NTTS including Tech Tracs, TechFinder, and SBIR Handbook) and reports generated from NTTS on an Ad-Hoc basis.

The contractor shall provide Metrics data as required for measuring performance in the area of the IP / Patent License Process, Partnerships and Agreements Process,

SBIR/STTR/Crosscutting Services Process and Communication Management. Performance measurement criteria will include quantitative goals for licenses, new technology disclosures and SUAs, quantitative goals for partnerships, QMS and crosscutting services and Communication Management.

5.1.1 Engineering and Administrative Services in Support of the SOPD Office
Project Code:

See above

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1050.1	JSC Procedural requirements for Space Act Agreements	B 7/18/2012
NPD 1050.1	Authority to Enter Into Space Act Agreements	I 12/23/2008
NPD 2090.6	Authority To Enter Into License Agreements and Implementation of Licensing Authority	12/23/2008
NPR 2210.1	Release of NASA Software	C 8/11/2010
SSPS 2006-1	NASA SBIR/STTR Policy Statement	

c. Required DRDs

5.1.1 Engineering and Administrative Services in Support of the SOPD Office		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		n/a

d. Products

5.1.1 Engineering and Administrative Services in Support of the SOPD Office		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Performance Management Review Package	12	Last week of Following Month
SOPD Assignment List	2	As Requested
Management Plan	1	November 14, 2014

e. Product Verification

5.1.1 Engineering and Administrative Services in Support of the SOPD Office	
. Monthly Performance Management Review Package	
- Review and Approval by JSC SOPD Business & Partnership Processes Office Manager or Designated Alternate	
i. SOPD Assignment List	
- Review and Approval by JSC SOPD Business & Partnership Processes Office Manager or Designated Alternate	
ii. Management Plan	
- Review and Approval by JSC SOPD Business & Partnership Processes Office Manager or Designated Alternate	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ14HA58T TO# 141	Revision Number: 7	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Aerosciences and GN&C R&D Engineering Services (TO77) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,416,660	-\$78,963	\$1,337,698

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, ou=2342.19200300.100.1.1--cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.15 13:42:42 -05'00'</small> Signature: _____ Date: 7/15/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ14HA58T-TO141 REV 7

Originator: DENA HAYNES (EG1) (281) 244-5122 **TMR:** DENA HAYNES (EG) (281) 244-5122

Revision Summary:

TO141-03 Aerosciences R&D Engineering Services - De-scope & add travel
TO141-04 GN&C Lab Sustaining - De-scope & add travel
TO141-08 International Docking Adapter Rendezvous Prox Ops Engineering Services - Add scope for new target prototype fab & travel
TO141-09 Halliburton Capping Stack Toolset Engineering Services - De-scope

1. Title of Effort: FY15 Aerosciences and GN&C R&D Engineering Services (TO77) (LOE)

2. Date of Request: 07/07/2015

3. Statement of Work Task Description

a. **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.

b. **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.

c. **2.6 Special Projects**

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

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Aerosciences Flight Mechanics Division Institutional Safety & Facility Support Deleted Rev 2

5.2 Morpheus/ALHAT Project Integration Deleted Rev 1

5.3 Aerosciences R&D Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at modeling and analysis of the aerosciences for advanced exploration systems. Tasks include development of analysis methods, analytical tools, and application of these methods & tools for conducting vehicle aerodynamics and aerothermodynamics performance trades.

5.3.1 Aerosciences R&D Engineering Services

Project Code:

The Contractor shall provide engineering and technical services directed at modeling and analysis of the aerosciences for advanced exploration systems. Tasks include development of analysis methods, analytical tools, and application of these methods & tools for conducting vehicle aerodynamics and aerothermodynamics performance trades.

Actions to perform specific tasks shall be assigned by the technical manager through action items.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	No Title Entered	LOE

- c. **Required DRDs**

5.3.1 Aerosciences R&D Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

- d. **Products**

5.3.1 Aerosciences R&D Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

- e. **Product Verification**

5.3.1 Aerosciences R&D Engineering Services	
i. LOE	
- LOE	

5.4 GN&C Lab Sustaining & Maintenance Updated Rev 3

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at GN&C Lab sustaining and for maintaining high fidelity 6 DOF GN&C simulations, visualization capabilities, real-time human in the loop simulations, and GN&C analytic tools. Provide technical services directed at Integrated Power Avionics & Software (iPAS) network and system administration support. Updated Rev 3

5.4.1 GN&C Lab Sustaining & Maintenance Updated Rev 3**Project Code:**

provide engineering and technical services directed at GN&C Lab sustaining and for maintaining high fidelity 6 DOF GN&C simulations, visualization capabilities, real-time human in the loop simulations, and GN&C analytic tools. Provide technical services directed at Integrated Power Avionics & Software (iPAS) network and system administration support.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
Loe	LOE	LOE

c. Required DRDs

5.4.1 GN&C Lab Sustaining & Maintenance		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.4.1 GN&C Lab Sustaining & Maintenance		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.4.1 GN&C Lab Sustaining & Maintenance	
i. LOE	
- LOE	

5.5 SpaceX Aerosciences Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at performing aerodynamic and aerothermal analysis that will be used by SpaceX to support development of the Dragon

5.5.1 SpaceX Aerosciences Engineering Services**Project Code:**

In compliance with the above identified SOW(s), the contractor shall provide engineering and technical services directed at performing aerodynamic and aerothermal analysis that will be used by SpaceX to support development of the Dragon spacecraft.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.5.1 SpaceX Aerosciences Engineering Services
--

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. **Products**

5.5.1 SpaceX Aerosciences Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.5.1 SpaceX Aerosciences Engineering Services		
i. LOE		
- LOE		

5.6 Advanced Spacecraft Guidance and Navigation

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Advanced Spacecraft Guidance and Navigation engineering services for payload integration, safety, and vehicle interface-work identified for a Commercial Orbital Transportation System (COTS) vehicle flight integration template.

5.6.1 Advanced Spacecraft Guidance and Navigation Engineering Services

Project Code:

Provide Advanced Spacecraft Guidance and Navigation engineering services required for payload integrated testing and Phase II/ III Safety Reviews for a Commercial Orbital Transportation System (COTS) vehicle flight integration

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

5.6.1 Advanced Spacecraft Guidance and Navigation Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		DRD

d. **Products**

5.6.1 Advanced Spacecraft Guidance and Navigation Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.6.1 Advanced Spacecraft Guidance and Navigation Engineering Services		
i. LOE		
- LOE		

5.7 PDT Project Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Propulsive Descent Technology (PDT) project directed at FY14 and FY15 implementation cost, content and schedule. As necessary, the contractor shall also provide planning for new FY15 and FY16 content including engineering and technical services directed at establishing integrated cost, content and schedule baseline.

5.7.1 PDT Project Engineering Services Updated Rev 5

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Propulsive Descent Technology (PDT) project directed FY15 implementation cost, content and schedule. As necessary, the contractor shall also provide planning for new FY15 and FY16 content including engineering and technical services directed at establishing integrated cost, content and schedule baseline, expert support to PDT reviews, expert input on a mid L/D vehicle development activity. Additionally, the contractor shall provide engineering and technical services directed at SpaceX Falcon vehicle aerodynamic flight data reconstruction, generation of aerodynamic and aerothermal databases for the SpaceX Red Dragon capsule, and an SRP vehicle design study.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

- c. **Required DRDs**

5.7.1 PDT Project Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Loe

- d. **Products**

5.7.1 PDT Project Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

- e. **Product Verification**

5.7.1 PDT Project Engineering Services	
i. LOE	
- LOE	

5.8 International Docking Adapters Rendezvous & Prox Ops Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services for the Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA). and also provide IDA testing and verification support.

5.8.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services

Project Code:

The contractor shall provide engineering services for the Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA). and also provide IDA testing and verification support.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

5.8.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. **Products**

5.8.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.8.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services	
i. LOE	
- LOE	

5.9 Halliburton Capping Stack Toolset Engineering Services Added Rev 3

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at developing a toolset that will allow for the design and certification of deep ocean blow out recoveries including near field dynamics of capping stack installation caused by the blow out jet hydrodynamics, capping stack geometry design trades, operational procedure development, and critical response team certification. Added Rev 3

5.9.1 Halliburton Capping Stack Toolset Engineering Services Added Rev 3

Project Code:

The Contractor shall provide engineering and technical services directed at developing a toolset that will allow for the design and certification of deep ocean blow out recoveries including near field dynamics of capping stack installation caused by the blow out jet hydrodynamics, capping stack geometry design trades, operational procedure development, and critical response team certification.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NA/LOE Added Rev 3	NA	NA/LOE

c. **Required DRDs**

5.9.1 Halliburton Capping Stack Toolset Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 3		NA

d. Products

5.9.1 Halliburton Capping Stack Toolset Engineering Services		
Product(s)	Quantity	Delivery Date
LOE Added Rev 3	LOE	LOE

e. Product Verification

5.9.1 Halliburton Capping Stack Toolset Engineering Services	
i. LOE	
- LOE Added Rev 3	

5.10 SpaceX CCP Aerosciences Engineering Services Added Rev 6

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Conduct aerodynamic and aerothermodynamic analyses of the SpaceX Dragon vehicle during ascent, abort, reentry, and landing flight phases. Tasks will include calculating aerodynamic forces and moments, aerothermodynamic heat flux loads, and jet efficiency of the Draco and Super Draco engines in different power-on configurations. Added Rev 6

5.10.1 SpaceX CCP Aerosciences Engineering Services Added Rev 6

Project Code:

Conduct aerodynamic and aerothermodynamic analyses of the SpaceX Dragon vehicle during ascent, abort, reentry, and landing flight phases. Tasks will include calculating aerodynamic forces and moments, aerothermodynamic heat flux loads, and jet efficiency of the Draco and Super Draco engines in different power-on configurations.

b. Applicable Documents

Document Number	Document Name	Rev.
LOE Added Rev 6	No Title Entered	

c. Required DRDs

5.10.1 SpaceX CCP Aerosciences Engineering Services		
DRD #	DRD Title	Quantity/Frequency
None Added Rev 6		LOE

d. Products

5.10.1 SpaceX CCP Aerosciences Engineering Services		
Product(s)	Quantity	Delivery Date
NA LOE Added Rev 6	LOE	LOE

e. Product Verification

5.10.1 SpaceX CCP Aerosciences Engineering Services	
i. NA LOE	
- LOE Added Rev 6	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ15HA03T TO# 142	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Propulsion and Power Division Development and Test Operations Support

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,886,301	\$43,919	\$2,930,220

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.09 07:38:06 -05'00'</small> Signature: _____ Date: 7/9/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA03T-TO142 REV 2

Originator: MARTIN MCCLEAN (EP6) (281) 483-6478 **TMR:** ROBERTO EGUSQUIZA (EP) (281) 483-8284

Revision Summary:

Revision increases test operations required and adds travel to support operations.

1. Title of Effort: FY15 Propulsion and Power Division Development and Test Operations Support (TO114)

2. Date of Request: 12/10/2014

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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

e. **2.4 Facilities**

f. **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.

g. **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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 ESTA Development and Test Support Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall support test operations, hardware and software development and production, capability maintenance and capability projects for NASA flight and advanced development programs. The primary technical disciplines supported are electrical power distribution and control, batteries, pyrotechnics, in-space vehicle propulsion, fuel cells, and in-situ resource utilization (chemical processing).

Test Operations:

Test operations gather data on product performance, safety, life, and anomaly resolution in laboratory or simulated ground and space environments. Environments supported include thermal, vacuum, thermal-vacuum, elevated external pressure, varying atmospheric oxygen levels, vibration, classical shock, pyrotechnic shock, and power quality. Test operations may be applied to materials, components, subassemblies, and complete assemblies. Test support ranges from early development and demonstration through flight equipment production (acceptance, qualification, and certification) and sustaining engineering.

The contractor shall support test operations as defined by individual test requirements which may include the development and execution of plans, hazard analyses, and procedures, the estimation of labor, procurements, and schedule, the creation or modification of mechanical, electrical, and data acquisition and control systems, the demonstration of test readiness, the conduct of test operations, the generation and analysis of data, and creation of reports which document the performance of the product under test.

Hardware and Software Products:

Hardware and software products support NASA flight and advanced programs for development, ground test, ground support, and spaceflight.

The contractor shall support production of ground and flight hardware and software products as defined by individual project requirements which may include the estimation of labor, procurements, and schedule, the design, fabrication, test, maintenance, repair, hardware and software integration, the pre and post use processing, the development of 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 for all assigned product support.

Capability Maintenance:

Capability maintenance serves to keep the capabilities for performing test operations and producing hardware and software products within the Propulsion and Power Division available in a working and ready state.

The contractor shall support maintenance of the following capabilities.

- Environmental testing including thermal, vacuum, thermal-vacuum, vibration, shock, pyroshock, power quality, elevated external pressure, and varying atmospheric oxygen levels
- Chemical laboratory analysis and processing (FTIR, GC, etc)
- Fluid component and system pressure testing
- Battery testing including physical examination (weights, dimensions, imagery), performance (capacity, rate capability, life), and safety (external short circuit, internal short circuit, heat-to-vent, vent/burst, drop) testing
- Fuel cell testing
- In-situ Resource Utilization chemical processing
- Pyrotechnics testing
- Electrical power component and system testing
- In space vehicle propulsion testing up to nominal 200 bf thrust

The contractor shall support maintenance of the following types of facility test support systems and equipment.

- Pressure and fluid handling systems
- Data acquisition and control systems including calibrated transducers and certified signal conditioning and data recording
- Electrical power and control systems
- Hazard containment systems and equipment
- Environmental test systems

The contractor shall support the following as assigned.

- Hazardous chemical inventories
- Periodic safety reviews by external parties
- Periodic verifications of systems and equipment
- Work control and logging of work authorizing documents
- Certifications of lifting equipment
- Administrative activities including processing of test and project requests, test and project estimates, and test and project files
- Procurement of consumable and test specific materials
- Logistics activities including material inventories and store stock operations

Capability Projects:

Capability projects serve to create, modify, or remove capabilities for performing test operations and producing hardware and software products within the Propulsion and Power Division.

The contractor shall support capability projects as defined by individual project requirements which may include the development and execution of project plans, hazard analyses, and procedures, the creation or modification of mechanical, electrical, and data acquisition and control systems, the demonstration of capability readiness, the validation of capability performance, and creation of reports which document the performance of the capability.

The contractor shall maintain document and system configuration control for all assigned support that comply with applicable JSC requirements in the General Operating Procedures Manual for EA Testing Facilities (EA-WI-024), the ESTA General Operating Procedures Manual (EP-WI-004), JSC SAFETY and Health Handbook (JPR1700.1), and individual test/project requirements. The contractor shall coordinate schedules and workforce for all assigned support.

The contractor shall provide supplemental labor data relating hours and roles to each test or project identified.

5.1.1 ESTA Development and Test Operations Updated REV 1

Project Code:

Tests, projects, and maintenance are defined in a Task Database maintained by NASA on an organizational file server.

A nominal test or project is based on the requirements for the Next Generation Ultrasound (NGU) System Battery Certification. Test and capability project quantities are based on the complexity of this nominal test having a weighted value of 1. Test and projects typically range in complexity from 0.1 to 10.0 times this

complexity. Complexity of test, specified in the Task Database, shall be used by the contractor in estimating resources and schedule for actual tests, including capability projects.

In performing ESTA Development and Test Operations, the contractor shall

- provide a skilled workforce and leadership with the appropriate mentoring, training, and technical expert oversight that ensures the delivery of quality EP products.
- apply best practices across the contract for lean operations
- provide a safe work environment in ESTA hazardous operations
- provide accurate business reporting on actuals and projected expenditures
- provide partnership opportunities that take advantage of unused capacity or create new work
- provide fast turnaround for surge or destaffing of personnel with the appropriate skill levels – including reach-back expertise
- provide timely and readily available test capacity across EP facilities
- provide support for four development and test operations at locations remote from the NASA JSC site

Metrics:

Required Service: Provide operational facilities to support ESTA Development and Test Operations

Standard of Excellence: 100% availability and functionality to support scheduled operations due to factors within the scope of the SOW.

Minimum Requirement: 95% availability and functionality to support scheduled operations due to factors within the scope of the SOW.

Required Service: Ensure ESTA customer satisfaction

Standard of Excellence: Zero tests have complaints about impacts to customer.

Minimum Requirement: Less than 5% of tests have complaints about impacts to customer.

Required Service: Ensure availability of required skills:

Standard of Excellence: Required skills available 100% of time.

Minimum Requirement: Required skills available greater than 95% of the time

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Current
EP-WI-004	ESTA General Operating Procedures Manual	Current

c. Required DRDs

5.1.1 ESTA Development and Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	1 per assigned test

d. Products

5.1.1 ESTA Development and Test Operations		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Tests and Projects, Weighted Updated REV 1	68	Per Task Database
Monthly Status Report Updated REV 1	12	At work group reviews
Test and Product Schedules (contractor maintains or provides input via Task Database)	12	At work group reviews

e. Product Verification

5.1.1 ESTA Development and Test Operations	
i. Tests and Projects, Weighted	
- Test and project products shall be verified through Task Database review at scheduled periodic status meetings and review of test reports with NASA EP6 branch personnel.	
ii. Monthly Status Report	
- The periodic status reports shall be verified by review with NASA EP6 branch personnel.	
iii. Test and Product Schedules (contractor maintains or provides input via Task Database)	
- Schedules shall be verified through Task Database review at scheduled periodic status meetings with NASA EP6 branch personnel.	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA10T TO# 143	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EC5 Space Suit and Crew Survival Systems Equipment Branch Laboratory-Crew Escape and Life Support Equipment Services (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,266,390	\$2,266,390

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard  Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.09 16:09:27 -05'00' Signature: _____ Date: 09/09/2014 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA10T-TO143

Originator: KIMBERLEE PROKHOROV (EC3) (281) 244-5714 **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY15 EC5 Space Suit and Crew Survival Systems Equipment Branch Laboratory-Crew Escape and Life Support Equipment Services (TO30) (LOE)

2. Date of Request: 08/28/2014

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Crew Escape and Life Support Equipment (CELSE) Laboratory

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall Perform sustaining engineering services including, but not limited to project engineering, test, and documentation necessary to conduct daily operations within the Space Suit and Crew Survivability Systems Laboratory in compliance with JSC 47745, "Standard Operating Procedures for the CELSE Laboratory." This includes sustaining engineering necessary to support equipment and configuration, documentation revision requirements and procedure development for new and modified hardware, and failure analysis including Advanced Crew Escape Suit Systems, modified ACES, Orion Crew Seats, manned Neutral Buoyancy Laboratory (NBL) Events, Intermediate Pressure Integrated Systems Testing (IPIST) and Vacuum Integrated Systems Testing (VPIST). The contractor shall provide engineering and technical services for: the modification to the NASA owned Dual Suit Controller (DSC); the modification of the Modified Advanced Crew Escape Suit (MACES) in support of the ACRM; overhaul of a NASA owned oxygen regulator; and preparations and support of the Vacuum Pressure Integrated Suit Test (VPIST).

5.1.1 Crew Escape and Life Support Equipment (CELSE) Laboratory Project Code:

The contractor shall provide engineering services including, but not limited to project engineering, design, test, analysis, fabrication, inspection and documentation necessary to conduct daily operations within the CELSE laboratory in compliance with JSC 47745, "Standard Operating Procedures for the CELSE Laboratory." This includes, but is not limited to sustaining engineering of the suit and suit hardware test operations, documentation and procedure development for new and modified hardware, and failure analysis. Appropriate hardware includes, but is not limited to Advanced Crew Escape Suit Systems and Components, Modified Advanced Crew Escape Suit Systems, Support of Required Events and additional hardware Include: a) launch/entry suit development tasks for Orion b) launch/entry suit integration and test for Orion ECLSS c) Orion Crew Seats and Survival Subsystems d) Commercial suits, seats, and/or crew survival activities as defined by EC technical leads e) NASA Architecture and trade studies involving L/E suits and EVA related modifications. The CELSE Laboratory is a government managed laboratory and the contractor shall provide services necessary for on-going projects for the ORION program and associated training/evaluation events.

b. Applicable Documents

Document Number	Document Name	Rev.
CTSD-ADV-1001	Standard Operating Procedure for the Crew Escape Equipment Test Stand	Current
CTSD-ADV-1034	Modified ACES Overhaul Inspection & Fabrication Procedures	Current
CTSD-ADV-1045	Interface Control Drawing for Neural Buoyancy Laboratory	Current
CTSD-ADV-1046	Hazard Assessment for Neutral Buoyancy Laboratory	Current
CTSD-ADV-911	CELSE Lab Modified ACES Configuration Description Control Document	Current
CTSD-SH-1289 (JSC 39185)	Integrated Hazard Analysis for the Crew Escape and Life Support Equipment Laboratory, Building 7A	Current
CTSD-SH-1402 (JSC 47743)	Standard Operating Procedure for the CELSE Test Stand	Current
CTSD-SH-2056	Hazard Analysis for the Life Support Equipment Test Stand Building 7A	Current
CTSD-SH-2064	Modified Advanced Crew Escape Suit Testing Procedures	Current
CTSD-SH-2067	Hazard Analysis for Advanced Crew Escape Suit (ACES) & Modified ACES Testing/Evaluations	Current
EA-WI-023	Project Management of GFE Flight Projects	Current
ES4-10-042A	Operation and Configuration Control Plan (OCCP) for Safe Ground Pressurization of Advanced Crew Escape Suit	Current
JSC 47745	Standard Operating Procedure for CELSE Laboratory	Current
L50-M00010	Advanced Crew Escape Suit(ACES) Derivative Ground Support Hardware Configuration/Integration Drawing	Current
L50-M00011	Advanced Crew Escape Suit Testing Drawing	Current
L50-M00012	Carbon Monoxide Washout Testing Configuration	Current

c. Required DRDs

5.1.1 Crew Escape and Life Support Equipment (CELSE) Laboratory		
DRD #	DRD Title	Quantity/Frequency
None		0

d. Products

5.1.1 Crew Escape and Life Support Equipment (CELSE) Laboratory		
Product(s)	Quantity	Delivery Date
None	0	NA

e. Product Verification

5.1.1 Crew Escape and Life Support Equipment (CELSE) Laboratory	
i. None	
- NA	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ15HA23T TO# 144	Revision Number: Rev 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Spacecraft Software Engineering

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,226,991	-\$9,651	\$2,217,340

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☒ is, ☐ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

**CHRISTIAN
GASPARD**

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA,
ou=People, 0.9.2342.19200300.100.1.1=cgaspard,
cn=CHRISTIAN GASPARD
Date: 2015.05.29 13:07:46 -05'00'

Signature: _____ Date: **5/29/2015**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA23T-TO144 REV 1

Originator: PEDRO MARTINEZ (ER6) (281) 483-9792 **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Rev 1:

- a) Add scope to CLIN 1 for procurement of software licenses, including a corresponding update to the master plan and schedule.
- b) Add scope to CLIN 3 for PRACA and semantic text analysis; no master plan and schedule update is required for this change.
- c) RV-02 DRD Summary Reporting on a Monthly Basis has been added to all Subtasks.

1. Title of Effort: FY15 Spacecraft Software Engineering (TO100)

2. Date of Request: 03/12/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 ISS Countermeasures System (CMS) Software Engineering **Updated REV 1**

a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) software for on-orbit operations and ground operations as defined in the subsequent paragraphs. The contractor shall provide software sustaining engineering products and services for the Countermeasures System Software (CMSS) applications as follows:

- a) Participate as Subject Matter Expert in CMS project meetings.
- b) Perform engineering analyses as part of on-orbit anomaly investigations.

- c) Perform assessments of software change requests.
- d) Track software assets.
- e) Maintain software process tools.

This activity includes renewal of software licenses originally purchased through JETS.

ER6 will supply the tools necessary for the contractor to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. ER6 will supply laboratory space and development systems required by the contractor to accomplish the tasks. **Updated REV 1**

5.1.1 ISS Countermeasures System (CMS) Software Engineering

Project Code:

The contractor shall develop and sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) software for on-orbit operations and ground operations.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-025	GFE Flight Project Software and Firmware Development Work Instruction	Rev D
ER6-TM144	ER6 TO-144 Master Plan and Schedule	Original
ER6-TM144 Added REV 1	ER6 TO-144 Master Plan and Schedule	Rev 1

c. Required DRDs

5.1.1 ISS Countermeasures System (CMS) Software Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Added REV 1	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.1.1 ISS Countermeasures System (CMS) Software Engineering		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	Per ER6-TM144	Per ER6-TM144

e. Product Verification

5.1.1 ISS Countermeasures System (CMS) Software Engineering	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	

5.2 Orion Software Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide software engineering services for the Orion Multi-Purpose Crew Vehicle (MPCV). The contractor shall evaluate requirements, architecture, processes, designs, and configuration management. Additionally, the contractor will foster a collaborative environment with the Orion prime contractor to create an open forum that allows for the exchange of information that will allow the NASA Orion team to assess the prime contractor's software development activities for the entire software life cycle.

The contractor shall perform the following:

- a) Evaluate Orion Communications & Tracking (C&T) flight and flight support software plans, metrics, concepts, requirements, design, integration, verification, validation, certification and acceptance, implementation, operations, maintenance, decommissioning and overall life cycle, as follows:
 - a1. Evaluate Type 1 and Type 2 documents and provide approval recommendations.
 - a2. Review Type 3-5 documents for impact on Orion Software.
 - a3. Assess Orion Software Change Requests (CRs) and Discrepancy Reports (DRs) and provide closure recommendations.
 - a4. Perform conceptual design trades consistent with subsystem requirements.
 - a5. Perform testability analysis of subsystem instrumentation design using system modeling tools.
 - a6. Provide technical reporting to the Software System Manager and Orion Software System Manager in programmatic level reviews, technical meetings, and control boards.
 - a7. Participate in C&T meetings at other NASA centers and Orion contractor facilities.
- b) Perform development, integration and operations of the Kedalion Software Engineering Environment, as follows:
 - b1. Assist in equipment selection, procurements, hardware and software integration, test coordination, planning, set up, system administration, and overall development of the environment.
 - b2. Maintain and track environment hardware inventory and configuration, software tool versions and configuration, development environment, and software deliveries. Maintain Configuration Management (CM) documentation within the environment CM system and perform property custodian duties.
 - b3. Develop, maintain and operate the facility through the Orion lifecycle.
 - b4. Integrate and maintain Orion Data Services (ODS) databases.
- c) Perform development, integration, and operation tasks associated with the Orion Software Tool Chain and the JSC instance of the Orion Software Collaborative Environment (SCE-lite), as follows:
 - c1. Assist in equipment selection, procurements, hardware and software integration, test coordination, planning, set up, system administration, and overall development of the Orion Software Tool Chain.
 - c2. Develop and maintain the JSC SCE-lite environment including integration of required SCE-lite software packages, development of capabilities to accept, distribute, and exchange Orion software product deliveries, and maintenance of the environment.
 - c3. Track, maintain, and ensure correct configuration of required software capabilities such as Synergy, Change, DOORS, Oracle, and LDRA in the JSC SCE-lite node.
 - c4. Perform property custodian duties to develop, maintain, and operate the JSC SCE-lite node through the Orion lifecycle.
- d) Perform development, integration, and operation tasks associated with the Houston Orion Test Hardware (HOTH) environment, as follows:
 - d1. Equipment selection and procurement.
 - d2. Hardware and software integration.
 - d3. Test coordination.
 - d4. Scheduling and planning.
 - d5. Procurement, fabrication, and integration of test hardware.
 - d6. Participate as HOTH Subject Matter Expert in Orion technical meetings at other NASA centers and Orion contractor facilities.
 - d7) Perform systems engineering and process services for data integration, processes, and tools.

The contractor will use ER6 products necessary to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. The contractor will use ER6 laboratory space, and development systems required to accomplish Orion Software Engineering Services tasks.

5.2.1 Orion Software Engineering

Project Code:

The contractor shall provide software engineering services for the Orion Multi-Purpose Crew Vehicle (MPCV).

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CxP-72099	Crew Exploration Vehicle Software Management Plan	Basic September 18 2007
ER6-TM144	ER6 TO-144 Master Plan and Schedule	Original
ER6-TM144 Added REV 1	ER6 TO-144 Master Plan and Schedule	Rev 1

c. Required DRDs

5.2.1 Orion Software Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-02 Added REV 1	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.2.1 Orion Software Engineering		
Product(s)	Quantity	Delivery Date
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	Per ER6-TM144	Per ER6-TM144

e. Product Verification

5.2.1 Orion Software Engineering	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	

5.3 Intelligent Systems Research and Development Updated REV 1

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide research, technology development, and analysis engineering services associated with intelligent systems projects.

This activity includes research and development of methods and tools for analyzing complex systems, analysis and study for development of content for proposals for new projects; and prototyping and development of content for planning and scheduling products for new projects.

This activity includes application and modification of the Semantic Text Analysis Tool (STAT) software to extract descriptors from text in anomaly databases and documents, for data integration to assess adverse hardware and software trends. Use the extracted descriptors to enable data transformation and evaluation of data coding and translation rules for data that includes text fields.

This activity includes formulation of rules for identifying proxy codes for PRACA defect codes, using extracted semantic tags and code definitions.

This activity includes extension of Semantic Text Analysis Tool software to automatically identify proxy codes for failure mode codes and defect codes in multiple problem report data sources including PRACA, GFE PRACA, IFIs and Anomaly Reports.

This activity includes purchase of laboratory equipment. Updated REV 1

5.3.1 Intelligent Systems Research and Development

Project Code:

The contractor shall provide research, technology development, and analysis engineering services associated with intelligent systems projects.

b. Applicable Documents

Document Number	Document Name	Rev.
ER6-TM144	ER6 TO-144 Master Plan and Schedule	Original

ER6-TM144 Added REV 1	ER6 TO-144 Master Plan and Schedule	Rev 1
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c. Required DRDs

5.3.1 Intelligent Systems Research and Development		
DRD #	DRD Title	Quantity/Frequency
RV-02 Added REV 1	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.3.1 Intelligent Systems Research and Development		
Product(s)	Quantity	Delivery Date
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	Per ER6-TM144	Per ER6-TM144

e. Product Verification

5.3.1 Intelligent Systems Research and Development	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	

5.4 JSC SEPG Engineering Services

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide JSC SEPG engineering services, including the following:

a) Analysis of NPR 7150.2A, JPR 7150.2 and related Agency, JSC and Industry software process artifacts, and provide engineering recommendations related to JSC software process compliance and improvement.

b) Cost estimation for software projects.

5.4.1 JSC SEPG Engineering Services

Project Code:

The contractor shall provide JSC SEPG engineering services.

b. Applicable Documents

Document Number	Document Name	Rev.
NPR 7150.2	NASA Software Engineering Requirements	Rev. A, Oct. 2009
ER6-TM144 Added REV 1	ER6 TO-144 Master Plan and Schedule	Rev 1
JPR 7150.2	JSC Software Engineering Requirements	5/14/2012

c. Required DRDs

5.4.1 JSC SEPG Engineering Services		
DRD #	DRD Title	Quantity/Frequency
RV-02 Added REV 1	Regular Status Report/Summary Review	Monthly

TD-08	Engineering Analysis	One per analysis
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d. **Products**

5.4.1 JSC SEPG Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	Per ER6-TM144	Per ER6-TM144

e. **Product Verification**

5.4.1 JSC SEPG Engineering Services		
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule		
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule		

5.5 ISS Simplified Aid for EVA Rescue (SAFER) Software Engineering Products and Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide software sustaining engineering for the ISS Simplified Aid for EVA Rescue (SAFER) as follows:

- a) Participate as Subject Matter Expert in SAFER project meetings.
- b) Perform engineering analyses as part of on-orbit anomaly investigations.
- c) Perform assessments of software change requests.
- d) Maintain software process tools.

ER6 will supply the tools necessary for contractor to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. ER6 will supply laboratory space, and development systems required by contractor to accomplish the tasks defined in this TO. ER6 will supply the tools necessary for contractor to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. ER6 will supply laboratory space, and development systems required by contractor to accomplish the tasks defined in this TO.

The contractor shall obtain specialized testing and development equipment.

5.5.1 ISS Simplified Aid for EVA Rescue (SAFER) Software Engineering Products and Services
Project Code:

The contractor shall provide ISS Simplified Aid for EVA Rescue (SAFER) GFE sustaining engineering.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-025	GFE Flight Project Software and Firmware Development Work Instruction	Rev D
ER6-TM144	ER6 TO-144 Master Plan and Schedule	Original
ER6-TM144 Added REV 1	ER6 TO-144 Master Plan and Schedule	Rev 1

c. **Required DRDs**

5.5.1 ISS Simplified Aid for EVA Rescue (SAFER) Software Engineering Products and Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-02 Added REV 1	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. **Products**

5.5.1 ISS Simplified Aid for EVA Rescue (SAFER) Software Engineering Products and Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	Per ER6-TM144	Per ER6-TM144

e. **Product Verification**

5.5.1 ISS Simplified Aid for EVA Rescue (SAFER) Software Engineering Products and Services	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM144, ER6 TO 144 Master Plan and Schedule	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 3
Task Order Number: NNJ15HA22T TO# 146	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Simulated Robotics Work Station (SRWS) Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$70,981	-\$773	\$70,208

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Christian C. Gaspard</p> <p>CHRISTIAN GASPARD</p> <p><small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.21 16:12:31 -05'00'</small></p> <p>Signature: _____ Date: 5/21/15</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ15HA22T-TO146 REV 1

Originator: JARED WOODFILL (ER7) (281) 483-6331 **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

The significant change in Revision One of TO_146 R1 is removing the words "in the NBL" from 1.01 and replacing them with "in the SRWS Lab". Though this might not seem significant, it eliminates the installation and testing of the latest MSS software in the Neutral Bouyancy Lab (NBL) itself. Such yields an anticipated reduction in required funding from about \$128K to \$66K.

1. Title of Effort: FY15 Simulated Robotics Work Station (SRWS) Engineering Services (TO106)

2. Date of Request: 11/24/2014

3. Statement of Work Task Description

a. 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.

b.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Technical Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide technical services and products per ER7-TM146 for NASA programs and special projects.

Additionally:

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of TO-146 and its supporting Master Plan and Schedule ER7-TM146 and may include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow.

5.1.1 Advanced Robotics Lab Development and Testing Services

Project Code:

All revisions to ER7-TM146 ER7 SRWS Engineering Services Requirements, must be approved by the NASA Simulation Graphics Branch (ER7) and accepted by the contractor Task Order Branch Technical Manager and Division Technical Manager. Changes which impact cost or product delivery of performance will require a revision to this task order.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER7-TM146 Added REV 1	SRWS Master Plan and Schedule	Revision One

c. Required DRDs

5.1.1 Advanced Robotics Lab Development and Testing Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		None

d. Products

5.1.1 Advanced Robotics Lab Development and Testing Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER7-TM146 Updated REV 1	1	by September 30, 2015
Informal Status Reports	12	by end of each month

e. Product Verification

5.1.1 Advanced Robotics Lab Development and Testing Services	
i. Implementation of ER7-TM146	
- - i. Implementation of ER7-TM146 - NASA TO Technical Manager will review/accept completed product. Acceptance by TM will be documented through TMR/Alternate TMR	
ii. Informal Status Reports	
- - Completion of regular status/reports summary review	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 24
Task Order Number: NNJ15HA18T TO# 148	Revision Number: 6	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ES Structural Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

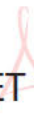
Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$7,424,468	(\$85,268)	\$7,339,200

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet  ROCHELLE OVERSTREET <small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnoverst, cn=ROCHELLE OVERSTREET Date: 2015.08.20 16:56:53 -05'00'</small> Signature: _____ Date: 8/20/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA18T-TO148 R6

Originator: SHIRLEY HOLLAND-HUNT (ES18) **TMR:** SHIRLEY HOLLAND-HUNT (ES) (281) 483-3254

Revision Summary:

CLIN 5.4 The contractor shall reduce the Engineering Services required in the ISS/Material and Fracture control, NASGRO, Ellington Aircraft, NDE projects and Orion MF areas.

CLIN 5.9 The contractor shall reduce Engineering Services required in subcontracting the inflatable bladder material testing since this work will be shifted to the Civil Servant workforce.

1. Title of Effort: FY15 ES Structural Engineering Services (TO46) (Hybrid CF)

2. Date of Request: 08/10/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. **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.

f. **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

g. **2.2.4 Training**

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

h. **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.

i. **2.3 Analysis and Assessment**

j. **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.

k. **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.

l. **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.

m. **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.

n. **2.4 Facilities**

o. **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.

p. **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.

q. **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.

r. **2.5 Research and Development**

s. **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, Descent, 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.

t. **2.6 Special Projects**

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

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4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 .1 ES18 Managment Integration Office Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall (INACTIVE)

5.1.1 (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirement for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. **Required DRDs**

5.1.1 (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. **Products**

5.1.1 (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. **Product Verification**

5.1.1 (INACTIVE)	
i. Hybrid	
- Hybrid	

5.2 ES2 Structural Branch Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide
Review of structural engineering estimates
Review of performance of trade studies
Review of performance of structural engineering assessments and analysis
Safety assessments
Development of anomaly resolution recommendations
Participation in GFE project technical reviews

Related to:

Spacecraft payloads
ISS, Orion, GFE projects
Technology Development projects

Representative of:

Engineering requirements analysis reports for ISS Program projects
Orion Project Stress Analysis Summary reports
GFE Technology Development projects

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.2.1 Orion CSM (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.2.2 PSRP/GCAR Review (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

5.2.3 GFE Core Team (INACTIVE)

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34241)JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware	Baseline
NSTS 08307	Criteria for Pre-Loaded Bolts	Rev A
NSTS 13830	Payload Safety Review and Data Submittal Requirements for Payloads Using the Shuttle and ISS	Rev C, Change 4 01-02
NSTS 14046	Payload Verification Requirements	Rev E, Change 3 08-02
NSTS 1700.7B ISS	Safety Policy and Requirements for Payloads Using the ISS	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. Required DRDs

5.2.1 Orion CSM (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.2.2 PSRP/GCAR Review (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

None		Hybrid
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5.2.3 GFE Core Team (INACTIVE)		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

d. **Products**

5.2.1 Orion CSM (INACTIVE)			
Product(s)		Quantity	Delivery Date
Hybrid		Hybrid	Hybrid

5.2.2 PSRP/GCAR Review (INACTIVE)			
Product(s)		Quantity	Delivery Date
Hybrid		Hybrid	Hybrid

5.2.3 GFE Core Team (INACTIVE)			
Product(s)		Quantity	Delivery Date
Hybrid		Hybrid	Hybrid

e. **Product Verification**

5.2.1 Orion CSM (INACTIVE)	
i. Hybrid	
- Hybrid	

5.2.2 PSRP/GCAR Review (INACTIVE)	
i. Hybrid	
- Hybrid	

5.2.3 GFE Core Team (INACTIVE)	
i. Hybrid	
- Hybrid	

5.3 Thermal Design Branch Services Updated Rev 5

Requirement - In compliance with the above identified SOW(s) the contractor shall provide Thermal Analysis Support and Reports
Contractor shall add Engineering Services to develop software to automate execution of multiple CHAR simulation runs.

Related to:
International Space Station Program
Orion MPCV Program
Commercial Crew Integrated Capability (CCiCap) Program

Representative of:
On-orbit thermal analyses
Entry thermal analysis
Thermal test simulation

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES3 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.3.1 ES3 Thermal Design Branch Services Updated Rev 4

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	Current

c. Required DRDs

5.3.1 ES3 Thermal Design Branch Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.3.1 ES3 Thermal Design Branch Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.3.1 ES3 Thermal Design Branch Services	
i. Hybrid	
- Hybrid	

5.4 ES4 Materials and Processes Branch Services Updated Rev 4

Requirement - In compliance with the above identified SOW(s) the contractor shall provide
Assessments
Support for technology development projects for fracture and materials
Support for technology development projects for fracture mechanics
Prepare releases of the fracture mechanics software NASGRO, including but not limited to alpha, beta, and production releases, with maintenance and user support as required
Develop new features in NASGRO.
Attend two annual program meetings and shall prepare and deliver presentations at those two annual meetings.
Develop models to improve understanding of crack instability formation and grow
Travel for inspection and certification of program hardware.

Related to:
ISS Program
Orion Program
Technology Development projects

Representative of:
Life cycle reviews
Safety Data Package Reviews
Problem Resolutions
Certifications
Hardware design support
Oversight activities
OCCPs
Payload TRR Reviews
Hardware inspections
Drawing reviews
NDE development tasks

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
Standard of excellence: 50% of excess capacity utilized
Minimum Requirement: > 35% of excess capacity utilized

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)

Project Code:

See PD for all charge code and reporting requests

5.4.2 ISS EVA Materials/Fracture

Project Code:

See PD for all charge code and reporting requests

5.4.3 ISS Materials/Fracture Control

Project Code:

See PD for all charge code and reporting requests

5.4.4 NASGRO

Project Code:

See PD for all charge code and reporting requests

5.4.5 Ellington Aircraft

Project Code:

See PD for all charge code and reporting requests

5.4.6 NDE Projects

Project Code:

See PD for all charge code and reporting requests

5.4.7 Orion Materials/Fracture Control Added Rev 3

Project Code:

See PD for all charge code and reporting requests

5.4.8 Fracture Mechanics Crack Instability Modeling Added Rev 4

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
AOD 33890	WB-57 Users Guide	Baseline/Feb 2002
EA-WI-025	GFE Flight Project Software and Firmware Development	Rev A 11-01
JSC 22267	Fatigue Crack Growth Computer Program NASGRO V 3.0	A
JSC 25863	Fracture Control Plan for JSC Spaceflight Hardware	B/April 2009
JSC 27301	Materials Control Plan for JSC Flight Hardware	F/August 2009
MIL-HDBK-6870A	Inspection Program Requirements Nondestructive for Aircraft and Missile Materials and Parts	Current
MSFC-HDBK-527/JSC 09604	Materials Selection List for Space Hardware Systems	F/09-88
NASA-STD-5003	Fracture Control Requirements for Payloads Using the Space Shuttle	10-96
NASA-STD-5009	Nondestructive Evaluation Requirements for Fracture Control Programs	Current
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware	Baseline/Jan 2008
NASA-STD-6016	Standard Materials and Processes Requirements for Spacecraft	Baseline/July 2008
NASA/SP-2007-6105	NASA Systems Engineering Handbook	1/12-07
NSTS 14046	Payload Verification Requirements	Rev E Change 3 08-02
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System	Change 13 08-02

NSTS 1700.7B ISS Addendum	Safety Policy and Requirements for Payloads Using the International Space Station	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-007.5	Materials and Processes Drawing Approval	D/July 2009
SOP-007.6	Materials and Fracture Control Certification	C/July 2009
SOP-009.98	Preparation of an Operation & Configuration Control Plan (OCCP) for Category B Pressure Vessels/Systems (PV/S)	Baseline/Jan 2010
SSP 30233	Space Station Requirements for Materials and Processes	G/November 2004
SSP 30558	Fracture Control Requirements for Space Station	Rev C 11-01
SSP 52005	ISS Payload Flight Equipment Requirements for Safety Critical Structures	C/December 2002

c. Required DRDs

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.2 ISS EVA Materials/Fracture		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.3 ISS Materials/Fracture Control		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.4 NASGRO		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.5 Ellington Aircraft		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.6 NDE Projects		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.4.7 Orion Materials/Fracture Control		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 3		Hybrid

5.4.8 Fracture Mechanics Crack Instability Modeling		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 4		Hybrid

d. Products

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.2 ISS EVA Materials/Fracture		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.3 ISS Materials/Fracture Control		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.4 NASGRO		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.5 Ellington Aircraft		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.6 NDE Projects		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.7 Orion Materials/Fracture Control		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid Added Rev 3	Hybrid Added Rev 3	Hybrid

5.4.8 Fracture Mechanics Crack Instability Modeling		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid Added Rev 4	Hybrid Added Rev 4	Hybrid

e. Product Verification

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
i. Hybrid		
- Hybrid		

5.4.2 ISS EVA Materials/Fracture		
i. Hybrid		

- Hybrid

5.4.3 ISS Materials/Fracture Control

i. Hybrid

- Hybrid

5.4.4 NASGRO

i. Hybrid

- Hybrid

5.4.5 Ellington Aircraft

i. Hybrid

- Hybrid

5.4.6 NDE Projects

i. Hybrid

- Hybrid

5.4.7 Orion Materials/Fracture Control

i. Hybrid

Added Rev 3

- Hybrid

Added Rev 3

5.4.8 Fracture Mechanics Crack Instability Modeling
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i. Hybrid

Added Rev 4

- Hybrid

Added Rev 4

5.5 ES5 Mechanical Design and Analysis Branch Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide
Mechanical system safety assessments
Design and analysis of structures and mechanisms
Design, analysis, testing, planning, components, prototypes, training, and technical review for the development mechanical system technologies and projects

Related to:
ISS Program
Orion Program
Technology Development projects

Representative of:
PSRP and SRP document package reviews representative of those for flight safety reviews of spacecraft systems, payloads, and experiments
Orion mechanism motion and separation analyses
Half-year design activity for a prototype mechanism or concept development planned and delivered

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES5 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

5.5.1 Orion Mechanical System Assessments (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

5.5.2 Mechanical System Safety Reviews (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

5.5.3 Mechanical Technology Development (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
MA2-00-057	Mechanical System Safety	Sept 2000
NASA-STD-5017	Design & Development Requirements for Mechanisms	current
NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements	Rev B
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP 30599	Safety Review Process International Space Station	current
SSP 50021	ISS Safety Requirements Documents	current

c. Required DRDs

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.5.3 Mechanical Technology Development (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.5.3 Mechanical Technology Development (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
i. Hybrid		
- Hybrid		

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
i. Hybrid		
- Hybrid		

5.5.3 Mechanical Technology Development (INACTIVE)		
i. Hybrid		
- Hybrid		

5.6 Loads and Dynamics Branch Services (INACTIVE)

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide loads and dynamics engineering and testing of aerospace systems (i.e. launch vehicle, spacecraft, payloads, GFE, and extraterrestrial vehicles)

Related to:
 ISS Program
 Orion Program
 SLS Program
 Commercial Crew Program
 GFE
 Technology Development projects
 Space Act Agreements

Representative of:
 Linear and non-linear analyses
 Assessments
 Model development
 Prototype model development
 Mission flight rules
 Missions support
 Software tool development
 Test support
 Processes

In accordance with:
 SOP-001.31
 SOP-001.32

Under the governance of:
The ES6 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

5.6.1 Extraction and Berthing Integration (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

5.6.2 Orion Loads & Dynamics (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

5.6.3 Technology Development (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP-41000	International Space Station System Specification	Current
SSP-50808	ISS to COTS IRD	Current

c. Required DRDs

5.6.1 Extraction and Berthing Integration (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.6.2 Orion Loads & Dynamics (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.6.3 Technology Development (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.6.1 Extraction and Berthing Integration (INACTIVE)
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<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.6.2 Orion Loads & Dynamics (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.6.3 Technology Development (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.6.1 Extraction and Berthing Integration (INACTIVE)		
i. Hybrid		
- Hybrid		

5.6.2 Orion Loads & Dynamics (INACTIVE)		
i. Hybrid		
- Hybrid		

5.6.3 Technology Development (INACTIVE)		
i. Hybrid		
- Hybrid		

5.7 ES Static and Dynamic Test Facility (SDTF)

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide
Test execution
Day-to-day maintenance and operations
Lab upgrades
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:
Static Testing
Dynamic Testing
Fracture Testing

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief, ES6 Branch Chief and/or SDTF Lab Manager(or delegated authority) and Structural

Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Contractor support team availability of >97%

Minimum Requirement: Contractor support team availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.7.1 ISS Testing

Project Code:

See PD for all charge code and reporting requests

5.7.2 Other Testing Updated Rev 4

Project Code:

See PD for all charge code and reporting requests

The contractor shall provide engineering services for Acoustic Testing Preparation on CLIN 7 SubCLIN 7.2, including providing a cooling tower for at least 5 months of use during the period Jan-Sept 2015.

The contractor shall add materials for load actuators and a flex test controller in SCLIN 7.2

5.7.3 Fracture Testing

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34417)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.7.1 ISS Testing		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.7.2 Other Testing		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.7.3 Fracture Testing		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.7.1 ISS Testing			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Hybrid		Hybrid	Hybrid

5.7.2 Other Testing			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Hybrid		Hybrid	Hybrid

5.7.3 Fracture Testing			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Hybrid		Hybrid	Hybrid

e. Product Verification

5.7.1 ISS Testing	
i. Hybrid	
- Hybrid	

5.7.2 Other Testing	
i. Hybrid	
- Hybrid	

5.7.3 Fracture Testing	
i. Hybrid	
- Hybrid	

5.8 ES Radiant Heat Test Facility Updated Rev 5

Requirement - In compliance with the above identified SOW(s) the contractor shall Test execution
Day-to-day maintenance and operations
Savings for required consumables/products/services by utilizing economies of scale for similar requirements
of other Directorate divisions.
Contractor shall no longer perform the R1 Orion heat/ load combination test that was originally planned

Related to:
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Radiant Heat Testing

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The RHTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Contractor support team availability of >97%

Minimum Requirement: Contractor support team availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.8.1 ES Radiant Heat Test Facility

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.8.1 ES Radiant Heat Test Facility		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.8.1 ES Radiant Heat Test Facility		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. **Product Verification**

5.8.1 ES Radiant Heat Test Facility
i. Hybrid
- Hybrid

5.9 ES Materials and Evaluation Laboratory

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Test execution
Day-to-day maintenance and operations
Lab upgrades and Welding
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:

ISS Program

Orion Program

CC Program

Technology Development projects

Space Act Agreements

Representative of:

Material Analysis Request

In accordance with:

SOP-001.24

SOP-001.31

SOP-001.32

Under the governance of:

The MEL Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Contractor support team availability of >97%

Minimum Requirement: Contractor support team availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.9.1 ES Materials and Evaluation Laboratory Updated Rev 4

Project Code:

See PD for all charge code and reporting requests

The contractor shall add engineering services to support Impermeable Composites in SCLIN 9.1

The contractor shall add engineering services to support Testing of Inflatable Bladder Material in SCLIN 9.1.

5.9.2 Composite Added Rev 1

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.9.1 ES Materials and Evaluation Laboratory		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.9.2 Composite		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None Added Rev 1		Hybrid

d. Products

5.9.1 ES Materials and Evaluation Laboratory		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.9.2 Composite		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid Added Rev 1	Hybrid Added Rev 1	Hybrid

e. Product Verification

5.9.1 ES Materials and Evaluation Laboratory	
i. Hybrid	
- Hybrid	

5.9.2 Composite	
i. Hybrid Added Rev 1	
- Hybrid Added Rev 1	

5.10 ES Additive Manufacturing Lab (AML) (INACTIVE) Updated Rev 1

Requirement - In compliance with the above identified SOW(s) the contractor shall provide

Part Fabrication
Day-to-day maintenance and operations
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate/Divisions.

Related to:
ISS Program
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Plastic Parts and Plastic Scale Models

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The AML Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Lab availability of >97%
Minimum Requirement: Lab availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure

5.10.1 ES Additive Manufacturing Lab (AML) Updated Rev 1

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Most current
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 4200.1	Management of Controlled Equipment	Most current
NPR 4200.2	Equipment Management Manual for Property Custodian	Most current

c. Required DRDs

5.10.1 ES Additive Manufacturing Lab (AML)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

None		Hybrid
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d. Products

5.10.1 ES Additive Manufacturing Lab (AML)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.10.1 ES Additive Manufacturing Lab (AML)		
i. Hybrid		
- Hybrid		

5.11 ES Manufacturing Services (INACTIVE)

a. Requirement - In compliance with the above identified SOW(s) the contractor shall (INACTIVE)

5.11.1 (INACTIVE)

Project Code:

See PD for all charge code and reporting requests (INACTIVE)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. Required DRDs

5.11.1 (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.11.1 (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.11.1 (INACTIVE)		
i. Hybrid		
- Hybrid		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ15HA21T TO# 150	Revision Number: 3A	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Dynamic Systems Test Branch Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form


Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,421,891	\$53,555	\$1,475,446

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD  <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.24 15:56:40 -05'00'</small> Signature: _____ Date: 7/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA21T-TO150 REV 2

Originator: Asher Lieberman (ER) (281) 483-0076 **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Increased scope for SDTS Test Support and ARGOS Human in the Loop Development. Only modifying requirements in the attached master plan and schedule.

1. Title of Effort: FY15 Dynamic Systems Test Branch Services (TO97)

2. Date of Request: 04/22/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. **2.2.4 Training**

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

f. **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.

g. **2.3 Analysis and Assessment**

h. **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.

i. **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.

j. **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.

k. **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.

l.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Dynamic Systems Test Branch Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services as described in ER5-TM150. All maintenance and operations, mechanical design and design analysis, electrical engineering, services for the design, testing and evaluation of hardware in SR&SD projects as well as training/test operations for several of the Building 9 robotic laboratories and training/test facilities will be done as described in ER5-TM150. Additionally, the contractor shall provide engineering services associated with the systems engineering, design, analysis, general manufacturing, test, and sustaining engineering for Simplified Aid For EVA Rescue (SAFER) project hardware.

Additionally:

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of TO-150 and its supporting Master Plan and Schedule and may include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow.

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering

Project Code:

The contractor shall provide engineering services necessary to continue the operation of the SAFER and Test Module flight systems in accordance with ER5-TM150, Section I.

5.1.2 Engineering Service Pool Tasks

Project Code:

The contractor shall provide engineering services necessary to continue the operation of SR&SD assets in the building 9 high bay and building 9NE in accordance with ER-TM150, Section II.

5.1.3 SDTS Facility Maintenance and Operations/Test Operations

Project Code:

The contractor shall provide the engineering services necessary to continue facility maintenance and test operations in accordance with ER5-TM150, Section III.

5.1.4 Active Response Gravity Offload System (ARGOS) Engineering Services

Project Code:

The contractor shall provide the engineering services necessary to continue development and test operations for the ARGOS in accordance with ER5-TM150, Section IV.

5.1.5 Manufacturing Robotic Flight Hardware

Project Code:

The contractor shall provide the engineering services necessary for flight hardware manufacturing in accordance with ER5-TM150, Section V.

5.1.6 Advanced Jetpack Engineering Services Updated Rev 1**Project Code:**

The contractor shall provide the engineering services necessary for flight hardware manufacturing in accordance with ER5-TM150, Section VI.

5.1.7 ISS SAFER Follow-on Added Rev 1**Project Code:**

The contractor shall provide the engineering services necessary for flight hardware manufacturing in accordance with ER5-TM150, Section VII.

5.1.8 VIII. DMT Maintenance and Operations/Test Operations Added Rev 1**Project Code:**

The contractor shall provide the engineering services necessary for flight hardware manufacturing in accordance with ER5-TM150, Section VIII.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-023	Project Management of GFE Flight Projects	G
EA-WI-025	GFE Flight Project Software and Firmware Development	D
ER5-TM150 Added REV 2	Master Plan and Schedule	Rev 2
JPR 2310.1	JSC Organizational Learning Program	May 8, 2008

c. Required DRDs

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.2 Engineering Service Pool Tasks		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.3 SDTS Facility Maintenance and Operations/Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.4 Active Response Gravity Offload System (ARGOS) Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.5 Manufacturing Robotic Flight Hardware		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.6 Advanced Jetpack Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.7 ISS SAFER Follow-on		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Added Rev 1	Regular Status Report/Summary Review	15th of each month

5.1.8 VIII. DMT Maintenance and Operations/Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Added Rev 1	Regular Status Report/Summary Review	15th of each month

d. **Products**

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section I Updated REV 2		1	9/30/2015

5.1.2 Engineering Service Pool Tasks			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section II Updated REV 2		1	9/30/2015

5.1.3 SDTS Facility Maintenance and Operations/Test Operations			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section III Updated REV 2		1	9/30/2015

5.1.4 Active Response Gravity Offload System (ARGOS) Engineering Services			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section IV Updated REV 2		1	9/30/2015

5.1.5 Manufacturing Robotic Flight Hardware			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section V Updated REV 2		1	4/30/2015

5.1.6 Advanced Jetpack Engineering Services			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section VI Updated REV 2		1	9/30/2015

5.1.7 ISS SAFER Follow-on			
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<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section VII Updated REV 2	1	9/30/2015

5.1.8 VIII. DMT Maintenance and Operations/Test Operations

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER-TM150, Section VIII Added Rev 1	1	9/30/2015

e. Product Verification

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering

i. Implementation of ER-TM150, Section I

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section I.

5.1.2 Engineering Service Pool Tasks

i. Implementation of ER-TM150, Section II

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section II.

5.1.3 SDTS Facility Maintenance and Operations/Test Operations

i. Implementation of ER-TM150, Section III

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section III.

5.1.4 Active Response Gravity Offload System (ARGOS) Engineering Services

i. Implementation of ER-TM150, Section IV

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section IV.

5.1.5 Manufacturing Robotic Flight Hardware

i. Implementation of ER-TM150, Section V

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section V.

5.1.6 Advanced Jetpack Engineering Services

i. Implementation of ER-TM150, Section VI

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section VI.

5.1.7 ISS SAFER Follow-on

i. Implementation of ER-TM150, Section VII

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section VII.

5.1.8 VIII. DMT Maintenance and Operations/Test Operations

i. Implementation of ER-TM150, Section VIII

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM150, Section VIII. **Added Rev 1**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 9
Task Order Number: NNJ15HA31T TO# 151		Revision Number: 1		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$9,896,629	-\$24,340	\$9,872,289

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name:		CHRISTIAN GASPARD	
Signature: _____ Date: _____		Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.21 16:18:12 -05'00'	
Signature: _____ Date: _____		Signature: _____ Date: 5/21/15 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA31T-TO151

Originator: REAGAN REDMAN (EC4) (281) 483-9213 **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY15 Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations (TO91)

2. Date of Request: 09/19/2014

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. 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.

f. 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

g. **2.2.4 Training**

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

h. **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.

i. **2.4 Facilities**

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide day-to-day preventative and reparative maintenance and test operations activities common to all test facilities, systems and laboratories in the Crew and Thermal Systems Division.

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)

Project Code:

This work shall be performed , in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document, CTSD-SS-3057. This document defines the metrics by which the maintenance effort is monitored; the operational readiness levels that are expected, and contains comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

The contractor shall also perform projects required to retain current facility capabilities as well as enhance their capabilities with improvements in vacuum chamber, instrumentation, and data collection technology. The number of projects conducted per year changes as the systems age and with changes in customer needs but two projects are expected in FY15. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and operational verification of the final product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.2 EVA Test Operations

Project Code:

The contractor shall provide test data and quick look reports for EVA testing performed in the Crew and Thermal Systems Laboratory test chambers. Testing shall include crew training events performed in the SSATA as well as unmanned and manned EMU testing performed in the Eight Foot and Eleven Foot Chambers respectively. Crew Training events simulate flight conditions, and provide the crewmembers with experience in performing ISS Airlock EVA prep and post procedures under de-pressurization, vacuum, and re-pressurization conditions expected on-orbit. Each crew training activity will include a power functional and dry run. Altitude runs will be performed when requested. Eight Foot chamber testing consists of three 8-hour EVA simulations. The PLSS and SEMU are checked out with all facility interfaces during a sea-level power functional. The contractor will also perform testing in the Eleven Foot Chamber to verify the performance of the PLSS for flight certification. The Eleven Foot Chamber test is human rated, and consists of a power functional, a dry run, and an altitude run. Approximately six crew training events, three simulated EVAs in the Eight Foot Chamber, and one manned run in the Eleven Foot chamber are expected during FY15.

Test Data will be identified, reviewed, and archived as specified in STF-F-413, Management and Archival Storage of Original Test Data Media, and STB-F-616, Reduction of Test Data. Specific test requirements relative to each test will be indicated on the Form 90, Test Request. The contractor will perform testing according to the requirements of the test requestor, STB-E-554, STB Test Operations Guidelines and referenced documents.

5.1.3 Diversified Testing

Project Code:

The contractor shall provide test data and quick look reports for tests performed in the Building 7 Vacuum Chambers, Building 32 Chamber B Thermal Vacuum Chamber, Building 33 Special Chambers Complex or in the Building 360 Active Thermal Control System Test Bed.

Once a customer's Form 90, Test Request, has been received, the contractor will perform humidity, thermal, or thermal vacuum testing on a wide variety of test articles in the CTSD test facilities. Specific test articles have not been identified, however the capability of the facilities cover a range from high-fidelity space simulation to simple

thermal, thermal vacuum, humidity tests, and bench top testing. The JETs contractor will choose the proper facility based on the test requirements. Approximately 50 tests will be conducted in CTSD facilities during fiscal 2015.

Test Data will be identified, reviewed, and archived as specified in STB-F-413, Management and Archival Storage of Original Test Data Media, and STB-F-616, Reduction of Test Data. The contractor will perform testing according to the requirements of the test requestor, STB-E-554, STB Test Operations Guidelines and referenced documents.

5.1.4 Station Active Thermal Control System (Bldg. 360)

Project Code:

The contractor shall Maintain Building 360 and the ATCS equipment in a Stand-By condition in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057 Should testing be required in the facility the test operations would be conducted under the Diversified Test section (Section 5.1.3) of this Task Order.

5.1.5 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)

Project Code:

This work shall be performed in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document. This document defines the metrics by which the maintenance effort is monitored; the operational readiness levels that are expected, and contains comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

The contractor shall also perform projects required to retain current facility capabilities as well as enhance their capabilities with improvements in vacuum chamber, instrumentation, and data collection technology. The number of projects conducted per year changes as the systems age and with changes in customer needs but ten projects are expected in FY15. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and verification of the project product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.6 Division Safety, Information Technology, and Special Project Support

Project Code:

The contractor shall Provide engineering, technical, and clerical support for the safe and efficient operation of the Crew and Thermal Systems Division facilities.

All EC Data System IT maintenance and operations requirements are identified in CTSD-SS-3055, CTSD IT Program Requirements document. Facility Safety Representatives conduct the facility safety inspections, brief contractor and subcontractor personnel about on-site safety practices, and work to correct and close any close call or incident reports. Failure Modes and Effects Analysis and Integrated Hazards Analysis are developed as a critical portion of the review processes that ensure safe operations in both facilities maintenance and test operations.

Specific projects in support of EC division goals are identified periodically and will be negotiated, and approved at the EC4 Branch Level with contractor concurrence. Approximately two projects are expected in fiscal 2015. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and verification of the project product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.7 Laboratory Operations

Project Code:

The contractor shall Provide day-to-day laboratory operations support activities common to all test facilities, systems and laboratories in the Crew and Thermal Systems Division, in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

Special Purpose Maintenance required in the general CTSD laboratory areas is performed as directed in CTSD-SS-3057. That document contains the EC Specific list of Maintenance and Operations Requirements. It defines the metrics by which the maintenance effort is monitored; the operational readiness levels that are expected, and contain comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system.

This task will also cover the many routine activities that support every maintenance action and tests required to keep the CTSD facilities operational. These activities include but are not limited to:

- Drafting and Design required for configuration control
- Document Development and Maintenance for Checklists, Procedures, and Personnel Certification
- Customer Service Representative for test customers support
- Property Custodian Services
- Tool Crib Operators
- Administrative Services
- Budget Analyst Services
- Facility Data Acquisition Recording and Control System Maintenance and Operation

5.1.8 Develop Facility Efficiency Initiatives

Project Code:

The contractor shall Develop and implement a plan to continuously identify and propose methods that a)reduce waste and b)promote and improve overall efficiency of processes, activities and resources in the Crew and Thermal Systems Division laboratories and facilities, leveraging industry best practices and internal company initiatives to achieve this requirement

CTSD has many processes which have originated over many years and are well documented. These processes have been reviewed and refined through many rounds of Continuous Improvement, Total Quality Management, and International Standards of Operation. The processes are well understood and refined, but our transition from paper processes to digital processes has been slow. All test process paperwork currently ends up as a digital file through manual scanning. Electronic processes could make running Pre and Post-test checklists as well as the Detailed Test Procedures run more efficiently while eliminating the need to scan a final product.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CTSD-SS-3055	CTSD IT Program Requirements Document	Basic
CTSD-SS-3057	CTSD List of Facilities, Systems, Laboratories and M&O Requirements Document	B
EA-WI-024	General Operating Procedures for EA Testing Facilities	B
STB-E-084	CTSD STB Drawing System and Configuration Control Procedure	E
STB-E-367	Safety Analysis Techniques and Preparation Procedure	D
STB-E-493	CTSD STB Training and Certification Plan	I
STB-E-554	STB Test Operations Guideline	H
STB-E-557	STB Facility and Major Test Buildup Guidelines	E
STB-E-574	Systems Test Branch Facility Maintenance Guidelines	Basic
STB-F-001	CTSD STB General Operating Procedures Manual	P
STB-F-413	Management and Archival of Original Test Data Media	J
STB-F-616	Reduction of Test Data	M

c. Required DRDs

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.2 EVA Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	One per completed test

5.1.3 Diversified Testing		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	One per completed test

5.1.4 Station Active Thermal Control System (Bldg. 360)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.5 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.6 Division Safety, Information Technology, and Special Project Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.7 Laboratory Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.8 Develop Facility Efficiency Initiatives		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Perform maintenance tasks in accordance with CTSD-SS-3057	per CTSD-SS-3057	9/30/2015
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2015

5.1.2 EVA Test Operations		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>

Test Requirements Reviews, Test Schedules, Test Team and Crewmember Briefings, Test Readiness Review Packages, Test Data, and Quick Look Reports	One set per test	9/30/2015
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5.1.3 Diversified Testing

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Test Requirements Reviews, Test Schedules, Test Readiness Review Packages, Test Data, and Quick Look Reports	One set per test	9/30/2015

5.1.4 Station Active Thermal Control System (Bldg. 360)

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Perform Standby Readiness Tasks	Per CTSD-SS-3057	9/30/2015

5.1.5 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Perform maintenance tasks in accordance with CTSD-SS-3057	Per CTSD-SS-3057	9/30/2015
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2015

5.1.6 Division Safety, Information Technology, and Special Project Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Facility and Test HA and FMEA Documents	Per CTSD-SS-3057	9/30/2015
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2015

5.1.7 Laboratory Operations

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Facility Operation Procedures and Policies	Per CTSD-SS-3057	9/30/2015

5.1.8 Develop Facility Efficiency Initiatives

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Facility Efficiency Initiatives	As applicable	9/30/2015

e. Product Verification

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)

i. Perform maintenance tasks in accordance with CTSD-SS-3057
- - - NASA EC4 Branch management periodically reviews the Maintenance Database
ii. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package
- - - NASA EC4 Branch management will sign URR acceptance form to indicate acceptance of project completion..

5.1.2 EVA Test Operations

i. Test Requirements Reviews, Test Schedules, Test Team and Crewmember Briefings, Test Readiness Review Packages, Test Data, and Quick Look Reports

- - - NASA EC4 Branch management signs the test quick look to indicate acceptance of test completion

5.1.3 Diversified Testing

i. Test Requirements Reviews, Test Schedules, Test Readiness Review Packages, Test Data, and Quick Look Reports

- - - NASA EC4 Branch management signs the test quick look to indicate acceptance of test completion

5.1.4 Station Active Thermal Control System (Bldg. 360)

i. Perform Standby Readiness Tasks

- - - NASA EC4 Branch management periodically reviews the Maintenance Database

5.1.5 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)

i. Perform maintenance tasks in accordance with CTSD-SS-3057

- - - NASA EC4 Branch management periodically reviews the Maintenance Database

ii. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package

- - - NASA EC4 branch management will sign URR acceptance form to indicate acceptance of project completion..

5.1.6 Division Safety, Information Technology, and Special Project Support

i. Facility and Test HA and FMEA Documents

- - - NASA EC4 Branch management will sign HA and FMEA documents to indicate their acceptance

ii. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package

- - - NASA EC4 Branch management will sign URR acceptance form to indicate acceptance of project completion..

5.1.7 Laboratory Operations

i. Facility Operation Procedures and Policies

- - - NASA EC4 Branch management periodically reviews the Maintenance and Calibration Database

5.1.8 Develop Facility Efficiency Initiatives

i. Facility Efficiency Initiatives

- - - NASA EC4 Branch management will evaluate proposed initiatives

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 3
Task Order Number: NNJ15HA08T TO# 152	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Systems Engineering Simulator (SES) Engineering Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form


Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,985,278	\$99,510	\$2,084,789

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD  Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.24 17:08:45 -05'00' Signature: _____ Date: 7/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA08T-TO152 R2

Originator: MICHAEL MCFARLANE (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

This revision adds several tasks, including updating outdated computer equipment and floor tiles, building a simulation based on MSS 7.2, procuring equipment to enhance the SES video wall, and providing support to TS-21 activities in support of their upcoming ORR.

1. Title of Effort: FY15 Systems Engineering Simulator (SES) Engineering Services (TO96)

2. Date of Request: 07/13/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. **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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Systems Engineering Simulator (SES) Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services associated with the Systems Engineering Simulator (SES) in accordance with ER7-TM152 (SES FY15) and under the technical authority of the Simulation and Graphics Branch of the Software, Robotics and Simulation Division (SRSD). All design, development, integration and validation of hardware and software will be done in accordance with SES WI 1005 (SES Project Life Cycle Process).

5.1.1 Engineering Services Development

Project Code: The contractor shall provide engineering services necessary to conduct simulation development in accordance with ER7-TM152 (SES FY15)

The contractor shall provide systems engineering design services for all facility and non-program specific software efforts in the SES, assist with high level design of new additions to the SES, and review drawings and designs that involve both hardware and software from outside organizations and vendors in accordance with ER7-TM152 (SES FY15) and under the technical authority of the Simulation and Graphics Branch of the Software, Robotics, and Simulation Division.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER7-TM152 (SES FY15) Deleted R2	SES Master Plan and Schedule Requirements	Original
ER7-TM152 (SES FY15) Added R2	SES Master Plan and Schedule Requirements	Revision 1
SESWI 1005	SES Project Life Cycle Process	5

c. **Required DRDs**

5.1.1 Engineering Services Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		None

d. **Products**

5.1.1 Engineering Services Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER7-TM152 (SES FY15)	1	September 30, 2015

e. **Product Verification**

5.1.1 Engineering Services Development	
i. Implementation of ER7-TM152 (SES FY15)	
- SRSD Simulation and Graphics Branch review, witness and acceptance of simulation engineering data	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 3
Task Order Number: NNJ15HA19T TO# 153	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Risk Intelligence Software Engineering Services (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$23,991	\$23,991

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input checked="" type="checkbox"/> is, <input type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: Lon F. Miller / Sr. VP & General Manager</p> <p>Signature:  Date: 9/16/14</p>	<p>Name: Christian C. Gaspard</p> <p>CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, ou=340.18020365.1001.1, cn=christian.gaspard, cn=CHRISTIAN GASPARD Date: 2014.09.15 12:39:57 -0500</small></p> <p>Signature: _____ Date: 9/15/14</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ15HA19T-TO153

Originator: PEDRO MARTINEZ (ER6) (281) 483-9792 **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY15 Risk Intelligence Software Engineering Services (TO107) (LOE)

2. Date of Request: 09/02/2014

3. Statement of Work Task Description

a. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Deloitte & Touche Space Act Agreement (SAA)

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide software engineering services for the Deloitte & Touche Space Act Agreement (SAA). The services includes work described below as level of effort support to the ER6 TO-153 (LOE) Task Order Manager.

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed below and may include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow.

5.1.1 Deloitte & Touche Space Act Agreement (SAA).

Project Code:

The contractor shall provide software engineering services for the Deloitte & Touche Space Act Agreement (SAA). This work includes:

1. Coordination with the NASA SAA technical points of contact (POC), regarding the content and format of all project initiatives prior to development of all final products.
2. Identifying any Task Order risks and reporting these to the NASA SAA technical POC upon earliest identification. In performance of
3. Providing subject matter expertise to:
4. Discuss concepts with the client and design the modifications to existing applications STAT and Flamenco+ for extraction, management and access to large bodies of related information from diverse sources.

5. Develop user interface concepts and designs for presentations that organize diverse information for analysts.
6. Develop presentations and demonstrations for customer engagement and feedback.
7. Maintain STAT and Flamenco+ software so that they can be demonstrated and used to evaluate requirements and design concepts.
8. Provide information on the STAT, Flamenco+ and Aerospace Ontology development history.
9. Work with Deloitte & Touche and gather requirements for emerging risk identification and dataset requirements for the ontology and STAT semantic processing, which may require some work in offsite locations (including but not limited to Deloitte & Touche and client/prospective client locations).

The contractor shall support assessment of risk sensing requirements.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NA	NA	NA

c. Required DRDs

5.1.1 Deloitte & Touche Space Act Agreement (SAA).		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

d. Products

5.1.1 Deloitte & Touche Space Act Agreement (SAA).		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	NA	NA

e. Product Verification

5.1.1 Deloitte & Touche Space Act Agreement (SAA).	
i. LOE	
- LOE	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 10
Task Order Number: NNJ15HA14T TO# 154	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Propulsion and Power Division Services (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action (Basic)	Current Value (Basic)
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,836,380	\$2,836,380

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.09.17 13:24:52 -05'00'</small> Signature: _____ Date: 9/17/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA14T-TO154

Originator: ROBERTO EGUSQUIZA (EP5) (281) 483-8284

TMR: ROBERTO EGUSQUIZA (EP) (281) 483-8284

1. Title of Effort: FY15 Propulsion and Power Division Services (TO108) (LOE)

2. Date of Request: 09/02/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Propulsion & Power Division Support Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical services, analysis, and hardware and software design and development for the Propulsion & Power Division on projects specified by the Propulsion & Power Division (PPD). Depending on project life cycle, requirements include conceptual design, feasibility studies, analysis, development, manufacturing, qualification testing, flight certification, safety and risk analysis, operations, sustaining engineering, project management, and property management.

PPD functional areas include:

Propulsion
Batteries and Chargers
Chemical Processing
Power Generation
Fluids Distribution, Storage and On-orbit Transfer
In-Situ Resource Utilization (ISRU)
Energy Conversion & Storage
Power Distribution & Control
Pyrotechnics

5.1.1 Division Management and Operations Support

Project Code: (This is a level of effort task.)

Services provided for Division Management and Operations Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.2 NiMH GFE Battery Sustaining Support

Project Code: (This is a level of effort task.)

Services provided for ISS NiMH GFE Battery Sustaining Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.3 EVA Li-Ion Battery Upgrades Support

Project Code: (This is a level of effort task.)

Services provided for EVA Li-Ion Battery Upgrades Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.4 OB Battery Surveillance Support

Project Code: (This is a level of effort task.)

Services provided for OB Battery Surveillance Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.5 AES Modular Power Systems Support

Project Code: (This is a level of effort task.)

Services provided for Modular Power Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.6 NESC Thermal Runaway Propagation Study Support

Project Code: (This is a level of effort task.)

Services provided for NESC Thermal Runaway Propagation Study Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.7 SAFER Battery Support

Project Code: (This is a level of effort task.)

Services provided for SAFER Battery Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.8 Q-Thruster Support

Project Code: (This is a level of effort task.)

Services provided for Q-Thruster Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.9 Fluids/Thermal Analysis Support

Project Code: (This is a level of effort task.)

Services provided for Fluid/Thermal Analysis Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.10 Orion Pyro Support

Project Code: (This is a level of effort task.)

Services provided for Orion Pyrotechnic Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.11 Dual Frangible Joint Phase A Support

Project Code: (This is a level of effort task.)

Services provided for Dual Frangible Joint Phase A Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.12 EP Multimedia Support

Project Code: (This is a level of effort task.)

Services provided for EP Multimedia Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.13 Energy Conversion Systems Support

Project Code: (This is a level of effort task.)

Services provided for Energy Conversion Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.14 Power Systems Support

Project Code: (This is a level of effort task.)

Services provided for Power Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.15 Propulsion Systems Support

Project Code: (This is a level of effort task.)

Services provided for Propulsion Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.1.1 Division Management and Operations Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-02	Regular Status Report/Summary Review	LOE
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5.1.2 NiMH GFE Battery Sustaining Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.3 EVA Li-Ion Battery Upgrades Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.4 OB Battery Surveillance Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.5 AES Modular Power Systems Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.6 NESC Thermal Runaway Propagation Study Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.7 SAFER Battery Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.8 Q-Thruster Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.9 Fluids/Thermal Analysis Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.10 Orion Pyro Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.11 Dual Frangible Joint Phase A Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
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RV-02	Regular Status Report/Summary Review	LOE
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5.1.12 EP Multimedia Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.13 Energy Conversion Systems Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.14 Power Systems Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.15 Propulsion Systems Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.1.1 Division Management and Operations Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.2 NiMH GFE Battery Sustaining Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.3 EVA Li-Ion Battery Upgrades Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.4 OB Battery Surveillance Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.5 AES Modular Power Systems Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.6 NESC Thermal Runaway Propagation Study Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.7 SAFER Battery Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.8 Q-Thruster Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.9 Fluids/Thermal Analysis Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.10 Orion Pyro Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.11 Dual Frangible Joint Phase A Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.12 EP Multimedia Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.13 Energy Conversion Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.14 Power Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.15 Propulsion Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.1.1 Division Management and Operations Support		
i. LOE		
- LOE		

5.1.2 NiMH GFE Battery Sustaining Support		
i. LOE		
- LOE		

5.1.3 EVA Li-Ion Battery Upgrades Support
i. LOE
- LOE

5.1.4 OB Battery Surveillance Support
i. LOE
- LOE

5.1.5 AES Modular Power Systems Support
i. LOE
- LOE

5.1.6 NESC Thermal Runaway Propagation Study Support
i. LOE
- LOE

5.1.7 SAFER Battery Support
i. LOE
- LOE

5.1.8 Q-Thruster Support
i. LOE
- LOE

5.1.9 Fluids/Thermal Analysis Support
i. LOE
- LOE

5.1.10 Orion Pyro Support
i. LOE
- LOE

5.1.11 Dual Frangible Joint Phase A Support
i. LOE
- LOE

5.1.12 EP Multimedia Support
i. LOE
- LOE

5.1.13 Energy Conversion Systems Support
i. LOE
- LOE

5.1.14 Power Systems Support
i. LOE
- LOE

5.1.15 Propulsion Systems Support
i. LOE
- LOE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 13
Task Order Number: NNJ15HA42T TO# 155	Revision Number: 3	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Life Support Systems

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,796,576	\$149,896	\$2,946,472

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=movers, t, cn=ROCHELLE OVERSTREET Date: 2015.09.21 11:25:39 -05'00' Signature: _____ Date: 9/21/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA42T-TO155 R3

Originator: COY KOUBA (EV171) **TMR:** MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

Revision 3 adds scope to:

CLIN 2, ECLSS Sustaining Engineering - for additional hardware deliveries;
CLIN 3, Atmosphere Revitalization Systems - for continued support of projects and regulator modifications;
CLIN 4, Water Recovery Systems Lab Support - for additional testing of alternate urine pretreat solutions, lab consumables and equipment maintenance;
CLIN 5, AES and other Advanced Projects - for continued support of CDS and BRIC projects.

1. Title of Effort: FY15 Life Support Systems (EC3) (TO36)

2. Date of Request: 08/27/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. **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.

f. **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

g. **2.3 Analysis and Assessment**

h. **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.

i. **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.

j. **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.

k. **2.4 Facilities**

l. **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.

m. **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.

n. **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.

o.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Internal Thermal Control Systems (ITCS) Sustaining Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall a. perform all sustaining activities as related to hardware being sustained (listed below). This includes, but may not be limited to delivering hardware for flight (performing builds, calibration, pre-delivery tests), tracking of limited life items, updating certifications when required due to ops scenario changes, obsolescence of parts, etc, performing and supporting both ground and on-orbit failure investigations, supporting operations and needs of other systems/groups by maintaining detailed knowledge of hardware and answering questions related to the hardware. Specific tasks and schedules within this scope will be defined by Project Directive (PD). Deliverables will be uploaded to the EC3 ITCS share folder and Design and Data Management System (DDMS).
- b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

5.1.1 Sustaining Engineering Hardware

Project Code: 02196

Hardware:

1. Internal Thermal Control Systems (ITCS) Sampling Kit

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of Government Furnished Equipment (GFE) Flight Projects	G

c. Required DRDs

5.1.1 Sustaining Engineering Hardware		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-04	Acceptance Data Package (ADP)	AR
TD-06	Certification Data Package	AR

d. Products

5.1.1 Sustaining Engineering Hardware		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Shelf Life Test Report	3	Per PD
Sustaining Engineering (FY15)	1	Per PD
Limited Life Tracking Spreadsheet	4	Quarterly
Monthly Project Status of Technical and Costs	12	Monthly
GCAR Revision	1	Per PD
DR Tracking Spreadsheet	4	Quarterly
Hardware Delivery per Flight Manifests Added Rev 1	2 flights Added Rev 1	Per PD

e. Product Verification

5.1.1 Sustaining Engineering Hardware
i. Shelf Life Test Report
- Review by EC3 PM
ii. Sustaining Engineering (FY15)
- Review by EC3 PM
iii. Limited Life Tracking Spreadsheet
- Review by EC3 PM
iv. Monthly Project Status of Technical and Costs
- Review by EC3 PM
v. GCAR Revision
- Review by EC3 PM
vi. DR Tracking Spreadsheet
- Review by EC3 PM
vii. Hardware Delivery per Flight Manifests
Added Rev 1
- Review by EC3 PM
Added Rev 1

5.2 Environmental Control and Life Support Systems (ECLSS) Sustaining Engineering Updated R3

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall a. perform all sustaining activities as related to hardware being sustained (listed in section 5.2.1). This includes, but may not be limited to delivering hardware for flight (performing builds, calibration, pre-delivery tests), tracking of limited life items, updating certifications when required due to ops scenario changes, obsolescence of parts, etc, performing and supporting both ground and on-orbit failure investigations, supporting operations and needs of other systems/groups by maintaining detailed knowledge of hardware and answering questions related to the hardware. Specific tasks and schedules within this scope will be defined by Project Directive (PD). Deliverables will be uploaded to the EC3 ECLSS share folder and DDMS.

b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

The contractor shall perform Acceptance testing of the new Fire Cartridges to be built. In addition, the contractor shall procure additional AMK hardware to mitigate potential risks to upcoming flight deliveries.

The contractor shall procure additional fire cartridges as well as additional catalyst to allow for additional fire cartridges to be built.

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall a. perform all sustaining activities as related to hardware being sustained (listed in section 5.2.1). This includes, but may not be limited to delivering hardware for flight (performing builds, calibration, pre-delivery tests), tracking of limited life items, updating certifications when required due to ops scenario changes, obsolescence of parts, etc, performing and supporting both ground and on-orbit failure investigations, supporting operations and needs of other systems/groups by maintaining detailed knowledge of hardware and answering questions related to the hardware. Specific tasks and schedules within this scope will be defined by Project Directive (PD). Deliverables will be uploaded to the EC3 ECLSS share folder and DDMS.

b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

The contractor shall perform Acceptance testing of the new Fire Cartridges to be built. In addition, the contractor shall procure additional AMK hardware to mitigate potential risks to upcoming flight deliveries.

The contractor shall procure additional fire cartridges as well as additional catalyst to allow for additional fire cartridges to be built.

The contractor shall procure and deliver additional DCMS chips to replace DCMS chip packets lost onboard SpaceX-7. Updated R3

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware
Project Code: See Below

Hardware:

- i. Fire Cartridges: project code 00110
- ii. Velocicalc and Operations Hardware: project code 00065
- iii. Ammonia Measurement Kit (AMK): project code 02236
- iv. Ammonia Respirator/Cartridges: project code 2C902
- v. Emergency Response Mask (EM): project code 00110

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of Government Furnished Equipment (GFE) Flight Projects	G

c. Required DRDs

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-04	Acceptance Data Package (ADP)	AR
TD-06	Certification Data Package	AR

d. Products

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
FROM:		
Hardware delivery per flight manifests	5 flights	Per PD
TO:		
Hardware delivery per flight manifests	6 flights Updated R3	Per PD
Sustaining Engineering (FY15)	1	Per PD
Monthly Project status of Technical and Costs	12	Monthly
Limited Life Tracking Spreadsheet	4	Quarterly
Emergency Trainer Hardware Delivery	1	Per PD
Emergency Mask Surveillance Test Report	1	Per PD
AMK Life Extension Test Data Spreadsheet	12	Monthly
DR Tracking Spreadsheet	4	Quarterly

e. Product Verification

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware	
i. Hardware delivery per flight manifests	
- Review by EC3 PM	
ii. Sustaining Engineering (FY15)	
- Review by EC3 PM	

iii. Monthly Project status of Technical and Costs
- Review by EC3 PM
iv. Limited Life Tracking Spreadsheet
- Review by EC3 PM
v. Emergency Trainer Hardware Delivery
- Review by EC3 PM
vi. Emergency Mask Surveillance Test Report
- Review by EC3 PM
vii. AMK Life Extension Test Data Spreadsheet
- Review by EC3 PM
viii. DR Tracking Spreadsheet
- Review by EC3 PM

5.3 Atmosphere Revitalization Systems (ARS) Updated R3

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall provide consultation, planning, integration, testing, reporting, and data analysis supporting development of Atmosphere Revitalization Systems (ARS) process technologies including operation of the ARTD test articles and equipment in the Air Revitalization Technology Evaluation Facility (ARTEF) located in Building 7B, room 1302 and the CTSD Gas Lab located in Building 7, room 1023. The contractor shall also provide, under direction from EC3 ARTD personnel, in conjunction with the CTSD Systems Test Branch planning, design, buildup, integration, and testing for development of advanced Air Revitalization Systems (ARS) technologies by facilitating operation of ARS test articles in CTSD managed test facilities. Deliverables will be uploaded to the EC3 ARTD share folder and DDMS, except the bi-weekly status reports and budget assessment which will be only to the share folder due to its financial data.

Requirements for this scope includes, but is not limited to, work on the following projects: Advanced Exploration Systems Life Support Systems (AES LSS), Amine Swingbed, ARTEF, Solid Electrolyte Oxygen Separator (SEOS), Trace Contaminant Sorbent Characterization, evaluation of Thermal Amine off-gassing products, Desiccant Wheel Water Management, Human Metabolic Simulator, support of the Multi-Purpose Crew Vehicle (MPCV) and CTSD gas lab services.

The contractor shall develop test plans to conduct tests as needed within ARTEF, the Air Lab and the Gas Lab. This may include design and buildup of test equipment needed to conduct testing. The contractor shall also provide coordination of all test activities including test documentation, test readiness reviews and the preparation of hazard reports and analysis. Test activities include but are not limited to: Ammonia Monitoring Kit Chip Measurement Systems Drift Studies, Chamber A Sampling, Z-2 Suit Testing, Suit Trace Contaminant Studies, and Manned Suit Testing.

To assist with monitoring tasks and costs, a monthly budget assessment shall be generated that includes a breakdown of activities by task.

The contractor shall provide sensor characterization testing and online data analysis reduction of sensor calibrated by Gas Lab for the Orion Vacuum Pressure Integrated Suit Test (VPIST).

The contractor shall provide ARTD Laboratory consumable materials.

The contractor shall provide console support for Swingbed as required by ISS customer and post-test analyses as requested.

- b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

The contractor shall procure materials to support HESTIA test objectives.

Based on the requirements described above, it is expected that contractor support will be required through September 2015.

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall provide consultation, planning, integration, testing, reporting, and data analysis supporting development of Atmosphere Revitalization Systems (ARS) process technologies including operation of the ARTD test articles and equipment in the Air Revitalization Technology Evaluation Facility (ARTEF) located in Building

7B, room 1302 and the CTSD Gas Lab located in Building 7, room 1023. The contractor shall also provide, under direction from EC3 ARTD personnel, in conjunction with the CTSD Systems Test Branch planning, design, buildup, integration, and testing for development of advanced Air Revitalization Systems (ARS) technologies by facilitating operation of ARS test articles in CTSD managed test facilities. Deliverables will be uploaded to the EC3 ARTD share folder and DDMS, except the bi-weekly status reports and budget assessment which will be only to the share folder due to its financial data.

Requirements for this scope includes, but is not limited to, work on the following projects: Advanced Exploration Systems Life Support Systems (AES LSS), Amine Swingbed, ARTEF, Solid Electrolyte Oxygen Separator (SEOS), Trace Contaminant Sorbent Characterization, evaluation of Thermal Amine off-gassing products, Desiccant Wheel Water Management, Human Metabolic Simulator, support of the Multi-Purpose Crew Vehicle (MPCV) and CTSD gas lab services.

The contractor shall develop test plans to conduct tests as needed within ARTEF, the Air Lab and the Gas Lab. This may include design and buildup of test equipment needed to conduct testing. The contractor shall also provide coordination of all test activities including test documentation, test readiness reviews and the preparation of hazard reports and analysis. Test activities include but are not limited to: Ammonia Monitoring Kit Chip Measurement Systems Drift Studies, Chamber A Sampling, Z-2 Suit Testing, Suit Trace Contaminant Studies, and Manned Suit Testing.

To assist with monitoring tasks and costs, a monthly budget assessment shall be generated that includes a breakdown of activities by task.

The contractor shall provide sensor characterization testing and online data analysis reduction of sensor calibrated by Gas Lab for the Orion Vacuum Pressure Integrated Suit Test (VPIST).

The contractor shall provide ARTD Laboratory consumable materials.

The contractor shall provide console support for Swingbed as required by ISS customer and post-test analyses as requested.

b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

The contractor shall procure materials to support HESTIA test objectives.

Based on the requirements described above, it is expected that contractor support will be required through September 2015.

The contractor shall establish a method to upgrade a development regulator for use in the second VPIST test series. (Note: the plan needs to be agreed upon by NASA but nothing will be delivered in FY15. Additional work will continue in FY16 on a new TO).

The contractor shall provide test support for HESTIA, sorbent testing, and SEOS interface requirements development. **Updated R3**

5.3.1 Hardware and Analyses associated with Advanced Tech Development of ARS

Project Code: None

The Contractor shall provide support for hardware and analyses associated with Advanced Tech Development of ARS

b. Applicable Documents

Document Number	Document Name	Rev.
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Basic
STB-E-084	Drawing System and Configuration Control Procedure	B
STB-E-557	STB Facility and Major Test Build-up Procedure	C

c. Required DRDs

5.3.1 Hardware and Analyses associated with Advanced Tech Development of ARS

DRD #	DRD Title	Quantity/Frequency
TD-11	Test Report	AR

d. Products

5.3.1 Hardware and Analyses associated with Advanced Tech Development of ARS		
Product(s)	Quantity	Delivery Date
Monthly Budget Assessment	12	Monthly
Bi-Weekly Status Report	19	Bi-Weekly

e. Product Verification

5.3.1 Hardware and Analyses associated with Advanced Tech Development of ARS	
i. Monthly Budget Assessment	
- Review and approval by EC3 PM	
ii. Bi-Weekly Status Report	
- Review and approval by EC3 PM	

5.4 Water Recovery Systems (WRS) - Lab Support Updated R3

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall provide testing, data analysis, and reporting of test data supporting development of advanced water recovery technologies in the facilities located in building 7B, rooms 1300, 1300A, 1300B, 1300C, and building 7 room 2010. Other development and testing activities for ISS and commercial cargo and other advanced technology development programs may be required as necessary. Deliverables will be uploaded to the EC3 WRS share folder and Design and Data Management Systems (DDMS), except the budget assessment which will be only to the share folder due to its financial data.

b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

Requirements for this scope includes work on the following projects: Alternate Pretreatment Development, Precipitation Prevention, ACTEX, and ALCLR.

The contractor shall continue support resolution of EMU Ion Filter's recent issues. This includes support in the following: investigation and troubleshooting, water sample and analyses and processing and testing of flight hardware and providing verified DI water as requested.

The contractor shall execute testing of the mixed pre-treat solutions.

The contractor shall procure an ICP-MS unit for the lab.

Based on the requirements described above, it is expected that contractor support will be required through September 2015

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall provide testing, data analysis, and reporting of test data supporting development of advanced water recovery technologies in the facilities located in building 7B, rooms 1300, 1300A, 1300B, 1300C, and building 7 room 2010. Other development and testing activities for ISS and commercial cargo and other advanced technology development programs may be required as necessary. Deliverables will be uploaded to the EC3 WRS share folder and Design and Data Management Systems (DDMS), except the budget assessment which will be only to the share folder due to its financial data.

b. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

Requirements for this scope includes work on the following projects: Alternate Pretreatment Development, Precipitation Prevention, ACTEX, and ALCLR.

The contractor shall continue support resolution of EMU Ion Filter's recent issues. This includes support in

the following: investigation and troubleshooting, water sample and analyses and processing and testing of flight hardware and providing verified DI water as requested.

The contractor shall execute testing of the mixed pre-treat solutions.

The contractor shall procure an ICP-MS unit for the lab.

Based on the requirements described above, it is expected that contractor support will be required through September 2015.

The contractor shall perform preventative maintenance on the lab ion chromatograph.

The contractor shall procure additional consumables to support continued operations in the Water Analysis Lab. These consumables are required to be purchased before Sept 30, 2015, in order to support near-term lab operations.

The contractor shall provide continued support for the next sequence of PPP test activities. This work continues through the end of FY15, and will finish in FY16 under a new TO. **Updated R3**

5.4.1 Hardware: WRS Lab Equipment

Project Code: None

The Contractor shall provide support for hardware: WRS Lab Equipment

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NONE	No Title Entered	

c. Required DRDs

5.4.1 Hardware: WRS Lab Equipment		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.4.1 Hardware: WRS Lab Equipment		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Budget Assessment	12	Monthly

e. Product Verification

5.4.1 Hardware: WRS Lab Equipment	
i. Monthly Budget Assessment	
- Reviewed and approved by EC3 PM or lead	

5.5 Water Recovery Systems (WRS) - AES and other Advanced Projects **Updated R3**

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall provide testing, data analysis, and reporting of test data supporting development of advanced water recovery technologies in the facilities located in building 7B, rooms 1300, 1300A, 1300B, 1300C, and building 7 room 2010; and building 29 room 142. Development and testing activities for AES and other advanced technology development programs may be required as necessary. Deliverables will be uploaded to the EC3 WRS share folder and Design and Data Management Systems (DDMS), except the budget assessment which will be only to the share folder due to its financial data.

Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

Requirements for this scope includes work on the following projects: Biological Water Processor (BWP), Cascade Distiller System (CDS), Brine Residual in Containment (BRIC), Green Pretreatment, Coiled Brine Removal Assembly (CoBRA), and Silver Biocide.

Contractor shall provide additional support with CoBRA by developing drawings, develop test plan, support test readiness and testing.

Based on the requirements described above, it is expected that contractor support will be required through May 2015

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall provide testing, data analysis, and reporting of test data supporting development of advanced water recovery technologies in the facilities located in building 7B, rooms 1300, 1300A, 1300B, 1300C, and building 7 room 2010; and building 29 room 142. Development and testing activities for AES and other advanced technology development programs may be required as necessary. Deliverables will be uploaded to the EC3 WRS share folder and Design and Data Management Systems (DDMS), except the budget assessment which will be only to the share folder due to its financial data.

Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

Requirements for this scope includes work on the following projects: Biological Water Processor (BWP), Cascade Distiller System (CDS), Brine Residual in Containment (BRIC), Green Pretreatment, Coiled Brine Removal Assembly (CoBRA), and Silver Biocide.

Contractor shall provide additional support with CoBRA by developing drawings, develop test plan, support test readiness and testing.

Based on the requirements described above, it is expected that contractor support will be required through May 2015.

The contractor shall provide continued project and test support through FY15 for the CDS and BRIC activities, including execution of the CDS test series and BRIC test plan development. **Updated R3**

5.5.1 Water Recovery Systems (WRS) - AES and other Advanced Projects **Updated Rev 2**

Project Code: None

The Contractor shall provide support for the following hardware: Biological Water Processor (BWP), Cascade Distillation System (CDS), Brine Residual in Containment (BRIC), Coiled Brine Removal Assembly (CoBRA)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NONE	No Title Entered	

c. Required DRDs

5.5.1 Water Recovery Systems (WRS) - AES and other Advanced Projects		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.5.1 Water Recovery Systems (WRS) - AES and other Advanced Projects		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Budget Assessment	8	Monthly

e. Product Verification

5.5.1 Water Recovery Systems (WRS) - AES and other Advanced Projects
i. Monthly Budget Assessment
- Review by EC3 PM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 1
Task Order Number: NNJ15HA32T TO# 156	Revision Number: R1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015/2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: CPAS - MPCV Capsule Parachute Assembly System

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$30,152,507	\$76,011	\$30,228,518

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

This revision is for updated FY16 rate adjustments in section B.8 of the contract.

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rloverst, cn=ROCHELLE OVERSTREET Date: 2015.09.11 10:25:44 -05'00' Signature: _____ Date: 9/11/2015 Contracting Officer
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA26T TO# 157	Revision Number: R2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 ER3 Exercise Countermeasures System Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,921,972	-\$141,124	\$3,780,849

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN
GASPARD
Date: 2015.07.24 15:51:10 -0500

Signature: _____ Date: **7/24/15**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA26T-TO157 R2

Originator: VI TRUONG (ER3) **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

change scope

1. Title of Effort: FY15 ER3 Exercise Countermeasures System Services (TO89)

2. Date of Request: 07/14/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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~~

e. **2.2.4 Training**

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

f. **2.3 Analysis and Assessment**

g. **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.

h. **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.

i. **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.

j. **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.

k.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 FY15 ER3 Exercise Countermeasures System Services (89) Updated R2

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support on-orbit operations and ground operations as defined in the subsequent paragraph.

The contractor shall deliver flight performance engineering analysis, assessments, and products for flight hardware failure resolution, engineering products for flight hardware and ground support hardware design changes, and engineering products to support ISS Program Office engineering, planning, and operational decisions for the following ISS CHeCS CMS projects per JSC 61931 Exercise Countermeasures System (CMS) Products Plan).

1. Cycle Ergometer with Vibration Isolation & Stabilization (CEVIS) System
2. Blood Pressure/Electrocardiogram Device (BP/ECG)
3. Second Generation Heart Rate Monitor (HRM2)
4. Advanced Resistive Exercise Device (ARED)

In compliance with the above identified SOW(S) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support for the following CHeCS CMS projects:

1. Countermeasures System (CMS) Resupply
2. CMS Trainer Maintenance
3. Advanced CMS Development

Also, the Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT) the contractor shall provide technical R&D services for the ER3/CMS. The IPT is made up of Civil Servants, and contractor employees. Overall Project Management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of the task order which follows and may include: software development, preparing flight hardware, mechanical design, and other specified in the requirements which follow.

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support on-orbit operations and ground operations as defined in the subsequent paragraph.

The contractor shall deliver flight performance engineering analysis, assessments, and products for flight hardware failure resolution, engineering products for flight hardware and ground support hardware design changes, and engineering products to support ISS Program Office engineering, planning, and operational decisions for the following ISS CHeCS CMS projects per JSC 61931 Exercise Countermeasures System (CMS) Products Plan).

1. Cycle Ergometer with Vibration Isolation & Stabilization (CEVIS) System
2. Blood Pressure/Electrocardiogram Device (BP/ECG)
3. Second Generation Heart Rate Monitor (HRM2), including Bluetooth Technology Investigation
4. Advanced Resistive Exercise Device (ARED)

In compliance with the above identified SOW(S) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support for the following CHeCS CMS projects:

1. Countermeasures System (CMS) Resupply
2. CMS Trainer Maintenance
3. Advanced CMS Development (for Close-Out purposes only)

Also, the Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT) the contractor shall provide technical R&D services for the ER3/CMS. The IPT is made up of Civil Servants, and contractor employees. Overall Project Management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of the task order which follows and may include: software

development, preparing flight hardware, mechanical design, and other specified in the requirements which follow. **Updated R2**

5.1.1 FY15 ER3 Exercise Countermeasures System Services (89)

Project Code:

Contractor shall provide engineering support to sustain the following ISS projects: CEVIS, BP/ECG, HRM2 and ARED. Both standard sustaining engineering of flight hardware and logistics and maintenance support of this flight hardware shall be provided. Also, the contractor shall maintain the CMS Trainer hardware and shall develop new exercise hardware concepts and/or related technologies.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC 61931 Deleted R2	Exercise Countermeasures System (CMS) Products Plan	B
JSC 61931 Added R2	Exercise Countermeasures System (CMS) Products Plan	C

c. Required DRDs

5.1.1 FY15 ER3 Exercise Countermeasures System Services (89)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		None

d. Products

5.1.1 FY15 ER3 Exercise Countermeasures System Services (89)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
FROM:		
Contractor shall provide engineering products and services per JSC 61931	AR	per JSC 61931
TO:		
Contractor shall provide engineering products and services per JSC 61931 Rev C Updated R2	AR	per JSC 61931 Rev C Updated R2

e. Product Verification

5.1.1 FY15 ER3 Exercise Countermeasures System Services (89)	
i. Contractor shall provide engineering products and services per JSC 61931 Rev C Updated R2	
FROM:	
- Product and service verifications as detailed in JSC 61931	
TO:	
- Product and service verifications as detailed in JSC 61931 Rev C Updated R2	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ15HA29T TO# 158	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Flight Robotics System Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,682,516	-\$292,424	\$3,390,091

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.24 15:46:27 -05'00'</small> Signature: _____ Date: 7/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA29T-TO158 R2

Originator: VI TRUONG (ER3) TMR: JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Change Current Scope of Work

1. FROM Title of Effort: FY15 Flight Robotics System Services (TO105) Updated R2

1. Title of Effort: FY15 Flight Robotics System Services (TO158)

2. Date of Request: 07/09/2015

3. Statement of Work Task Description

a. 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.

b. 2.3 Analysis and Assessment

c. 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.

d. 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.

e. **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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Flight Robotics System Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide robotics flight engineering products and system services.

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of TO-158 and its Master Plan and Schedule ER3-TM158. Efforts include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow.

5.1.1 SSRMS Analyses (Robotic Support to SSRMS Integration Team) Updated R2

Project Code:

FROM:

The contractor shall perform robotic analyses for capture and release of the JAXA H-II vehicle, the Space X Dragon vehicle, the Orbital Cygnus vehicle and ISS payloads using the SSRMS on the International Space Station, in accordance with ER3-TM158.

The contractor shall perform data processing, including organizing berthing analysis data and expanding the SSRMS digital error database, in accordance with ER3-TM158.

TO:

The contractor shall perform robotic analyses for capture and release of the JAXA H-II vehicle, the Space X Dragon vehicle, the Orbital Cygnus vehicle and ISS payloads using the SSRMS on the International Space Station, in accordance with ER3-TM158.

The contractor shall perform data processing, including organizing berthing analysis data and expanding the SSRMS digital error database, in accordance with ER3-TM158..

5.1.2 Mobile Servicing System (MSS) Manager and Subsystem Management (SSM) Updated R2

Project Code:

The contractor shall provide system management and subsystem management engineering services for the Mobile Servicing System in accordance with ER3-TM158.

The contractor shall provide sustaining engineering services required for Centerline Berthing Camera System (CBCS) implementation on COTS and other ISS elements utilizing the Common Berthing Mechanism (CBM) interface in accordance with ER3-TM158.

5.1.3 ISS Robotics Integration Task Deleted R2

Project Code:

The contractor shall provide ISS Robotics integration in accordance with ER3-TM158.

5.1.4 ISS RWS Flight Hardware Transition and Sustaining Engineering Deleted R2**Project Code:**

The contractor shall provide engineering services and support in the transition of the RWS flight hardware sustaining engineering task.

5.1.5 ISS Robotics Integration Task Added R2**Project Code:**

The contractor shall provide ISS Robotics integration in accordance with ER3-TM158.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
E.O 12600 Added R2	Freedom of Information Act	Jun. 1987
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
ER3-TM158 Deleted R2	Master Plan and Schedule	Original
ER3-TM158 Added R2	Master Plan and Schedule	Rev 2
JPG-2810.1	JSC Information Technology Security Handbook	B 1-01

c. Required DRDs

5.1.1 SSRMS Analyses (Robotic Support to SSRMS Integration Team)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01 Deleted R2	Project Schedule	Monthly
RV-01 Added R2	Project Schedule	Monthly
RV-02 Added R2	Regular Status Report/Summary Review	Monthly
RV-02 Deleted R2	Regular Status Report/Summary Review	Monthly

5.1.2 Mobile Servicing System (MSS) Manager and Subsystem Management (SSM)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	Monthly
RV-02	Regular Status Report/Summary Review	Monthly

5.1.3 ISS Robotics Integration Task Deleted R2		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01 Deleted R2	Project Schedule	Monthly
RV-02 Deleted R2	Regular Status Report/Summary Review	Monthly

5.1.4 ISS RWS Flight Hardware Transition and Sustaining Engineering Deleted R2		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-01 Deleted R2	Project Schedule	Monthly
RV-02 Deleted R2	Regular Status Report/Summary Review	Monthly

5.1.5 ISS Robotics Integration Task		
DRD #	DRD Title	Quantity/Frequency
RV-01 Added R2	Project Schedule	monthly
RV-02 Added R2	Regular Status Report/Summary Review	Monthly

d. Products

5.1.1 SSRMS Analyses (Robotic Support to SSRMS Integration Team)		
Product(s)	Quantity	Delivery Date
FROM:		
Implementation of ER3-TM158	Per ER3-TM158	Per ER3-TM158
TO:		
Implementation of ER3-TM158 Rev 2 Updated R2	Per ER3-TM158	Per ER3-TM158 Rev 2 Updated R2

5.1.2 Mobile Servicing System (MSS) Manager and Subsystem Management (SSM)		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM158	Per ER3-TM158	Per ER3-TM158

5.1.3 ISS Robotics Integration Task Deleted R2		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM158 Deleted R2	Per ER3-TM158 Deleted R2	Per ER3-TM158 Deleted R2

5.1.4 ISS RWS Flight Hardware Transition and Sustaining Engineering Deleted R2		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM158 Deleted R2	Per ER3-TM158 Deleted R2	Per ER3-TM158 Deleted R2

5.1.5 ISS Robotics Integration Task		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM158 Rev 2 Added R2	Per ER3-TM158 Added R2	Per ER3-TM158

e. Product Verification

5.1.1 SSRMS Analyses (Robotic Support to SSRMS Integration Team)	
i. Implementation of ER3-TM158 Rev 2 Updated R2	
- Flight Systems Branch (ER3) monthly review of status report/project schedule	

5.1.2 Mobile Servicing System (MSS) Manager and Subsystem Management (SSM)
i. Implementation of ER3-TM158
- Flight Systems Branch (ER3) monthly review of status report/project schedule

5.1.3 ISS Robotics Integration Task Deleted R2
i. Implementation of ER3-TM158 Deleted R2
- Flight Systems Branch (ER3) monthly review of status report/project schedule Deleted R2

5.1.4 ISS RWS Flight Hardware Transition and Sustaining Engineering Deleted R2
i. Implementation of ER3-TM158 Deleted R2
- Flight Systems Branch (ER3) monthly review of status report/project schedule Deleted R2

5.1.5 ISS Robotics Integration Task
i. Implementation of ER3-TM158 Rev 2 Added R2
- Flight Systems Branch (ER3) monthly review of status report/project schedule Added R2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA25T TO# 159	Revision Number: 4	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Robotics Technology Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,960,779	\$229,738	\$2,190,517

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle N. Overstreet <div style="text-align: center;"> ROCHELLE OVERSTREET </div> Digitally signed by ROCHELLE OVERSTREET <small>DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rover, st, cn=ROCHELLE OVERSTREET Date: 2015.07.27 15:50:03 -0500</small>
	Signature: _____ Date: 7/27/2015 Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ14HA53T-TO159 R4

Originator: JARED WOODFILL (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Revision 3 adds the additional material money for WBS02 for the purchase of spares and get ahead parts for the Lunar Resource Prospector project. The revision also adds WBS04 for engineering services and support for the EVA Scout project. The intended use is for a prototype of an EVA Scout based on a multi rotor drone for low gravity environments such as asteroid or moons of Mars.

1. Title of Effort: FY15 Robotics Technology Services (TO93)

2. Date of Request: 07/17/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 2.3 Analysis and Assessment

d. 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.

e. 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.

f. **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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Dynamic Systems Test Branch Engineering Services Updated Rev 1

Requirement - In compliance with the above identified SOW(s) the contractor shall provide technical services as described in ER4-TM159 and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD). All technology development will be done as described in ER4-TM159.

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of the task order which follows and may include: Software development, Controls systems design, Mechanical design, and other specified in the requirements which follow.

5.1.1 Robotic Technologies (GFY 2015) Updated Rev 1

Project Code: 34507

The contractor shall provide engineering services necessary to continue the development, maintenance, and operation of the Robonaut 2 robots, test-beds, and associated technologies in accordance with ER4-TM159, Section I.

5.1.2 Robotic Mobility Technologies (GFY 2015) Updated Rev 1

Project Code: NA

The contractor shall provide engineering services necessary to continue the operation of SR&SD Robotics Technology Branch assets in the building 9 high bay and building 9NE in accordance with ER4-TM159, Section II.

5.1.3 Robotics Shared Services and Management (GFY 2015) Updated Rev 1

Project Code: NA

The contractor shall provide the engineering services shall administrate IT, and TO management services to satisfy the requirements as described in accordance with ER4-TM159, Section III.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER4-TM159 Deleted Rev 1	ER4 Robotics Labs Master Plan and Schedule	Original
ER4-TM159 Rev 2 Deleted R4	ER4 Robotics Labs Master Plan and Schedule	R2
ER4-TM159 Rev 3 Added R4	ER4 Robotics Labs Master Plan and Schedule	R3
ER4-TM159-R1 Deleted Rev 2	ER4 Robotics Labs Master Plan and Schedule	R1
JPR 2310.1	JSC Organizational Learning Program	May 8, 2008

c. Required DRDs

5.1.1 Robotic Technologies (GFY 2015)

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Deleted Rev 2	Regular Status Report/Summary Review	Quarterly
RV-02 Added Rev 2	Regular Status Report/Summary Review	Monthly

5.1.2 Robotic Mobility Technologies (GFY 2015)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02 Deleted Rev 2	Regular Status Report/Summary Review	Quarterly
RV-02 Added Rev 2	Regular Status Report/Summary Review	Monthly

5.1.3 Robotics Shared Services and Management (GFY 2015)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Quarterly

d. Products

5.1.1 Robotic Technologies (GFY 2015)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER4-TM159, Section I	1	9/30/2015

5.1.2 Robotic Mobility Technologies (GFY 2015)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER4-TM159, Section II	1	9/30/2015

5.1.3 Robotics Shared Services and Management (GFY 2015)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER4-TM159, Section III	1	9/30/2015

e. Product Verification

5.1.1 Robotic Technologies (GFY 2015)	
i. Implementation of ER4-TM159, Section I	
- - SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM159, Section I.	

5.1.2 Robotic Mobility Technologies (GFY 2015)	
i. Implementation of ER4-TM159, Section II	
- - SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM159, Section I.	

5.1.3 Robotics Shared Services and Management (GFY 2015)	
i. Implementation of ER4-TM159, Section III	
- - SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM159, Section I.	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HD34T TO# 160	Revision Number: 1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Rochelle Overstreet Tel No.: 281-483-6768 E-mail: rochelle.n.overstreet@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: James Webb Space Telescope Project Support

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$3,298,814	\$74,225	\$3,373,039

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Digitally signed by ROCHELLE OVERSTREET
DN: c=US, o=U.S. Government, ou=NASA,
ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.08.11 16:04:17 -05'00'

Signature: _____ Date: **8/11/2015**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA34T R1-TO160

Originator: RUSSELL BACHTEL (EC4) (281) 483-9177 **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY15 James Webb Space Telescope Project Support (TO109) (LOE)

2. Date of Request: 09/19/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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 Failure Toxicity Screening by analytical means Off-gassing Wet Chemistry Metallurgy

d. 2.2.4 Training

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

e. **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.

f. **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.

g. **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.

h. **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.

i.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 James Webb Space Telescope Project Support

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide highly specialized engineering and technical services to accomplish the preparation and checkout of Chamber A in support of the James Webb Space Telescope program.

5.1.1 James Webb Space Telescope Project Support

Project Code:

The contractor shall assist with program specific GSE and GFE operations as specified in JWST-IRCD-003577 conducted within the Crew and Thermal Systems Division. Operation of the facility during 40 Day Commissioning test, 30 Day Optical Ground Support Tests 1 & 2.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures for EA Testing Facilities	B
JWST-IRCD-003577	James Webb Space Telescope Project Observatory to NASA JSC Test Facility Interface Requirements and Control Document	E
STB-E-084	CTSD STB Drawing System and Configuration Control Procedure	F
STB-E-367	Safety Analyses Techniques and Preparation Procedure	D
STB-E-493	CTSD STB Training and Certification Plan	I
STB-E-554	STB Test Operations Guideline	H
STB-E-557	STB Facility and Major Test Buildup Guidelines	E
STB-E-574	Systems Test Branch Facility Maintenance Guidelines	Basic
STB-F-001	CTSD STB General Operating Procedures Manual	P
STB-F-413	Management and Archival of Original Test Data Media	J
STB-F-616	Reduction of Test Data	M

c. **Required DRDs**

5.1.1 James Webb Space Telescope Project Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.1.1 James Webb Space Telescope Project Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
NA	NA	NA

e. **Product Verification**

5.1.1 James Webb Space Telescope Project Support	
. NA	
- NA	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 10
Task Order Number: NNJ15HA45T TO# 162	Revision Number: 1	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: EC2 Design & Analysis Branch

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,716,150	\$235,893	\$1,952,043

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Christian C. Gaspard</p> <p>CHRISTIAN GASPARD</p> <p>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=ccgaspard, cn=CHRISTIAN GASPARD Date: 2015.07.15 13:44:52 -0500</p> <p>Signature: _____ Date: 7/15/15</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ15HA45T-TO162 REV 1

Originator: MARIE KOWAL (EC1) (281) 483-8875 **TMR:** MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

Revision 1 increased the number of ELCSS/ATCS/EVA Analytical Study reports from 10 to 11 on CLIN 5.1; increased the number of EVA Thermal and Touch Temperature Evaluation Summary Reports to 3 on CLIN 5.2; and increases the number of AES Water Architecture Reports to 2, NGLS Project Analysis Reports to 3, and AES Logistics SE&I Analysis Reports to 3 on CLIN 5.3.

1. Title of Effort: FY15 EC2 Design & Analysis Branch (TO45)

2. Date of Request: 06/23/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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

e. **2.3 Analysis and Assessment**

f. **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.

g. **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.

h. **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.

i. **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.

j. **2.5 Research and Development**

k. **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, Descent, 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.

l. **2.6 Special Projects**

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

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Analysis Tools Maintenance and Development

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide analytical tools and evaluations in areas of ECLSS, ATCS, and EVA systems.

5.1.1 ECLSS, ATCS, and EVA Tool Enhancements and Analytical Studies Updated REV 1

Project Code: Multiple

The contractor shall add the required capabilities to the existing ECLSS, ATCS and EVA systems analysis tools and perform the engineering analyses and studies listed in the 5.1.1 Product Table. Required capabilities include upgrades to: human thermal modeling tools; life support, EVA and active thermal control equipment sizing analyzers; and detailed performance models that can predict performance characteristics of ECLSS, ATCS and EVA technologies. Engineering analysis and studies include: trade studies and investigations of technologies that could perform life support, ATCS, and EVA functions for future NASA missions; performance modeling of these technologies; and evaluations of human thermal comfort as well as ventilation characteristics within future mission architectures.

Products for this WBS are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx" where the xx is the last 2 digits of the corresponding year and DDMS. Native files are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx word" and DDMS.

Revision 1: Increases the number of ECLSS/ATCS/EVA Analytical Study Reports to 11.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC-28918	EVA Design Requirements and Considerations	Baseline
JSC-47804	Advanced Life Support Baseline Values and Assumptions Document	Rev. A
JSC-65527	Advanced Life Support Requirements Document	Rev. A

- c. **Required DRDs**

5.1.1 ECLSS, ATCS, and EVA Tool Enhancements and Analytical Studies		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	1 per report

- d. **Products**

5.1.1 ECLSS, ATCS, and EVA Tool Enhancements and Analytical Studies		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
ECLSS/ATCS/EVA Analysis Tool Upgrade Packages.	1	9/30/15
ECLSS/ATCS/EVA Analytical Study Reports. Updated REV 1	11	9/30/15

- e. **Product Verification**

5.1.1 ECLSS, ATCS, and EVA Tool Enhancements and Analytical Studies	
i. ECLSS/ATCS/EVA Analysis Tool Upgrade Packages.	
- - EC2 Branch review of deliverable	
ii. ECLSS/ATCS/EVA Analytical Study Reports.	

- - EC2 Branch review of deliverable

5.2 ISS EVA Thermal Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform assembly and stage EVA thermal analyses and general thermal evaluations of EVA hardware.

5.2.1 ISS EVA Pre-flight and EVA requirements evaluations Updated REV 1

Project Code: Multiple.

The contractor shall perform ISS EVA thermal analyses and general touch temperature and thermal evaluations of EVA hardware listed in the 5.2.1 Product Table.

Products for this WBS are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx" where the xx is the last 2 digits of the corresponding year and DDMS. Native files are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx word" and DDMS.

Revision 1: Increases the number of EVA Thermal and Touch Temperature Evaluation Summary Reports to 3

b. **Applicable Documents**

Document Number	Document Name	Rev.
HS MEMO EMUM1-01906	ISS EMU Thermal Certification for Flights STS-88 (2A) and Subsequent	Original
JSC 39117	EMU ISS EVA Thermal Environment Requirements for Certification	Rev. D
JSC-26557	On-Orbit Assembly, Modeling, and Mass Properties Handbook, International Space Station Program	REV. E, DCN-4
JSC-28918	EVA Design Requirements and Considerations	BASELINE

c. **Required DRDs**

5.2.1 ISS EVA Pre-flight and EVA requirements evaluations		
DRD #	DRD Title	Quantity/Frequency
TD-08	Engineering Analysis	A/R

d. **Products**

5.2.1 ISS EVA Pre-flight and EVA requirements evaluations		
Product(s)	Quantity	Delivery Date
Stage EVA Flight Plan Analysis Reports.	9	2 days Prior to EVA
EVA Hardware Thermal and Touch Temperature Evaluation Summary Report. Updated REV 1	3	9/30/2015

e. **Product Verification**

5.2.1 ISS EVA Pre-flight and EVA requirements evaluations	
i. Stage EVA Flight Plan Analysis Reports.	
- - EC2 Branch review of deliverable	
ii. EVA Hardware Thermal and Touch Temperature Evaluation Summary Report.	
- - EC2 Branch review of deliverable	

5.3 Environmental Control & Life Support Systems (ECLSS) Project Analysis Updated REV 1

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering analysis and evaluation products for the ECLSS project. The contractor shall provide evaluations of Life Support (LS) technology development progress, LS requirements and baseline values and assumptions for LS studies. The contractor shall also conduct computer modeling and simulations of LS fluid processing and solids handling systems and components to evaluate developments in the LS technologies. The contractor shall also provide trade-off studies and develop LS design database. The engineering analysis and evaluation products are listed in the 5.3.1 Product Table.

Products for this WBS are placed \\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx where the xx is the last 2 digits of the corresponding year and DDMS. Native files are placed in \\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx word and DDMS.

Revision 1: Increases the number of AES Water Architecture Reports to 2, NGLS Project Analysis Reports to 3, and AES Logistics SE&I Analysis Reports to 3 Updated REV 1

5.3.1 AES Water Architecture Analysis

Project Code: Multiple.

The contractor shall perform engineering analyses of water processing systems listed in the 5.3.1 Product Table. These analyses include: evaluations and comparisons of various architectures that could achieve water processing goals of future missions; trade studies to determine which technologies could best align with these goals; and detailed process simulation modeling of water processing systems to predict performance characteristics and efficiencies of potential technologies being considered for future missions.

5.3.2 NGLS Project Analysis

Project Code: Multiple

The contractor shall perform engineering analyses of technology development life support systems listed in the 5.3.2 Product Table. These analyses include: evaluations and comparisons of various architectures that could achieve Next Generation Life Support (NGLS) goals of future missions; trade studies to determine which life support technologies could best align with these goals; and detailed process simulation modeling of life support systems to predict performance characteristics and efficiencies of potential technologies being considered for future missions.

5.3.3 AES Logistics SE&I

Project Code: Multiple

The contractor shall perform engineering analyses and logistics assessments of life support systems listed in the 5.3.3 Product Table. These analyses include evaluations of life support clothing and laundry options, waste management technologies and options, methods for reduction of crew time on logistics tasks, reuse and reprocessing of logistical life support items, and conversion of wastes into primary gases that can be utilized for various purposes or vented to reduce waste volume. The evaluations include trade studies to compare competing technologies, architecture impact evaluations, and detailed performance modeling of logistics related technologies.

5.3.4 AES Air

Project Code: Multiple

The contractor shall perform engineering analyses of air processing life support systems listed in 5.3.4 Product Table. These analyses include: evaluations and comparisons of various architectures that could achieve life support air revitalization, water, and waste processing goals of future missions; trade studies to determine which technologies could best align with these goals; and detailed process simulation modeling of air revitalization, water, and waste systems to predict performance efficiencies of potential technologies being considered for future missions.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 39502	ALS Systems Integration, Modeling, and Analysis Reference Missions Document	A
JSC 47804	Advanced Life Support Baseline Values and Assumptions Document	A
JSC-65527	Advanced Life Support Requirements Document	A

c. **Required DRDs**

5.3.1 AES Water Architecture Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	A/R

5.3.2 NGLS Project Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	A/R

5.3.3 AES Logistics SE&I		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	A/R

5.3.4 AES Air		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-08	Engineering Analysis	A/R

d. **Products**

5.3.1 AES Water Architecture Analysis			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
AES Water Architecture Reports. Updated REV 1	2	9/30/15	

5.3.2 NGLS Project Analysis			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
NGLS Project Analysis Reports Updated REV 1	3	9/30/15	

5.3.3 AES Logistics SE&I			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
AES Logistics SE&I Analysis Reports Updated REV 1	3	9/30/15	

5.3.4 AES Air			
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>	
AES Air Analysis Reports	1	9/30/15	

e. **Product Verification**

5.3.1 AES Water Architecture Analysis
i. AES Water Architecture Reports.
- - EC2 Branch review of deliverable

5.3.2 NGLS Project Analysis
i. NGLS Project Analysis Reports
- - EC2 Branch review of deliverable

5.3.3 AES Logistics SE&I
i. AES Logistics SE&I Analysis Reports
- - EC2 Branch review of deliverable

5.3.4 AES Air
i. AES Air Analysis Reports
- - EC2 Branch review of deliverable

5.4 Vehicle ECLSS Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide analyses and evaluations of Vehicle ECLSS processes and hardware.

5.4.1 Vehicle ECLSS Analysis

Project Code: The contractor shall perform the Vehicle ECLSS analysis and evaluation products listed in the 5.4.1 Product Table.

These analyses and evaluations include detailed modeling of shuttle replacement vehicle life support technologies including air revitalization, water processing, and waste collection and processing hardware. Analyses also include trade studies of competing technologies that can perform specific life support functions and life support architecture evaluations that can evaluate advantages and disadvantages that these architectures can have in terms of mass, power, volume, crew time, performance and human thermal comfort characteristics.

Products for this WBS are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx" where the xx is the last 2 digits of the corresponding year and DDMS. Native files are placed in "\\js-ea-fs-01\PD01\EC\ESCG Thermal-Life Support Library\calxx word" and DDMS.

- b. **Applicable Documents**

Document Number	Document Name	Rev.
JSC 47804	Advanced Life Support Baseline Values and Assumptions Document	A
JSC 65527	Advanced Life Support Requirements Document Replaces JSC38571C	A
JSC-38571C	Advanced Life Support Requirements Document	C

- c. **Required DRDs**

5.4.1 Vehicle ECLSS Analysis		
DRD #	DRD Title	Quantity/Frequency
TD-08	Engineering Analysis	A/R

d. **Products**

5.4.1 Vehicle ECLSS Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Vehicle ECLSS Engineering Analysis Reports.	3	9/30/15

e. **Product Verification**

5.4.1 Vehicle ECLSS Analysis		
i. Vehicle ECLSS Engineering Analysis Reports.		
- - EC2 Branch review of deliverable		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 4
Task Order Number: NNJ15HA46T TO# 163		Revision Number: 1		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Aerosciences Flight Mechanics Division Institutional Safety & Facility Support

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$78,982	-\$25,600	\$53,382

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name: _____		CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=US Government, ou=NASA, ou=People 0 9 2342 19200300 100 1 1-cgaspard cn=CHRISTIAN GASPARD Date: 2015 05 27 16:29:37 -0500</small>	
Signature: _____ Date: _____		Signature: _____ Date: 5/27/15 Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA46T-TO163 Rev 1

Originator: DENA HAYNES (EG1) (281) 244-5122 **TMR:** DENA HAYNES (EG) (281) 244-5122

1. Title of Effort: FY15 Aerosciences Flight Mechanics Division Institutional Safety & Facility Support

2. Date of Request: 10/01/2014

3. Statement of Work Task Description

a. 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.

b.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Institutional Safety & Facility Management

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform Facility and Safety management for Aerospaces Flight Mechanics Division including Buildings 16/16E to ensure proper coordination and safe conduct of all activities taking place in or around the assigned facility, such as testing, operations, construction, modification, repairs, or maintenance.

5.1.1 Institutional Safety & Facility Management

Project Code:

The contractor shall provide facility manager(s) within the Division to ensure proper coordination and safe conduct of all activities taking place in or around the assigned facility, such as testing, operations, construction, modification, repairs, or maintenance. The facility manager shall have the following responsibilities:

- Review the general safety of all test operations conducted by personnel in Aerospaces Flight Mechanics Division (AFMD) as well as construction, modifications, and repair and maintenance of the building. Assess the implementation of JSC and OSHA safety/health regulations and policy directives and Engineering Directorate safety policy and procedures as appropriate to the building and keep the appropriate personnel apprised of any problems associated with such activities.
- Generate facility safety and health management policies and procedures as needed that ensure all applicable safety and health regulations are disseminated and enforced, and that optimal facility functionality is maintained and provided.
- Acquire & disseminate pertinent institutional and occupational safety and health information.
- Conduct and document facility safety inspections as established in JPR 1700.1 "JSC Safety and Health Handbook", ensuring institutional anomalies are appropriately addressed and subsequent resolutions are tracked to completion.
- Investigate and provide resolution for all incidents (mishaps, close calls, etc.) effectively for the AFMD and report to AFMD management.
- Ensure safety and emergency action procedures, fire evacuation plans, and facility security access requirements are in place and utilized.
- Review laboratory test procedures, safety training, operator/job certifications, documentation required, and hazard analyses for compliance with safety and health regulations.
- Determine that each laboratory in the building has generated and operates per a hazard analysis and Job Safety Analysis and has put into practice the identified hazard controls.
- Develop and maintain a building integrated hazard analysis that identifies the hazard exposures of one laboratory upon another and identifies effective controls to mitigate the risks.
- Monitor building construction, repair, modification and maintenance Prepare work requests and related documentation for facility changes and track to completion
- Determine that construction and maintenance work is being conducted in the facility per JSC and OSHA safety regulations and report non-compliances to the AFMD management.
- Ensure the implementation of the JSC Requirements for Safety and Health (JPR 1700.1) in the AFMD Division.
- Advise AFMD laboratory managers on preparing hazard analyses and interpreting JSC and OSHA safety regulations.
- Ensure the implementation of Directorate safety requirements in the AFMD laboratories and office areas.
- Ensure that the AFMD laboratories generate appropriate hazard analyses and prepare appropriate operating procedures.
- Provide AFMD Safety Representation at the EA Safety Implementation Committee (SIC) as needed where specific division safety requirements are identified and report AFMD incidents and close calls.
- Ensure that the branches conduct safety walk-throughs, record hazards, and assign actions to branch employees who own the hazardous conditions
- Act as interface to AFMD and Center Ops for all utility outages
- Accompany Fire Techs on annual fire protection audits upon notification
- Attend Facility Manager and Fire Warden Training as well as other trainings associated with tasks or buildings
- Maintain records of fire alarms, fire drills, occupants attending alarms and drills, outages, and reports (environmental, occupational health, VPP, fire, etc)
- Coordinate review for all documentation concerning Hurricane & Severe Weather Plans, Emergency Action Plans

- Coordinate environmental issues

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JWI 8831	Facility Manager Program Handbook	Initial 9/11/2009

c. Required DRDs

5.1.1 Institutional Safety & Facility Managemnent		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/Quarter

d. Products

5.1.1 Institutional Safety & Facility Managemnent		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Regular Status Report / Review	4	1/Quarter

e. Product Verification

5.1.1 Institutional Safety & Facility Managemnent	
i. Regular Status Report / Review	
- AFMD management Office Review and Approval	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA48T TO# 165	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 VASIMR Technology Maturation

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$899,281	\$899,281

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2014.11.04 16:39:17 -0600</small> Signature: _____ Date: 11/4/2014 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA48T-TO165

Originator: RICHARD HARDY (EA329) (281) 244-1088 **TMR:** JAN YOKLEY (EA5) (281) 483-7581

1. Title of Effort: FY15 VASIMR TECHNOLOGY MATURATION (TO87)

2. Date of Request: 10/23/2014

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 11/4/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Technology Maturation for the Variable Specific Impulse Magnetoplasma Rocket (VASIMR) Propulsion Systems

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform quality assurance, manufacturing tests, test rig preparation, thermal design evaluation, and risk management for VASIMR technology maturation. Each of these items are preparation activities for future Solar Electric Propulsion (SEP) Tests.

A Conceptual Design Review for SEP Test Preparation Activities will be conducted to status the following items: the conceptual design of the Plasma Dump, the tack welding and component specification of the chamber wall, the silicon nitride machining plan, and the project's Risk Management Plan.

A Manufacturing Review for the SEP Test Preparation Activities will be conducted to status the following items: the machining of the Silicon Nitride Plasma Source component, the grinding of the chamber wall, the preliminary design of the Plasma Shield, and the risk evaluation of the cooling system design.

A Preliminary Design Review for the SEP Test Preparation Activities will be conducted to status the following items: the machining of the Silicon Nitride Plasma Choke component, the seam welding and finishing of the chamber wall, the preliminary design of the Plasma Dump, and the risk evaluation of the thermal design.

A Final Design Review for the SEP Test Preparation Activities will be conducted to status the following items: the machining of the Silicon Nitride Plasma Booster component, the fit check and assembly test for the Silicon Nitride components, and the final design of the Plasma Dump.

5.1.1 Technology Maturation for VASIMR Propulsion Systems

Project Code:

The contractor shall perform tasks including, but not limited to, the following areas:

- Design and Analysis of a Plasma Dump and Plasma Shield
- Perform tack welding, seam welding, grinding and finishing in order to construct the Chamber Wall
- Grinding & polishing of Silicon Nitride Rocket Core Components
- Perform a fit check and assembly test for the Silicon Nitride Rocket Core Components
- Develop a risk management plan, and risk register

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

- c. **Required DRDs**

5.1.1 Technology Maturation for VASIMR Propulsion Systems		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		0

- d. **Products**

5.1.1 Technology Maturation for VASIMR Propulsion Systems		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Conceptual Design Review for SEP Test Preparation Activities	1	12/26/2014
Manufacturing Review for SEP Test Preparation Activities	1	2/6/2015
Preliminary Design Review for SEP Test Preparation Activities	1	4/17/2015
Final Design Review for SEP Test Preparation Activities	1	6/12/2015

e. Product Verification

5.1.1 Technology Maturation for VASIMR Propulsion Systems
i. Conceptual Design Review for SEP Test Preparation Activities
- As documented by a meeting summary report and approved by NASA VASIMR Project Manager or Deputy Project Manager
ii. Manufacturing Review for SEP Test Preparation Activities
- As documented by a meeting summary report and approved by NASA VASIMR Project Manager or Deputy Project Manager
iii. Preliminary Design Review for SEP Test Preparation Activities
- As documented by a meeting summary report and approved by NASA VASIMR Project Manager or Deputy Project Manager
iv. Final Design Review for SEP Test Preparation Activities
- As documented by a meeting summary report and approved by NASA VASIMR Project Manager or Deputy Project Manager

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA49T TO# 166	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Rochelle Overstreet Tel No.: 281-483-6768 E-mail: Rochelle.n.overstreet@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Morpheus/ALHAT (TO23) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$53,838.72	\$25,607.56	\$79,446.28

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **8/5/2015**
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rmovert,
cn=ROCHELLE OVERSTREET
Date: 2015.08.05 16:44:18 -05'00'

JSC Engineering, Technology and Science Contract

NNJ15HA49T-TO166 REV 2

Originator: ROBERT VILLARREAL (EV171) (281) 483-0143 **TMR:** JILL LIN (EA5) (281) 483-2460

Revision Summary:

This revision adds the requirement for Morpheus Igniter Test Fixture design and fabrication as well as Morpheus Tether Test support. This support effort includes mechanical analysis, design, fabrication and test support as well as approximately \$10K of materials for the test fixture buildup. Labor BOE for this effort is included in attachment "TO166 Labor BOE Table (Rev 2).xlsx", and material BOE is included in attachment "TO166-FY15 Materials BOE (Rev 2).xlsx".

1. Title of Effort: FY15 Morpheus/ALHAT (TO23) (LOE)

2. Date of Request: 07/22/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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

e. **2.3 Analysis and Assessment**

f. **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.

g. **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.

h. **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.

i. **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.

j. **2.4 Facilities**

k. **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.

l. **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.

m. **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.

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 11/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Project Morpheus/ALHAT Engineering Products and Services Updated REV 2

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall support the design, development and documentation of Project Morpheus/ALHAT engineering products, including drawings, models, analyses, vehicle assembly, integration, and inspection, test procedures and operations, to support a Morpheus tethered test and 2 free flight tests per the attached schedule.

A limited amount of materials may be purchased up to the limit allowed in this TO, as approved by the NASA PM. The materials may include, but are not limited to, Brackets, click bonds, fasteners, wire harness components, and fiber optic cable.

Travel will be required to support the activities on this TO. The contract should expect 3 trips to Kennedy Space Center.

The contractor shall provide support for the Morpheus Igniter Test Fixture design and fabrication as well as Morpheus Tether Test support. This support effort includes mechanical analysis, design, fabrication and test support as well as procurement of materials for the test fixture buildup. Updated REV 2

5.1.1 Morpheus/ALHAT Support

Project Code: 02219

1. **Vehicle Crew Chief, WBS 743588 (Morpheus SE&I)**
The Contractor shall provide a qualified and experienced Vehicle Crew Chief to manage Morpheus vehicles work flow during assembly, integration and testing in coordination with Morpheus/ALHAT project management and SE&I leads.
2. **Welding Support, WBS 743588 (Morpheus Vehicle Structures & Mechanics)**
The Contractor shall provide engineering and technical services directed at Morpheus vehicle structures welding. This includes guidance on Morpheus flight test vehicle welding best practices and preparation, and inspection and analysis of welding in Morpheus vehicle primary and secondary structure and pressure tanks at NASA and vendor facilities. Actions to perform specific tasks shall be assigned by Morpheus technical leads and vehicle managers.
3. **NDE Inspection, WBS 743588 (Morpheus Vehicle Structures & Mechanics)**
The Contractor shall provide Non-Destructive Examination (NDE) of Morpheus vehicle structural components and propellant tanks, and guidance on NDE best practices and preparation at NASA and vendor facilities. Actions to perform specific tasks shall be assigned by Morpheus technical leads and vehicle managers.
4. **Structural Engineering Support, WBS 743588 (Morpheus Vehicle Structures & Mechanics)**
The Contractor shall perform structural engineering tasks to assist the Morpheus Structures Lead. Tasks include engineering support for structural design and analyses, subsystem and integrated vehicle testing at JSC and flight testing at KSC. Tasks also include representing the structures subsystem in project meetings, assisting the project with resolving issues, coordinating various Structures & Mechanics Division (ES) resources (mechanical, structural, thermal, stress and fracture), overseeing and assisting Morpheus vehicle assembly and disassembly, integrated vehicle test support, coordinating mechanical design activities, coordinating structural fabrication and piece part purchases, overseeing general vehicle maintenance (e.g., bolt torque checks, condition of welds and lifting components, corrosion), maintaining a supply of structures spare parts and specialized tools, verifying lifting component tags are current, overseeing movement and transport of flight vehicle, and analyses and data reviews. Specific actions shall be assigned by the Morpheus structures lead and project management.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
No requirement	No Requirement	

c. **Required DRDs**

5.1.1 Morpheus/ALHAT Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As required

d. **Products**

5.1.1 Morpheus/ALHAT Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As required

e. Product Verification

5.1.1 Morpheus/ALHAT Support		
i. LOE		
- --As approved by Morpheus Project Manager		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA50T TO# 167	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: DARPA Robotics Challenge-DRC-Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$2,063,437	-\$7,342	\$2,056,095

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Christian C. Gaspard</p> <p>CHRISTIAN GASPARD</p> <p><small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0 9 2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.27 16:33:16 -05'00'</small></p> <p>Signature: _____ Date: 5/27/15</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ15HA50T-TO167 REV 2

Originator: JARED WOODFILL (ER7) (281) 483-6331 **TMR:** JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Revision 1 adds scope to extend the POP from the end of fiscal month of January through the end of the FY. Electrical and mechanical engineering services will shift between design, testing, and integration of Valkyrie robotic subsystems at the technical direction of the NASA project manager. Project administration services will also continue in support of: non-labor material procurement, IT support, facility management, and safety management. Additionally, Some support for high level ideation and planning of the Space Robotics Challenge (SRC) has been added. (See Master Plan and Schedule ER4-TM167_R1 for more specifics.)

1. Title of Effort: FY15 DARPA Robotics Challenge-DRC-Services (TO95)

2. Date of Request: 01/13/2015

3. Statement of Work Task Description

a. 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: ~~â€¢~~ Advanced studies ~~â€¢~~ Analysis and trade studies ~~â€¢~~ Concept definition ~~â€¢~~ Systems Engineering and Integration ~~â€¢~~ Mission architecture definition, design, and planning ~~â€¢~~ Engineering Design and Development ~~â€¢~~ Manufacturing, testing, verification, and certification ~~â€¢~~ Sustaining engineering activities [hardware resupply, refurbishment, mission hardware support activities, failure analysis, repair, operating procedures] ~~â€¢~~ Flight Hardware Requirements Survey, Assessment, and Consolidation ~~â€¢~~ Engineering, Quality, and Safety Analyses Types of Data and Design Documentation required may include but is not limited to: ~~â€¢~~ Design review documentation ~~â€¢~~ Safety review documentation ~~â€¢~~ Test, verification, and certification data ~~â€¢~~ Management Documentation ~~â€¢~~ 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.

b.

4. Period of Performance Updated REV 1

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 11/10/2014 and ends 09/30/2015.

5. Product Requirements

5.1 DARPA Robotics Competition Redesign and Production Effort Updated REV 1

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and design services in support of the redesign of specific DRC Valyrie Humanoid Robot subsystems. The NASA-led redesign effort will lead to a fully operational Va kyrie humanoid robot, capable of meeting the goals of the DARPA Robotics Challenge program. Finally, the NASA-led team will procure and assemble materials into subassemblies towards the eventual completion of new Va kyrie robots. Services shall be provided as specified in supporting document ER4-TM167. Updated REV 1

5.1.1 DARPA Robotics Competition Redesign and Production Effort

Project Code: NA

Requirement - In compliance with the above identified SOW(s) the contractor shall provide engineering and design services in support of the redesign of specific DRC Valyrie Humanoid Robot subsystems. The NASA-led redesign effort will lead to a fully operational Valkyrie humanoid robot, capable of meeting the goals of the DARPA Robotics Challenge program. Finally, the NASA-led team will procure and assemble materials into subassemblies towards the eventual completion of new Valkyrie robots. Services redesign and production effort shall be provided per ER4-TM167.

5.1.2 Engineering Support

Project Code:

- The contractor shall provide support in the development of the following:

Actuation Redesign

- Structural Design and Loads Analysis
- Electronics and Sensor packaging and Layout
- Procurement of Materials
- Assembly of Components
- Forward Development Plan for the production of several Valkyrie Humanoid Robots (more than two)

As part of the redesign effort, the contractor shall provide support in developing rapid-prototype conceptual parts.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
IPC-2221	Generic Standard on Printed Board Design	Rev A, May 2003
IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards	Feb. 1998
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NASA-STD-8739.1	Workmanship Standard for Polymeric Application on Electronic Assemblies	Rev. A, Mar. 2008 Chg. 2, Mar. 2011
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses, and Wiring	Baseline, Feb. 1998 Chg. 6, Mar-2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPR 9501.2	NASA Contractor Financial Management Reporting	Rev. E
ER4-TM167 Added REV 1	Master Plan and Schedule	Revision One
JPD 2800.4	JSC Information Technology (IT) Program Management	03-2001

JPG 2800.3	JSC Information Technology Product Implementation Guidelines, Requirements, and Standards	Original 09-1997
MIL-STD-882	Standard Practice for System Safety	Dev D/02-02
NASA-STD-8739.2	Surface Mount Technology	08-1999
NASA-STD-8739.3	Soldered Electrical Connection	12-1997
NPD-9501.1	NASA Contractor Financial Management Reporting System	Rev G/05-00
NPR 8715.3	NASA Safety Manual Change	1/06-02
NPR-8621.1	NASA Procedural Requirements for Mishap Reporting, Investigating, and Record keeping	Rev A/02-04
NSTS 22206	Requirements for Preparation and Approval of Failure Modes and Effects Analysis (FMEA) and Critical Item List (CIL)	Rev D 12-2001
NT-CWI-001	Task Performance Sheet (TPS)	Rev C/ 07-2008
NT-CWI-003	Quality Assurance Record Center Discrepancy Reporting and Tracking	Rec C 11-2006

c. **Required DRDs**

5.1.1 DARPA Robotics Competition Redesign and Production Effort		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		None

5.1.2 Engineering Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		None

d. **Products**

5.1.1 DARPA Robotics Competition Redesign and Production Effort			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of Requirements Set Forth in ER4-TM167	Updated REV 1	1	Per ER4-TM167

5.1.2 Engineering Support			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
Implementation of Requirements Set Forth in ER4-TM167		1	Per ER4-TM167

e. **Product Verification**

5.1.1 DARPA Robotics Competition Redesign and Production Effort	
i. Implementation of Requirements Set Forth in ER4-TM167	
- - SR&SD Robotics Technology Branch review, witness, and acceptance of engineering and data	

5.1.2 Engineering Support	
i. Implementation of Requirements Set Forth in ER4-TM167	
- - - SR&SD Robotics Technology Branch review, witness, and acceptance of engineering and data	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA51T TO# 168 (Mod 4)	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: EISD Operational Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: Increase the task order funding from \$68,000 to \$73,700. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$85,031	\$85,031

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN
GASPARD
Date: 2015.05.27 14:46:27 -05'00'

Signature: _____ Date: **5/27/15**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA51T-TO168

Originator: LISA FLETCHER (KA) (281) 483-2630 **TMR:** LISA FLETCHER (XA) (281) 483-2630

1. Title of Effort: FY15 EISD Operational Services

2. Date of Request: 11/13/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 12/01/2014 and ends 09/30/2015.

5. Product Requirements

5.1 Operational Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide the Exploration Integration and Science (EIS) Directorate operational services for (1) Information Technology (IT) security plans, documentation and services; and (2) proposal concept and development services.

5.1.1 IT Security Services

Project Code:

1. Develop and maintain EISD Security Plans and supporting documentation.
2. Perform duties as the Organizational Computer Security Official Representative (OCSO-R) and coordinate with the Organizational Computer Security Official (OCSO). Write the Plan of Action and Milestones (POA&M) or Risk Acceptances for vulnerabilities that cannot be resolved within the NASA-defined time frame. The Contractor shall be responsible for closing identified vulnerabilities and POA&Ms in a timely manner.
3. Oversee the implementation of IT policy and procedural standards and verify that the application of these standards is consistent with the interests of EISD. Where required, write waivers to policies that cannot be implemented upon specific systems within EISD, track them through the approval process, and verify their continued need on an annual basis.
4. Provide 24/7 on-call support for all security-related incidents which may adversely affect EISD. Upon detection of notification of a potential security issue, notify the JSC IT Security Office.

5.1.2 Proposal Concept and Development Services

Project Code:

1. Develop and maintain Mission proposal development processes, checklists, algorithm, and templates to ensure compliance with the proposal development guidelines and adherence to the proposal schedule requirements.
2. Provide proposal integration services for science and engineering sections, including technical editing, graphics services and development of the proposal master schedule.
3. Support special projects to investigate new EISD opportunities, such as:
 - o Science and analytical services for Mission concepts to specifically address small bodies as they are strong potential targets for future human exploration. Specific scientific services shall include data analysis from remote sensing of small bodies via ground- and space-based sensors, laboratory analyses of analog small body materials, and resource utilization of small body materials for exploration purposes, presentations of findings at technical interchange meetings and conferences.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

5.1.1 IT Security Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarterly

5.1.2 Proposal Concept and Development Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

TD-12	Delivery Acceptance Report	1/Quarterly
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d. Products

5.1.1 IT Security Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

5.1.2 Proposal Concept and Development Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

e. Product Verification

5.1.1 IT Security Services	
i. Delivery Acceptance Report (per DRD TD-12)	
- NASA TMR and TMR/Alternate of Delivery Acceptance Report	

5.1.2 Proposal Concept and Development Services	
i. Delivery Acceptance Report (per DRD TD-12)	
- NASA TMR and TMR/Alternate of Delivery Acceptance Report	

6. Task Order Funding

FAR 52.232-22 - Limitation of Funds (Apr 1984)

(a) The parties estimate that performance of this contract will not cost the Government more than

(1) the estimated cost specified in the task order or,

(2) if this is a cost-sharing contract, the Government's share of the estimated cost specified in the task order.

The Contractor agrees to use its best efforts to perform the work specified in the task order and all obligations under this contract within the estimated cost, which, if this is a cost-sharing contract, includes both the Government's and the Contractor's share of the cost.

(b) The task order specifies the amount presently available for payment by the Government and allotted to this contract, the items covered, the Government's share of the cost if this is a cost-sharing contract, and the period of performance it is estimated the allotted amount will cover. The parties contemplate that the Government will allot additional funds incrementally to the contract up to the full estimated cost to the Government specified in the task order, exclusive of any fee. The Contractor agrees to perform, or have performed, work on the contract up to the point at which the total amount paid and payable by the Government under the contract approximates but does not exceed the total amount actually allotted by the Government to the contract.

(c) The Contractor shall notify the Contracting Officer in writing whenever it has reason to believe that the costs it expects to incur under this contract in the next 60 days, when added to all costs previously incurred, will exceed 75 percent of

(1) the total amount so far allotted to the contract by the Government or,

(2) if this is a cost-sharing contract, the amount then allotted to the contract by the Government plus the Contractor's corresponding share.

The notice shall state the estimated amount of additional funds required to continue performance for the period specified in the task order.

(d) Sixty days before the end of the period specified in the task order, the Contractor shall notify the Contracting Officer in writing of the estimated amount of additional funds, if any, required to continue timely performance under the contract or for any further period specified in the task order or otherwise agreed upon, and when the funds will be required.

(e) If, after notification, additional funds are not allotted by the end of the period specified in the task order or another agreed-upon date, upon the Contractor's written request the Contracting Officer will terminate this contract on that date in accordance with the provisions of the Termination clause of this contract. If the Contractor estimates that the funds available will allow it to continue to discharge its obligations beyond that date, it may specify a later date in its request, and the Contracting Officer may terminate this contract on that later date.

(f) Except as required by other provisions of this contract, specifically citing and stated to be an exception to this clause --

(1) The Government is not obligated to reimburse the Contractor for costs incurred in excess of the total amount allotted by the Government to this contract; and

(2) The Contractor is not obligated to continue performance under this contract (including actions under the Termination clause of this contract) or otherwise incur costs in excess of --

(i) The amount then allotted to the contract by the Government or;

(ii) If this is a cost-sharing contract, the amount then allotted by the Government to the contract plus the Contractor's corresponding share, until the Contracting Officer notifies the Contractor in writing that the amount allotted by the Government has been increased and specifies an increased amount, which shall then constitute the total amount allotted by the Government to this contract.

(g) The estimated cost shall be increased to the extent that

(1) the amount allotted by the Government or,

(2) if this is a cost-sharing contract, the amount then allotted by the Government to the contract plus the Contractor's corresponding share, exceeds the estimated cost specified in the task order.

If this is a cost-sharing contract, the increase shall be allocated in accordance with the formula specified in the task order.

(h) No notice, communication, or representation in any form other than that specified in subparagraph (f)(2) above, or from any person other than the Contracting Officer, shall affect the amount allotted by the Government to this contract. In the absence of the specified notice, the Government is not obligated to reimburse the Contractor for any costs in excess of the total amount allotted by the Government to this contract, whether incurred during the course of the contract or as a result of termination.

(i) When and to the extent that the amount allotted by the Government to the contract is increased, any costs the Contractor incurs before the increase that are in excess of --

(1) The amount previously allotted by the Government or;

(2) If this is a cost-sharing contract, the amount previously allotted by the Government to the contract plus the Contractor's corresponding share, shall be allowable to the same extent as if incurred afterward, unless the Contracting Officer issues a termination or other notice and directs that the increase is solely to cover termination or other specified expenses.

(j) Change orders shall not be considered an authorization to exceed the amount allotted by the Government specified in the task order, unless they contain a statement increasing the amount allotted.

(k) Nothing in this clause shall affect the right of the Government to terminate this contract. If this contract is terminated, the Government and the Contractor shall negotiate an equitable distribution of all property produced or purchased under the contract, based upon the share of costs incurred by each.

(l) If the Government does not allot sufficient funds to allow completion of the work, the Contractor is entitled to a percentage of the fee specified in the task order equaling the percentage of completion of the work contemplated by this contract.

(End of Clause)

NFS 1852.232-81 – Contract Funding (Jun 1990)

(a) For purposes of payment of cost, exclusive of fee, in accordance with the Limitation of Funds clause, the total amount allotted by the Government to this contract is \$80,073. This allotment is for JSC Engineering, Technology and Science (JETS) efforts at NASA/JSC and covers the following estimated period of performance: December 3, 2014 through September 30, 2015.

(b) An additional amount of \$4,927.00 is obligated under this contract for payment of fee.

(End of Clause)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA52T TO# 169	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015 & 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: ARES DRAGONS

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,811,563	\$1,811,563

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small> Dig tally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=ccgaspard, cn=CHRISTIAN GASPARD Date: 2014.12.18 15:50:21 -0600 </small> Signature: _____ Date: 12/18/14 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA52T-TO169

Originator: SUSAN RUNCO (KX) (281) 244-8848 **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY15 ARES DRAGONS

2. Date of Request: 12/01/2014

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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 (BRDF) -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

d. 2.2.4 Training

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

e. 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.

f. 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.

g. 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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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, Descent, 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.

m. **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.

n. **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.

o. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 12/08/2014 and ends 09/30/2016.

5. Product Requirements

5.1 Design, Fabricate and Test DRAGONS for ISS Deployment

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall perform tasks associated with the Debris Resistive Acoustic Grid Orbital NASA-Navy Sensor (DRAGONS) flight instrument development including mechanical and electrical design, fabrication, verification and validation, and certification testing for deployment on the International Space Station. They shall provide related documents in accordance with the requirements stated in the ARES DRAGONS Development Plan (KX-OD-005) and in accordance with applicable documents - controlled per ARES Configuration Control Process. Deliverable products are listed in the Specific Product Requirements section.

5.1.1 DRAGONS Instrument Development Products

Project Code:

DRAGONS Instrument Development Products include:

- Electrical & Mechanical Designs: The contractor shall develop and maintain electrical & mechanical designs per KX-OD-005.
- Tailored Products to support Program Required Reviews (CDR/PDR) per KX-OD-005.
- DRAGONS Unit Delivery per KX-OD-005.
- Test and Analysis per KX-OD-005
- Safety Review per KX-OD-005
- Flight Unit Delivery per KX-OD-005
- Project Complete/Closeout items and reports per KX-OD-005
- Budget,Schedule, Deliverables Report (per DRD TD-12) per KX-OD-005

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011

NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
KA-INF-001	ARES Infrastructure Maintenance and Operations	Rev 1, 6/1/2014
KA-WI-001	ARES Master Work Instruction	Rev 5, 6/1/2012
KA-WI-002	ARES Configuration Management	Rev 3, 3/15/2012
KX-OD-005	ARES DRAGONS Development Plan	Orig, 11/25/2014

c. **Required DRDs**

5.1.1 DRAGONS Instrument Development Products		
DRD #	DRD Title	Quantity/Frequency
TD-12	Delivery Acceptance Report	1/Quarter

d. **Products**

5.1.1 DRAGONS Instrument Development Products		
Product(s)	Quantity	Delivery Date
Electrical & Mechanical Designs:	per KX-OD-005	per KX-OD-005
Tailored Products to support Program Required Reviews (CDR/PDR)	per KX-OD-005	per KX-OD-005
DRAGONS Unit Delivery	per KX-OD-005	per KX-OD-005
DRAGONS Test and Analysis	per KX-OD-005	per KX-OD-005
DRAGONS Safety Review	per KX-OD-005	per KX-OD-005
DRAGONS Flight Unit Delivery	per KX-OD-005	per KX-OD-005
DRAGONS Project Complete/Closeout items and reports	per KX-OD-005	per KX-OD-005
Budget,Schedule, Deliverables Report (per DRD TD-12)	1/quarter	end of quarter

e. **Product Verification**

5.1.1 DRAGONS Instrument Development Products	
i. Electrical & Mechanical Designs:	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
ii. Tailored Products to support Program Required Reviews (CDR/PDR)	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
iii. DRAGONS Unit Delivery	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
iv. DRAGONS Test and Analysis	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
v. DRAGONS Safety Review	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
vi. DRAGONS Flight Unit Delivery	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
vii. DRAGONS Project Complete/Closeout items and reports	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	
viii. Budget,Schedule, Deliverables Report (per DRD TD-12)	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 3
Task Order Number: NNJ15HA53T TO# 170		Revision Number: Base		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Advanced Crew Exercise System Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$145,960	\$145,960

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.12 08:26:54 -05'00'</small> Signature: _____ Date: 5/12/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA53T-TO170

Originator: ELISABETH MOORE (ER3) (281) 483-8780 **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY15 Advanced Crew Exercise System Services

2. Date of Request: 04/22/2015

3. Statement of Work Task Description

a. **1.1 Management**

b. **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.

c. **2.3 Analysis and Assessment**

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/12/2015 and ends 09/30/2015.

5. Product Requirements

5.1 Engineering Services to Support ER3 Advanced Crew Exercise at JSC

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services to support ER3 Advanced Crew Exercise System's activities to advance exercise system technology for exploration. These services include but are not limited to providing experienced exercise systems subject matter expertise, preparing and publishing lessons learned papers, evaluating and providing feedback, supporting strategic roadmap development, and providing proposals with scope, cost and schedules related to new hardware development.

In compliance with the above identified SOW(s), the contractor shall provide subject matter expertise to support and provide inputs to advanced exercise systems engineering and technology reviews. The contractor shall develop lessons learned papers related to exercise systems to capture insights learned in areas such as sparing, on-orbit operations, on-orbit maintenance, reliability, and wear items. The contractor shall develop cost, schedule and technical proposals and develop visual concepts (concepts potentially including prototype or physical model development) for new hardware designs as requested.

1. Provide consulting Subject Matter Expertise of lessons learned from JSC CMS experience on STS, ISS exercise devices.
2. Write papers on Lessons Learned involving sparing, reliability, operations, maintenance, and wear items.
3. Develop proposals with cost and schedule as related to new hardware development.

The contractor shall provide monthly Technical, Cost, and Schedule Review (TCSR) for this task.

5.1.1 Advanced Crew Exercise Systems Services and Management

Project Code:

The contractor shall provide a quantity of 3 papers according to the schedule which will be provided through Technical Direction within three weeks of ATP.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.1.1 Advanced Crew Exercise Systems Services and Management		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

d. Products

5.1.1 Advanced Crew Exercise Systems Services and Management		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Lessons Learned Papers	3	To be provided by Technical Direction, but prior to end of period of performance

e. Product Verification

5.1.1 Advanced Crew Exercise Systems Services and Management	
i. Lessons Learned Papers	
- Review and Acceptance of Final Papers by ER3 Adv. Crew Exercise Systems TO Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 3
Task Order Number: NNJ15HA54T TO# 171		Revision Number: Base		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.L.miller@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Docking Hatch

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$332,274	\$332,274

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.		Name: Christian C. Gaspard	
Name: _____		CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=ccgaspard, cn=CHRISTIAN GASPARD Date: 2015.02.26 07:44:20 -0600</small>	
Signature: _____ Date: _____		Signature: _____ Date: <u>2/26/15</u> Contracting Officer	

JSC Engineering, Technology and Science Contract

NNJ15HA54T-TO171

Originator: JAN YOKLEY (EA311) (281) 483-7581 **TMR:** JAN YOKLEY (EA) (281) 483-7581

1. Title of Effort: FY15 Docking Hatch (LOE)

2. Date of Request: 02/12/2015

3. Statement of Work Task Description

a. **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.

b. **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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 03/01/2015 and ends 09/30/2015.

5. Product Requirements

5.1 Docking Hatch Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of the Docking Hatch. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.1.1 Provide design, analysis, provurement, assembly and testing support for the Docking Hatch

Project Code:

Provide design, stress/pressure/v bration/dynamics analyses, procurement, assembly, and testing of the Docking Hatch Leak/Pressure/Vacuum/Vibration Test Fixture.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

5.1.1 Provide design, analysis, provurement, assembly and testing support for the Docking Hatch		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As needed.

- d. **Products**

5.1.1 Provide design, analysis, provurement, assembly and testing support for the Docking Hatch		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

- e. **Product Verification**

5.1.1 Provide design, analysis, provurement, assembly and testing support for the Docking Hatch	
i. LOE	
- - As approved by the Docking Hatch Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA55T TO# 172	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 EA Directorate Facility Management

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$317,304	\$317,304

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Christian C. Gaspard**

CHRISTIAN GASPARD

Digitally signed by CHRISTIAN GASPARD
DN: c=US, o=U.S. Government, ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN
GASPARD
Date: 2015.05.21 14:36:28 -05'00'

Signature: _____ Date: **5/21/2015**
Contracting Officer

JSC Engineering, Technology and Science Contract

NNJ15HA55T-TO172

Originator: SAMUEL DAUGHERTY (EA2) (281) 483-7304 **TMR:** JAN YOKLEY (EA) (281) 483-7581

1. Title of Effort: FY15 EA Directorate Facility Management

2. Date of Request: 04/17/2015

3. Statement of Work Task Description

a. 2.4 Facilities

b. 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.

c. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/22/2015 and ends 09/30/2015.

5. Product Requirements

5.1 Facility Management Requirements

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide day-to-day facility management for all EA Directorate facilities identified in attachment A per the facility management requirements in JWI 8831.1 and JPR 1700.1, and the additional requirements identified in this TO. This includes all utilities, building envelope, mechanical rooms, engineering research facilities, labs, machine shops, offices, working high bay overhead cranes and forklifts, controlled access areas and storage facilities. Consumables, equipment and other products required to accomplish these activities shall be coordinated with the Divisions that are responsible for the affected building/area.

Standard facility management tasks, that span the EA Directorate facilities, are included but not limited to the list below.

1. Ensure buildings are maintained in a safe, comfortable and productive environment and ensure safety and health information is communicated to all building occupants. Ensure daily occupant safety during construction activities, asbestos work, utility outages, radiation test, etc. Respond to chemical spills and blood borne pathogens, investigate, contact appropriate authorities and provide clean-up oversight as necessary. Coordinate with building occupants, Center Institutional and Industrial Safety and Health and Center Operations Directorate (COD), as required, to resolve building related safety and health issues.
2. Perform regular safety inspections per the requirements of JWI 8831.1 and JPR 1700.1. Develop inspection schedules, in coordination with the Division(s) that are responsible for the building or facility being inspected, and provide inspection schedules to the responsible Directorate Safety contact for development of a Directorate wide inspection schedule. Correct findings immediately, submit appropriate work orders or develop and implement corrective actions. Enter room/area inspections into the Building Inspection Tracking System (BITS) database and submit items to the Hazard Action Tracking System (HATS) that cannot be corrected within 30 days or lack sufficient funding.
3. Serve as the building Chief Fire Warden, coordinate with other building Fire Wardens, respond to fire alarms, maintain fire alarm reports, and train building occupants in safe evacuation procedures. Stay informed and keep other Fire Wardens informed of modifications, constraints, fire alarm outages and or any activity that might affect the evacuation of the building. Accompany Fire Technicians on annual fire protection audits, as notified.
4. Ensure Emergency Action Plans (EAPs), Hurricane and Severe Weather Plans and building Fire Evacuation Plans (FEPs) are in-place, updated as required and used.
5. Maintain training in the maintenance and use of the building AEDs. Coordinate to have AED operators in designated buildings. Perform weekly inspection of AEDs, record inspections and report discrepancies to the JSC AED Coordinator.
6. Review and concur, if required, Building, Lab and Shop Hazard Analysis for risk to employees and visitors, including physical hazards, chemical locations, utilities, OSHA compliance, fire safety, etc.
7. Investigate and provide resolution to close calls and mishaps, as requested by Division Management.
8. Coordinate preparations for VPP audits and attend/support OSHA VPP inspections upon notification.
9. Ensure hazardous material storage and disposal are maintained per the requirements and quarterly inventories are accurately and timely maintained.
10. Coordinate and approve, when required, Lock-out Tag-out (LOTO), Do Not Use, Hot Work, and Confined Space Entry permits. Ensure OSHA-permit required confined spaces and JSC-permit required confined spaces in buildings are properly identified and labeled. Maintain records as required.
11. Ensure crane, forklift, pallet jack and other equipment is maintained and has the proper certifications for use.
12. Ensure eye wash stations are inspected and flushed as required.
13. Review electrical panel schedules, floor plans, air handler floor plans and project and test schedules and coordinate/negotiate planned electrical or utility outages with center operations directorate, project and test personnel and inform building occupants of upcoming outages.
14. Maintain awareness of building asbestos containing material and inform maintenance personnel and building occupants when necessary to prevent employee exposure. Request air sampling as needed, receive notifications of findings and recommendations after indoor air quality investigations and submit appropriate work orders to fix indoor air quality issues.
15. Periodically have potable water tested for bacteria and heavy metals, review reports and take action if needed.
16. Attend audits and maintain records for inspections, Environmental Audits, Occupational Health Audits, Fire

Evacuations, Etc.

17. Serve as the building point of contact regarding disability accommodation requests and coordinate with the JSC Facility Manager Coordinator and the Office Equal Opportunity and Diversity.
18. Participate in all User Readiness Reviews (URRs) and Test Readiness Reviews (TRRs) that have impacts to the building facility manager's area of responsibility.
19. Perform work document initiation, review, coordination, in-process control, and close-out actions (Includes WAD coordination for the EA Directorate Office). Review and approve cost estimates, plans, safety requirements and environmental concerns, prior to initiation of work. Coordinate with Division funding authorization manager to ensure proper funds are used and authorized.
20. Schedule projects and coordinate work with contractors and building occupants to ensure job completion and personnel safety.
21. Ensure/maintain environmental compliance.
22. Be available 24-hours a day, 7 days a week by cell phone or alternate means of communication to help resolve emergency conditions that may arise in the building.
23. Approve/provide access to facility off-hours. Ensure building security access requirements are in-place and used. If requested by the respective Division, address key requests, cipher lock code approvals/distribution/change needs and provide building zoning and ID Max card reader authorizations.
24. Maintain awareness of pest control activity and inform building occupants when necessary.
25. Serve as the POC between Division/Directorate and the facilities contractor for building custodial and grounds issues
26. Serve as the POC between Division/Directorate and facilities contractor for energy conservation issues (lighting schedules, air handler schedules, etc.)
27. Support other audits, walkthroughs, inspections, as directed by Division/Directorate Management (Environmental Functional Review (EFR); Institutional Facility and Operational (IFO) audits; Deferred Maintenance walkthroughs, etc.
28. Assist the Division Emergency Planning Representative and Damage Assessment Team Member (DATM), as requested.
29. Develop Lab/Conference Room floor plans as directed by Division Management and manage and oversee implementation.
30. Serve as POC between Division/Directorate and Riggers for rigging support in building.
31. Serve as Division/Directorate POC for special events in the building.
32. Notify the responsible Division Management by email, within 8 hours, of all incidents in buildings occupied by their employees/contractors. Email shall contain time, location, and a brief description of the incident and the current status.
33. Coordinate tour requests as requested by the respective Division point of contact.
34. If requested by a Division, coordinate bike repairs, maintain bike inventory, look for missing bikes as appropriate and file reports with security when needed.

5.1.1 Facility Management Products

Project Code:

Facility Management products are made from Monthly Status Reports. The Monthly Status Reports shall be per zone and shall include the following topics:

1. Accomplishments for the reporting period (to include, but not limited to, list of inspections conducted (audits, safety walkthroughs, etc.), User Readiness Reviews (URRs) and Test Readiness Reviews (TRRs))
2. One month look ahead
3. List of incidents that occurred in the subject zone for the reporting period

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
Attachment A	EA Directorate Facility Management Coverage Matrix	Feb 2015
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JWI-8831.1	Facility Manager Program	Rev A, Sept 2014

c. **Required DRDs**

5.1.1 Facility Management Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

d. **Products**

5.1.1 Facility Management Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	12	10th of each month

e. **Product Verification**

5.1.1 Facility Management Products	
i. Monthly Status Report	
- The above stated product shall be verified through review at scheduled periodic status meetings with NASA Division and Directorate personnel	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA56T TO# 173	Revision Number: 2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Miniature Exercise Device (MED-2)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$341.904	\$31.578	\$373.482

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Lawrence Miller Signature: LAWRENCE MILLER <small>Digital y signed by LAWRENCE MILLER DN: c=US, o=U.S. Government, ou=NASA ou=People, cn=LAWRENCE MILLER 6/9/2015 10:20:00 100 1 1 + + mll42 Date: 2015.09.15 14:58:12 -0500</small> Contracting Officer Date: <u>9/15/2015</u>
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JSC Engineering, Technology and Science Contract

NNJ15HA56T-TO173 R2

Originator: FERNANDO ZUMBADO (ER5) TMR: JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

Revision 2 includes the extension of the Period of Performance through 11/30/15. Additional hours are being added to continue the tasks described in paragraph 5.1.1. In addition, the proposed revision adds scope to include support for hardware testing and verification closure for certification.

1. FROM Title of Effort: FY15 Miniature Exercise Device (MED-2) (LOE) Updated R2

1. Title of Effort: FY16/15 Miniature Exercise Device (MED-2) (LOE)

2. Date of Request: 08/31/2015

3. Statement of Work Task Description

a. 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~~ ~~Safety 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.

b.

4. Period of Performance Updated R2

The period of performance does not commence until the CO has granted authorization to proceed.

FROM:

This task order period of performance starts 03/03/2015 and ends 09/30/2015.

TO:

This task order period of performance starts 03/03/2015 and ends 11/30/2015.

5. Product Requirements

5.1 Miniature Exercise Device

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and design services in support of the assessment of the Miniature Exercise Device (MED-2). The NASA-led design effort will lead to an advanced exercise device design of a compact electromechanical unit following the new Class 1-E hardware designation. The MED-2 will be delivered for launch and used on the International Space Station to test candidate designs for inclusion in the Orion capsule. The MED-2 project is part of the Center's 2x2015 effort to develop, fly and test hardware on ISS.

5.1.1 Engineering Support Updated R2

Project Code:

FROM:

The contractor shall provide support in the development of the following:

- Actuation Design and Concept
- Structural Design Concept and Loads Analysis
- Computer Architecture Description
- Forward Development Plan for building a working prototype and Cost Estimate

As part of the design concept assessment, the contractor shall provide support in developing rapid-prototype conceptual parts and procurement of materials and other non-labor resources as necessary, but not to exceed the value authorized by the contracting officer. The Materials to procure include, but are not limited to, electric motors, encoders, absolute position sensors and other electromechanical sensors necessary for the actuator development. In addition the contractor shall provide support for procuring machined parts as designed by the project and material finishing.

TO:

The contractor shall provide support in the development of the following:

- Actuation Design and Concept
- Structural Design Concept and Loads Analysis
- Computer Architecture Description
- Verification of System Requirements and Hardware Testing
- Forward Development Plan for building a working prototype and Cost Estimate

As part of the design concept assessment, the contractor shall provide support in developing rapid-prototype conceptual parts and procurement of materials and other non-labor resources as necessary, but not to exceed the value authorized by the contracting officer. The Materials to procure include, but are not limited to, electric motors, encoders, absolute position sensors and other electromechanical sensors necessary for the actuator development. In addition the contractor shall provide support for procuring machined parts as designed by the project and material finishing. To aid in the certification of the hardware, the contractor shall provide support for hardware testing and closure of system verifications.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
IPC-2221	Generic Standard on Printed Board Design	Rev A, May 2003
IPC-6011	Generic Performance Specification for Printed Boards	Jul. 1996
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NASA-STD-8739.1	Workmanship Standard for Polymeric Application on Electronic Assemblies	Rev. A, Mar. 2008 Chg. 2, Mar. 2011
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses, and Wiring	Baseline, Feb. 1998 Chg. 6, Mar-2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPR 9501.2	NASA Contractor Financial Management Reporting	Rev. E
JPD 2800.4	JSC Information Technology (IT) Program Management	03-2001
JPG 2800.3	JSC Information Technology Product Implementation Guidelines, Requirements, and Standards	Original 09-1997
MIL-STD-882	Standard Practice for System Safety	Dev D/02-02
NASA-STD-8739.2	Surface Mount Technology	08-1999
NASA-STD-8739.3	Soldered Electrical Connection	12-1997
NPD-9501.1	NASA Contractor Financial Management Reporting System	Rev G/05-00
NPR 8715.3	NASA Safety Manual	Change 1/06-02
NPR-8621.1	NASA Procedural Requirements for Mishap Reporting, Investigating, and Record keeping	Rev A/02-04
NSTS 22206	Requirements for Preparation and Approval of Failure Modes and Effects Analysis (FMEA) and Critical Item List (CIL)	Rev D 12-2001
NT-CWI-001	Task Performance Sheet (TPS)	Rev C/ 07-2008
NT-CWI-003	Quality Assurance Record Center Discrepancy Reporting and Tracking	Rec C 11-2006

c. Required DRDs

5.1.1 Engineering Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.1.1 Engineering Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
N/A - LOE TO	0	N/A - LOE TO

e. Product Verification

5.1.1 Engineering Support	
i. N/A - LOE TO	
- N/A - LOE TO	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA57T TO# 174	Revision Number: R2	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Valkyrie Production for the University of Edinburgh

Task Order Contract Type: Cost Plus Award Fee – Completion Form


Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$1,144,452	\$426,578	\$1,571,030

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Signature:  Date: 9/21/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA57T-TO174 R2

Originator: JARED WOODFILL (ER7) TMR: JARED WOODFILL (ER) (281) 483-6331

Revision Summary:

This revision adds funding and scope to extend the Period of Performance (POP) from the end of FY15 to the end of the Fiscal Month for February of FY16. Electrical and mechanical engineering services will shift between design, testing, and integration of Valkyrie robotic subsystems at the technical direction of the NASA project manager. Project administration services will also continue in support of: non-labor material procurement, IT support, and safety management.

1. FROM Title of Effort: FY15 Valkyrie Production for the University of Edinburgh Updated R2

1. Title of Effort: FY16/15 Valkyrie Production for the University of Edinburgh

2. Date of Request: 08/27/2015

3. Statement of Work Task Description

a. 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.

b. 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 (BRDF)~~ ~~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~~

c.

4. Period of Performance Updated R2

The period of performance does not commence until the CO has granted authorization to proceed.

FROM:

This task order period of performance starts 04/01/2015 and ends 09/30/2015.

TO:

This task order period of performance starts 04/01/2015 and ends 02/26/2016.

5. Product Requirements

5.1 Updated R2

FROM: Project Valkyrie Build Services

TO: Valkyrie Production for the University of Edinburgh (GFY 2015-2016)

- a. **FROM: Requirement** - In compliance with the above identified SOW(s) the contractor shall provide core engineering and design services to satisfy the requirements as described in ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015) Services Requirements document and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD).

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of this IPT, the contractor shall provide technical R&D services for the above robotic technologies/project(s). This specific IPT consists of Civil Servants and other contractors. Overall project management is provided by a cognizant ER Civil Servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Product requirement for this TO are tied directly to the funding levels of the project as a whole. Several separate funding allotments are expected to impact this TO. These funding allotments will not have definitive dates associated with them; hence, additional funding will be added to the TO via revisions to the TO. The contractor shall not, at any point during the period of performance of this TO, exceed the current contract value.

* In compliance with the above identified SOW(s) the contractor shall provide Core Engineering and design services for the ongoing development of Project Valkyrie in the Robotic Systems Technology Branch. Core engineering and design services will be in the areas of Mechanical, Electrical and software in accordance with ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015).

* In compliance with the above identified SOW(s) the contractor shall provide technical services for the procurement, buildup, and integration of parts and subcomponents as needed towards the production of one Valkyrie robot for the University of Edinburgh in Scotland. Procurement and technician services shall be performed as required by the Robotic Systems Technology Branch in accordance with ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015).

* In compliance with the above identified SOW(s) The contractor shall provide supplemental cost account reporting, per DRD RV-02, for each specific WBS. Cost reporting shall be provided to the Robotic Systems Technology Branch as well as the WBS manager. Shared services as required by the Robotic Systems Technology Branch in accordance with ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015) include facility management of B36, IT, Safety management, and Lab management.

* In compliance with the above identified SOW(s) the contractor shall provide electrical, mechanical, and software engineering support services for the testing and verification towards the production of one Valkyrie robot for the University of Edinburgh in Scotland. Testing and Integration shall be provided as required by the Robotic Systems Technology Branch in accordance with ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015).

TO: Requirement - In compliance with the above identified SOW(s) the contractor shall provide core engineering and design services to satisfy the requirements as described in ER4-TM174 Valkyrie Production for the University of Edinburgh (GFY2015-2016) Services Requirements document and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD).

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of this IPT, the contractor shall provide technical R&D services for the above robotic technologies/project(s). This specific IPT consists of Civil Servants and other contractors. Overall project management is provided by a cognizant ER Civil Servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Product requirements for this TO are tied directly to the funding levels of the project as a whole. Several separate funding allotments are expected to impact this TO. These funding allotments will not have definitive dates associated with them; hence, additional funding will be added to the TO via revisions to the TO. The contractor shall not, at any point during the period of performance of this TO, exceed the current contract value. Updated R2

5.1.1 Updated R2

FROM: Project Valkyrie Build Services

TO: Valkyrie Production for the University of Edinburgh

Project Code: NA

FROM:

TO:

In support of the Valkyrie project, the contractor shall provide the following per ER4-TM174 Va kyrie Production for the University of Edinburgh (GFY2015-2016):.

- Engineering Core and Design Services
- Manufacturing Services
- Technical Services
- Cost Account Management
- Lab/IT Management
- Testing and Analysis Support

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER4-TM174 Deleted R2	Master Plan and Schedule	Original
ER4-TM174 Added R2	Master Plan and Schedule	Revision One
JPR 2310.1	JSC Organizational Learning Program	May 8, 2008

c. Required DRDs

5.1.1 Valkyrie Production for the University of Edinburgh		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
FROM:		
RV-02	Regular Status Report/Summary Review	Monthly by 15th of month
TO:		
RV-02 Updated R2	Regular Status Report/Summary Review	Monthly

d. Products

5.1.1 Valkyrie Production for the University of Edinburgh		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
FROM:		
Monthly Status Report (RV-02)	One	One per month by 15th

TO:		
Monthly Status Report (RV-02)	One	Monthly Updated R1
Implementation of ER4-TM174 Deleted R2	One Deleted R1	as per ER4-TM174 R1 Deleted R1

e. **Product Verification**

5.1.1 Valkyrie Production for the University of Edinburgh	
i. Monthly Status Report (RV-02)	
- SR&SD Robotics Technology Branch Review, Witness, and acceptance of engineering data	
ii. Implementation of ER4-TM174 Deleted R2	
- SR&SD Robotics Technology Branch Review, Witness, and acceptance	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA07T TO# 175	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ER3 Exercise Countermeasures System Services(157)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,704,906	\$3,704,906

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Signature: ROCHELLE OVERSTREET Date: 2015.09.29 14:09:18 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA58T-TO175 BASE

Originator: VI TRUONG (ER3) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 ER3 Exercise Countermeasures System Services (TO157)

2. Date of Request: 09/09/2015

3. Statement of Work Task Description

a. 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 JETST Technical Library and specified on each task order.

b. 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.

c. 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.

d. 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

e. **2.2.4 Training**

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

f. **2.3 Analysis and Assessment**

g. **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.

h. **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.

i. **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.

j. **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.

k.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ISS Countermeasures System Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support on-orbit operations and ground operations as defined in the subsequent paragraph.

The contractor shall deliver flight performance engineering analysis, assessments, and products for flight hardware failure resolution, engineering products for flight hardware and ground support hardware design changes, and engineering products to support ISS Program Office engineering, planning, and operational decisions for the following ISS CHeCS CMS projects per ER3-TM175-FY16 Exercise Countermeasures System (CMS) Products Plan).

1. Cycle Ergometer with Vibration Isolation & Stabilization (CEVIS) System
2. Blood Pressure/Electrocardiogram Device (BP/ECG)
3. Second Generation Heart Rate Monitor (HRM2)
4. Advanced Resistive Exercise Device (ARED)

In compliance with the above identified SOW(S) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) Countermeasures System (CMS) to support for the following CHeCS CMS projects:

1. Countermeasures System (CMS) Resupply
2. CMS Trainer Maintenance
3. CMS Strategic Plan

Also, the Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT) the contractor shall provide technical R&D services for the ER3/CMS. The IPT is made up of Civil Servants, and contractor employees. Overall Project Management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of the task order which follows and may include: software development, preparing flight hardware, mechanical design, and other specified in the requirements which follow.

5.1.1 ISS Countermeasures System Services

Project Code:

Contractor shall provide engineering support to sustain the following ISS projects: CEVIS, BP/ECG, HRM2 and ARED. Both standard sustaining engineering of flight hardware and logistics and maintenance support of this flight hardware shall be provided. Also, the contractor shall maintain the CMS Trainer hardware and shall develop new exercise hardware concepts and/or related technologies.

b. Applicable Documents

Document Number	Document Name	Rev.
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs

5.1.1 ISS Countermeasures System Services		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	1 per month

RV-02	Regular Status Report/Summary Review	1 per month
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d. **Products**

5.1.1 ISS Countermeasures System Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Engineering products and services as detailed in ER3-TO175-FY16	AR	Per attached ER3-TO175-FY16

e. **Product Verification**

5.1.1 ISS Countermeasures System Services	
. Engineering products and services as detailed in ER3-TO175-FY16	
- Product and service verifications as detailed in ER3-TO175-FY16	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ15HA59T TO# 176	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Lawrence Miller Tel No.: 281-483-3916 E-mail: Lawrence.l.miller@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY15 Innovation Charge Account (ICAs)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$35,000	\$35,000

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Christian C. Gaspard CHRISTIAN GASPARD <small>Digitally signed by CHRISTIAN GASPARD DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=cgaspard, cn=CHRISTIAN GASPARD Date: 2015.05.21 15:33:15 -05'00'</small> Signature: _____ Date: 5/21/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA59T-TO176

Originator: JEFFERSON DUTTON (EA211) (281) 483-2841

TMR: JEFFERSON DUTTON (EA5) (281) 483-2841

1. Title of Effort: FY15 Innovation Charge Account (ICAs)

2. Date of Request: 05/15/2015

3. Statement of Work Task Description

a. 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.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 05/18/2015 and ends 09/30/2015.

5. Product Requirements

5.1 High Performance Mars Liquid Cooling Garment

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall perform investigations of the following concepts:

EVA space suit mobility in micro-gravity is enough of a challenge and in the gravity of Mars, improvements in mobility will enable the suited crew member to efficiently complete EVA objectives. The idea proposed is to improve thermal efficiencies of the liquid cooling garment in the torso area in order to free up the arms and legs by removing the liquid tubes currently used in the ISS EVA suit in the limbs. By using small water tubes that greatly increase the contact area with the skin in the torso region of the body, the heat transfer efficiently can be increased to provide the entire cooling requirement and increase mobility by freeing up the arms and legs. Additional benefits of this approach include reduced LCVG mass, enhanced evaporation cooling, increased comfort during Mars EVA tasks, and easing of the overly dry condition of in the helmet associated with the current Advanced EMU ventilation loop.

5.1.1 High Performance Mars Liquid Cooling Garment

Project Code:

The contractor shall use its best efforts to perform the work specified below and all obligations under this CLIN within the estimated cost of \$10,000.

The contractor shall deliver sample small tube LCVG sections, test results, and calculations that will evaluate the thermal performance of these sections relative to sections representing the ISS EMU LCVG tube geometries. Test based efficiencies shall be calculated and the surface area requirement shall be calculated that meets the full LCVG heat transfer requirement. The contractor shall perform evaluations to evaluate the compatibility of this concept with the current Advanced Space Suit technology development configurations. The contractor shall deliver a report that discusses how the test results and calculations will scale up performance to the full LCVG sizing and evaluate the success of this effort.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
n/a	n/a	n/a

c. Required DRDs

5.1.1 High Performance Mars Liquid Cooling Garment		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		n/a

d. Products

5.1.1 High Performance Mars Liquid Cooling Garment		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Poster presentation for ICA event	1	October 2015

e. Product Verification

5.1.1 High Performance Mars Liquid Cooling Garment	
i. Poster presentation for ICA event	
- Confirmation of submission of poster	

5.2 Simulation of Parachutes Inflatable Habs & Modules

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall investigations of the following concepts:

Major mass reduction opportunities exist when spacecraft and habitation modules are built as inflatables instead of conventional composite or metallic hard structure. These inflatables as well as parachutes used for spacecraft descent and landing use softgood straps and tether cords extensively. Sophisticated analytical finite element analysis techniques exist to model metallic and composite structure but those that model softgoods and straps are very rudimentary. Safety margins of metallic links and structure that are tethered to are dependent on the loads transferred by such softgoods straps. Their elasticity and ability to adequately transfer loading to the metallic parts become critical to avoid the use of excessive safety factors that result in overdesign. This ICA proposes to develop methodology to simulate soft good straps in finite element analysis. This will address structural analysis blind spots discovered in the Orion parachute system modeling and simulations and extend to inflatable spacecraft and habitats.

5.2.1 Simulation of Parachutes Inflatable Habs & Modules

Project Code:

The contractor shall use its best efforts to perform the work specified below and all obligations under this CLIN within the estimated cost of \$10,000.

The contractor shall perform investigations into developing a methodology to simulate soft good straps in finite element analysis. The contractor shall provide a final report which documents the methodologies, sample analytical models, and other reports which substantiate the effort.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
n/a	n/a	n/a

c. Required DRDs

5.2.1 Simulation of Parachutes Inflatable Habs & Modules		
DRD #	DRD Title	Quantity/Frequency
None		n/a

d. Products

5.2.1 Simulation of Parachutes Inflatable Habs & Modules		
Product(s)	Quantity	Delivery Date
Poster presentation for ICA event	1	October 2015

e. Product Verification

5.2.1 Simulation of Parachutes Inflatable Habs & Modules	
i. Poster presentation for ICA event	
- Confirmation of submission of poster	

5.3 Humanoid Flight Metabolic Simulator

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall investigations of the following concepts:

NASA's Evolvable Mars Campaign (EMC) has identified several areas of technology that will require significant improvements in terms of performance, capacity, and efficiency, in order to make a manned mission to Mars possible. These include crew vehicle Environmental Control and Life Support System (ECLSS), EVA suit Portable Life Support System (PLSS) and Information Systems, autonomous environmental monitoring, radiation exposure monitoring and protection, and vehicle thermal control systems (TCS). (MADMACS) in a Suit can be configured to simulate human metabolism, consuming crew resources (oxygen) in the process. In addition to providing support for testing Life Support on unmanned flights, MADMACS will also support testing of suit thermal controls, and monitor radiation exposure, body zone temperatures, moisture, and loads

5.3.1 Humanoid Flight Metabolic Simulator

Project Code:

The contractor shall use its best efforts to perform the work specified below and all obligations under this CLIN within the estimated cost of \$10,000.

The contractor shall deliver a full-scale, low fidelity mockup of MADMACS in a Suit and a final report. The final report shall include human factors specifications related to metabolism, and full technical specifications of down-selected technologies. This lighter-weight mockup will provide a platform for demonstrating the technological capabilities that could be provided by such a system. Finally, the contractor shall develop a presentation to explain the investigation, existing technologies, specified components, areas of science and human factors supported and studied, and finally options for further development toward a flight qualified unit.

b. Applicable Documents

Document Number	Document Name	Rev.
n/a	n/a	n/a

c. Required DRDs

5.3.1 Humanoid Flight Metabolic Simulator		
DRD #	DRD Title	Quantity/Frequency
None		n/a

d. Products

5.3.1 Humanoid Flight Metabolic Simulator		
Product(s)	Quantity	Delivery Date
Poster presentation for ICA event	1	October 2015

e. Product Verification

5.3.1 Humanoid Flight Metabolic Simulator		
i. Poster presentation for ICA event		
- Confirmation of submission of poster		

5.4 EVA Swab Tool Prototype Development

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall investigations of the following concepts:

5.4.1 EVA Swab Tool Prototype Development

Project Code:

The contractor shall use its best efforts to perform the work specified below and all obligations under this CLIN within the estimated cost of \$5,000.

1. Review and provide comment to the NASA developed requirements document
2. Produce and deliver mechanical design of 2 custom swab attachments
 - o 1)Q-tip size and 2) 2x2 or 3x3 cm pad
 - o Design a swab stick that can clamp into the tool attachment, and heat-seal the purchased tip to the other end of the stick or develop a modified COTs swab stick that can clamp into the tool attachment
 - o See assumptions and sketches in supporting documents
3. Mechanical design of a multi-sample storage kit
 - o Based on the tile repair kit tool caddy
 - o Purchase off-the-shelf non-shatterable (Teflon, stainless, etc.), sterilizable sample tubes
 - o Modify/redesign swab stick-to-tube cap/seal as needed
 - o See sketch in supporting documents
4. Perform proof of concept testing in Glove-box
5. Review and provide comments to NASA developed technical report or conference paper

b. Applicable Documents

Document Number	Document Name	Rev.
n/a	n/a	n/a

c. Required DRDs

5.4.1 EVA Swab Tool Prototype Development		
DRD #	DRD Title	Quantity/Frequency
None		n/a

d. Products

5.4.1 EVA Swab Tool Prototype Development		
Product(s)	Quantity	Delivery Date
see above	see above	September 2015

e. Product Verification

5.4.1 EVA Swab Tool Prototype Development
i. see above
- Confirmation of delivery by TO manager

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058		ORDER FOR SUPPLIES OR SERVICES		Page 1 of 9
Task Order Number: NNJ15HD60T TO# 177		Revision Number: Rev 2		Appropriation Data: Funded at Contract
SOW WBS: See Item 3		Fiscal Year(s): 2015 and 2016		Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH4/Ashley Harral Tel No.: 281-792-8314 E-mail: ashley.e.harral@nasa.gov		Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058		Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C.

Title: Orion Crew Survival Systems Hardware

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$831,184	\$36,180	\$867,364

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle N. Overstreet Signature: _____ Date: _____ Contracting Officer
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JSC Engineering, Technology and Science Contract

RFP-TO177 R1BP1

Originator: Dustin Gohmert (EC5) TMR: MARIE KOWAL (EC) (281) 483-8875

Revision Summary:

R2 - Procure 20 ft umbilicals for VPIST 2 testing.

1. FROM Title of Effort: FY15-16, EC5, Orion Crew Survival Systems Hardware Updated Rev 1

1. Title of Effort: FY16/15, EC5, Orion Crew Survival Systems Hardware

2. Date of Request: 10/22/2015

3. Statement of Work Task Description

a. 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.

b.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 06/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Orion Crew Survival Systems Hardware Procurements

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall deliver hardware in compliance with NASA specific part numbers or requirements identified in Section 5.1.1. and subs.

5.1.1 Supply O2 Compatible Smooth Bore Silicone Hoses Updated Rev 1

Project Code:

Supply the following hardware as Class I items.

Item 1) Hose Smooth Bore, Silicone, .75" ID X 96±6.00" (8'), baseline part no.: REDAR A11392-XX. Dash number to be defined by vendor based on unique 8' length. Quantity: 8

Item 2) Hose Smooth Bore, Silicone, .75" ID X 96±6.00" (13'), baseline part no.: REDAR A11392-XX. Dash number to be defined by vendor based on unique 13' length. Quantity: 8

5.1.2 Supply Modified ACES Suit Components Added Rev 1

Project Code:

Supply the following Modified ACES suit hardware as Class I/II items:

Qty	P/N	Nomenclature
1	40169G-01LHAK0	RESTRAINT ASSY, S/R
1	40169G-01LHAZ0	RESTRAINT ASSY, M/R
5	AL24744(15255P-01)	Neck Ring Lip Seal, Inner
5	AL24743(15254P-01)	Neck Ring Lip Seal, Outer
1	40232G-01BHAAL	GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE A
1	40232G-01BHAAR	GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE A
1	40232G-01BHBBL	GLOVE BLADDER ASSY, ACES, SIZE B, LEFT HAND
1	40232G-01BHBRR	GLOVE BLADDER ASSY, ACES, SIZE B, RIGHT HAND
1	40401G-01ZZBBL	GLOVE ASSY, OUTER, SIZE B, LEFT
1	40401G-01ZZBBR	GLOVE ASSY, OUTER, SIZE B, RIGHT
1	40232G-01BHEEL	GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE E
1	40232G-01BHEER	GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE E
1	40232G-01BHKKL	GLOVE BLADDER ASSEMBLY, ACES, LEFT HAND, SIZE K
1	40232G-01BHKKR	GLOVE BLADDER ASSEMBLY, ACES, RIGHT HAND, SIZE K
1	40232G-01BHLLL	GLOVE BLADDER ASSEMBLY, ACES, SIZE L, LEFT HAND
1	40232G-01BHLLR	GLOVE BLADDER ASSY, ACES, SIZE L, RIGHT HAND

5.1.3 Supply Modified ACES Suit-to-ECLSS Connector Hardware Updated R1BP1

Project Code:

FROM:

Supply the following Modified ACES suit hardware as Class I/II items:

QTY	Part No.	Description
12	27037-1 (14234P-01)	Exhaust CW Outer Connector S/A
12	27038-1 (14233P-02)	Inlet CCW Outer Connector S/A
12	27040-1 (14235P-01)	Inlet Single Inner Connector S/A
12	27043-1 (14239P-01)	Exhaust Cage Inner Connector S/A
12	10504-01 (14231P-01)	Inlet 90 Poppeted Umbilical Connector Assy
12	10505-01 (14232P-01)	Exhaust 90 Poppeted Umbilical Connector Assy

TO:

Supply the following Modified ACES suit hardware as Class I/II items:

QTY	Part No.	Description
12	27037-1 (14234P-01)	Exhaust CW Outer Connector S/A
12	27038-1 (14233P-02)	Inlet CCW Outer Connector S/A
12	27040-1 (14235P-01)	Inlet Single Inner Connector S/A
12	27043-1 (14239P-01)	Exhaust Cage Inner Connector S/A
12	10504-01 (14231P-01)	Inlet 90 Poppeted Umbilical Connector Assy
12	10505-01 (14232P-01)	Exhaust 90 Poppeted Umbilical Connector Assy

5.1.4 Supply 20' Silicone Smooth Bore Hose Added R1BP1

Project Code:

Supply the following umbilicals as Class I/II Items:

Item	Part Number	Description	QTY
1	A11392-XX(TBD)	Hose, Smooth Bore, Silicone, .75" ID x 240+/-11" (20 ft approx)	8

b. Applicable Documents

Document Number	Document Name	Rev.
N/A	No Title Entered	

c. Required DRDs

5.1.1 Supply O2 Compatible Smooth Bore Silicone Hoses		
DRD #	DRD Title	Quantity/Frequency

None Deleted Rev 1		NA
None Added Rev 1		NA

5.1.2 Supply Modified ACES Suit Components		
DRD #	DRD Title	Quantity/Frequency
None Added Rev 1		NA

5.1.3 Supply Modified ACES Suit-to-ECLSS Connector Hardware		
DRD #	DRD Title	Quantity/Frequency
None Added Rev 1		NA

5.1.4 Supply 20' Silicone Smooth Bore Hose		
DRD #	DRD Title	Quantity/Frequency
None Added R1BP1		NA

d. Products

5.1.1 Supply O2 Compatible Smooth Bore Silicone Hoses		
Product(s)	Quantity	Delivery Date
A11392-(TBD based on 8' length)	8	30 JUN 2016
A11392-(TBD based on 13' length)	8	30 JUN 2016

5.1.2 Supply Modified ACES Suit Components		
Product(s)	Quantity	Delivery Date
40169G-01LHAK0 RESTRAINT ASSY, S/R Added Rev 1	1 Added Rev 1	30 JUN 2016
40169G-01LHAZ0 RESTRAINT ASSY, M/R Added Rev 1	1 Added Rev 1	30 JUN 2016
AL24744(15255P-01) Neck Ring Lip Seal, Inner Added Rev 1	5 Added Rev 1	30 JUN 2016
AL24743(15254P-01) Neck Ring Lip Seal, Outer Added Rev 1	5 Added Rev 1	30 JUN 2016
40232G-01BHAAL GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE A Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHAAR GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE A Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHBBL GLOVE BLADDER ASSY, ACES, SIZE B, LEFT HAND Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHBBL GLOVE BLADDER ASSY, ACES, SIZE B, RIGHT HAND Added Rev 1	1 Added Rev 1	30 JUN 2016
40401G-01ZZBBL GLOVE ASSY, OUTER, SIZE B, LEFT Added Rev 1	1 Added Rev 1	30 JUN 2016

40401G-01ZZBBR GLOVE ASSY, OUTER, SIZE B, RIGHT Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHEEL GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE E Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHEER GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE E Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHKKL GLOVE BLADDER ASSEMBLY, ACES, LEFT HAND, SIZE K Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHKKR GLOVE BLADDER ASSEMBLY, ACES, RIGHT HAND, SIZE K Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHLLL GLOVE BLADDER ASSEMBLY, ACES, SIZE L, LEFT HAND Added Rev 1	1 Added Rev 1	30 JUN 2016
40232G-01BHLLR GLOVE BLADDER ASSY, ACES, SIZE L, RIGHT HAND Added Rev 1	1 Added Rev 1	30 JUN 2016

5.1.3 Supply Modified ACES Suit-to-ECLSS Connector Hardware		
Product(s)	Quantity	Delivery Date
27037-1 (14234P-01), Exhaust CW Outer Connector S/A Added Rev 1	12 Added Rev 1	30 JUL 2016
27038-1 (14233P-02), Inlet CCW Outer Connector S/A Added Rev 1	12 Added Rev 1	30 JUL 2016
27040-1 (14235P-01), Inlet Single Inner Connector S/A Added Rev 1	12 Added Rev 1	30 JUL 2016
27043-1 (14239P-01), Exhaust Cage Inner Connector S/A Added Rev 1	12 Added Rev 1	30 JUL 2016
10504-01 (14231P-01), Inlet 90 Poppeted Umbilical Connector Assy Added Rev 1	12 Added Rev 1	30 JUL 2016
10505-01 (14232P-01), Exhaust 90 Poppeted Umbilical Connector Assy Added Rev 1	12 Added Rev 1	30 JUL 2016

5.1.4 Supply 20' Silicone Smooth Bore Hose		
Product(s)	Quantity	Delivery Date
P/N: A11392-XX(TBD), Hose, Smooth Bore, Silicone, .75 Added R1BP1	8 Added R1BP1	30 SEP 2016

e. Product Verification

5.1.1 Supply O2 Compatible Smooth Bore Silicone Hoses	
i. A11392-(TBD based on 8' length)	
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.	
ii. A11392-(TBD based on 13' length)	
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.	

5.1.2 Supply Modified ACES Suit Components

i. 40169G-01LHAK0 RESTRAINT ASSY, S/R

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

ii. 40169G-01LHAZ0 RESTRAINT ASSY, M/R

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

iii. AL24744(15255P-01) Neck Ring Lip Seal, Inner

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

iv. AL24743(15254P-01) Neck Ring Lip Seal, Outer

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

v. 40232G-01BHAAL GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE A

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

vi. 40232G-01BHAAR GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE A

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

vii. 40232G-01BHBBL GLOVE BLADDER ASSY, ACES, SIZE B, LEFT HAND

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

viii. 40232G-01BHBBL GLOVE BLADDER ASSY, ACES, SIZE B, RIGHT HAND

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

ix. 40401G-01ZZBBL GLOVE ASSY, OUTER, SIZE B, LEFT

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

x. 40401G-01ZZBBR GLOVE ASSY, OUTER, SIZE B, RIGHT

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

xi. 40232G-01BHEEL GLOVE BLADDER ASSY, ACES, LEFT HAND, SIZE E

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

xii. 40232G-01BHEER GLOVE BLADDER ASSY, ACES, RIGHT HAND, SIZE E

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

xiii. 40232G-01BHKKL GLOVE BLADDER ASSEMBLY, ACES, LEFT HAND, SIZE K

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

xiv. 40232G-01BHKKR GLOVE BLADDER ASSEMBLY, ACES, RIGHT HAND, SIZE K

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable.

Added Rev 1

xv. 40232G-01BHLLL GLOVE BLADDER ASSEMBLY, ACES, SIZE L, LEFT HAND

Added Rev 1

- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
xvi. 40232G-01BHLLR GLOVE BLADDER ASSY,ACES,SIZE L,RIGHT HAND Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1

5.1.3 Supply Modified ACES Suit-to-ECLSS Connector Hardware
i. 27037-1 (14234P-01), Exhaust CW Outer Connector S/A Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
ii. 27038-1 (14233P-02), Inlet CCW Outer Connector S/A Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
iii. 27040-1 (14235P-01), Inlet Single Inner Connector S/A Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
iv. 27043-1 (14239P-01), Exhaust Cage Inner Connector S/A Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
v. 10504-01 (14231P-01), Inlet 90 Poppeted Umbilical Connector Assy Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1
vi. 10505-01 (14232P-01), Exhaust 90 Poppeted Umbilical Connector Assy Added Rev 1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added Rev 1

5.1.4 Supply 20' Silicone Smooth Bore Hose
i. P/N: A11392-XX(TBD), Hose, Smooth Bore, Silicone, .75 Added R1BP1
- Delivery to NASA EC5 per JSC-528 or 1149 as applicable. Added R1BP1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ15HA61T TO# 178	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EC5 Crew Survival Engineering Support (TO143)(LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,233,062	\$2,233,062

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/23/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rnovers
t, cn=ROCHELLE OVERSTREET
Date: 2015.09.23 17:13:35 -0500

JSC Engineering, Technology and Science Contract

NNJ15HA61T-TO178 BASE

Originator: Dustin Gohmert (EC5) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 EC5 Crew Survival Engineering Support (TO143) (LOE)

2. Date of Request: 09/02/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Crew Survival Engineering Support

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s)the contractor shall Perform sustaining engineering servicesincluding, but not limited to project engineering, test, and documentation necessary to conduct daily operationswithin the Space Suit and Crew Survivability SystemsLaboratory in compliance with JSC 47745, "Standard Operating Proceduresfor the CELSE Laboratory." Thisincludesustaining engineering necessary to support equipment and configuration, documentation revision requirementsand procedure development for new and modified hardware, and failure analysisof Orion Crew Survival Systemsincluding Advanced Crew Escape Suit Systems, modified ACES, Orion Crew Seats, manned Neutral Buoyancy Laboratory (NBL) Events, ECLSS Pressure Integrated Systems Testing (PIST) and Vacuum Integrated Systems Testing (VPIST). The contractor shall provide engineering and technical services for: the modification to the NASA owned Dual Suit Controller (DSC); the modification of the Modified Advanced Crew Escape Suit (MACES); overhaul of a NASA owned oxygen regulator; and preparations and support of the Vacuum Pressure Integrated Suit Test (VPIST).

5.1.1 FY16 Crew Survival Engineering Support

Project Code:

The contractor shall provide engineering services including, but not limited to project engineering, design, test, analysis, fabrication, inspection and documentation necessary to conduct daily operations within the CELSE laboratory in compliance with JSC 47745, "Standard Operating Procedures for the CELSE Laboratory." This includes, but is not limited to sustaining engineering of the suit and suit hardware test operations, documentation and procedure development for new and modified hardware, and failure analysis. Appropriate hardware includes, but is not limited to Orion Crew Survival Systems, Advanced Crew Escape Suit Systems and Components, Modified Advanced Crew Escape Suit Systems, Support of Required Events and additional hardware Include: a) launch/entry suit development tasks for Orion b) launch/entry suit integration and test for Orion ECLSS c) Orion Crew Seats and Survival Subsystems d) Commercial suits, seats, and/or crew survival activities as defined by EC technical leads e) NASA Architecture and trade studies involving L/E suits and EVA related modifications. The CELSE Laboratory is a government managed laboratory and the contractor shall provide services necessary for on-going projects for the ORION program and associated training/evaluation events.

b. Applicable Documents

Document Number	Document Name	Rev.
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
CTSD-ADV-1001	Standard Operating Procedure for the Crew Escape Equipment Test Stand	Current
CTSD-ADV-1034	Modified ACES Overhaul Inspection & Fabrication Procedures	Current
CTSD-ADV-1045	Interface Control Drawing for Neural Buoyancy Laboratory	Current
CTSD-ADV-1046	Hazard Assessment for Neutral Buoyancy Laboratory	Current
CTSD-ADV-911	CELSE Lab Modified ACES Configuration Description Control Document	Current
CTSD-SH-1289 (JSC 39185)	Integrated Hazard Analysis for the Crew Escape and Life Support Equipment Laboratory, Building 7A	Current
CTSD-SH-1402 (JSC 47743)	Standard Operating Procedure for the CELSE Test Stand	Current
CTSD-SH-2056	Hazard Analysis for the Life Support Equipment Test Stand Building 7A	Current
CTSD-SH-2064	Modified Advanced Crew Escape Suit Testing Procedures	Current
CTSD-SH-2067	Hazard Analysis for Advanced Crew Escape Suit (ACES) & Modified ACES Testing/Evaluations	Current
EA-023	Project Management of GFE Flight Projects	Current
ES4-10-042A	Operation and Configuration Control Plan (OCCP) for Safe Ground Pressurization of Advanced Crew Escape Suit	Current
JSC 47745	Standard Operating Procedure for CELSE Laboratory	Current

L50-M00010	Advanced Crew Escape Suit(ACES) Derivative Ground Support Hardware Configuration/Integration Drawing	Current
L50-M00011	Advanced Crew Escape Suit Testing Drawing	Current
L50-M00012	Carbon Monoxide Washout Testing Configuration	Current

c. Required DRDs

5.1.1 FY16 Crew Survival Engineering Support		
DRD #	DRD Title	Quantity/Frequency
None		0/NA

d. Products

5.1.1 FY16 Crew Survival Engineering Support		
Product(s)	Quantity	Delivery Date
none	0	N/A

e. Product Verification

5.1.1 FY16 Crew Survival Engineering Support	
. none	
- No product verification for "none" deliverables	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA07T TO# 179	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Astromaterials Curation

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,519,242	\$3,519,242

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnover st, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA62T-TO179 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Astromaterials Curation (TO69)

2. Date of Request: 09/01/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 09/28/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Astromaterials Curation

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide specialized science, engineering, and technical products for the Astromaterials Acquisition and Curation Office as detailed in the specific product and service requirements and deliverables defined in the Astromaterials Curation Work Plan, XI2-AC-001:

Readiness and Functionality (2.0)
Capabilities (3.0)
Curation Products and Services (4.0)

* New/Returned Sample Processing and Inventories

- Lunar Sample Collections
- Meteorite Collection
- Genesis Solar Wind Collection
- Stardust Collections
- Cosmic Dust Collection
- Hayabusa Collections
- Space Exposed Hardware
- OSIRIS-REx Collections
- Future Collections

* Data Center and Informatics

* Advanced Curation

Communications, Education and Outreach (5.0)

Future Mission Planning (6.0)

Product Deliverables and Verification (7.0)

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process. No flight products are required.

5.1.1 Astromaterials Curation Products

Project Code:

Specific product and service requirements and deliverables are defined in the Astromaterials Curation Work Plan, XI2-AC-001

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPD 7100.10E	Curation of Extraterrestrial Materials	02/11/2003, Revalidated 01/10/2008
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Orig., 05/04/2015
XI-WI-001	ARES Master Work Instruction	Orig
XI-WI-002	ARES Configuration Management	Orig
XI2-001-CM	Astromaterials Acquisition and Curation Office Configuration Management	Orig
XI2-AC-001	ARES Astromaterials Curation Work Plan	Orig., 08/06/2015
XI2-WI-001	Process for Astromaterials Curation	Orig

c. Required DRDs

5.1.1 Astromaterials Curation Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

TD-12	Delivery Acceptance Report	1/Quarter/Quarterly
-------	----------------------------	---------------------

d. Products

5.1.1 Astromaterials Curation Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products defined in XI2-AC-001	1/Quarter	Quarterly

e. Product Verification

5.1.1 Astromaterials Curation Products	
i. Delivery Acceptance Report (per DRD TD-12) on products defined in XI2-AC-001	
- NASA TM and TMR/alternate approval of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ15HA63T TO# 180	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Astromaterials Research (TO#180)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,002,624	\$3,002,624

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **9/29/15**
Contracting Officer

Digitally signed by ROCHELLE
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DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
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t, cn=ROCHELLE OVERSTREET
Date: 2015.09.29 19:56:03 -0500

JSC Engineering, Technology and Science Contract

NNJ15HA63T-TO180 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Astromaterials Research (135)

2. Date of Request: 09/10/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m. **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.

n.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Astromaterials Research

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform the research identified in Section 5.1.1 and in accordance with referenced documents, controlled per ARES Configuration Control Process. The contractor shall provide services and invitational travel for visiting scientists and researchers when so requested by ARES. The contractor shall enhance NASA ARES competitiveness and quality of science via external collaborations, writing proposals, and pursuing resources from other relevant entities. No flight products will be required. Materials used for completion of research as identified in X13-AR-001 ARES Astromaterials Research Plan, shall be authorized by XI Project Directives approved by the XI TMR.

5.1.1 Astromaterials Research Initiatives

Project Code:

Perform the research outlined in the research plans listed in the following sections contained in document X13-AR-001 ARES Astromaterials Research Plan. Maintenance and Operations for the Astromaterials Research facilities is defined in the ARES Infrastructure task order and in XI-INF-001 ARES Infrastructure Maintenance and Operations Plan

Readiness (2.0), Capabilities and Systems Development (3.0), Research Areas (4.0), Organic Geochemistry (4.1), Experimental Petrology (4.2), Experimental Impact Research (4.3), Mars Research (4.4), Isotopes, Geochemistry, and Geochronology (4.5), Interplanetary Dust, Stardust, & Primitive Materials (4.6), Lunar Research (4.7), Astromaterials Projects (4.8), External Communications (5.0), Research Development (6.0), Product Deliverables and Verification (7.0)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Rev 1, 10/01/2015
XI-WI-001	ARES Master Work Instruction	Orig, 10/2015
XI-WI-002	ARES Configuration Management	Orig, 10/2015
XI-WI-003	ARES Management of Research Proposals	Orig, 10/2015
X13-001-CM	Office of Astromaterials Research Configuration Management Process	Orig, 10/2015
X13-AR-001	ARES Astromaterials Research Plan	Rev 1, 10/01/2015

c. Required DRDs

5.1.1 Astromaterials Research Initiatives		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Astromaterials Research Initiatives		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery/Acceptance Report (per DRD TD-12) on products identified in X3-AR-001	1/Quarter	Quarterly

e. Product Verification

5.1.1 Astromaterials Research Initiatives
i. Delivery/Acceptance Report (per DRD TD-12) on products identified in X3-AR-001
- NASA TM and TMR approval of Delivery/Acceptance Report

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ15HA65T TO# 182	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Orbital Debris(TO122)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,506,414	\$3,506,414

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnoverst, cn=ROCHELLE OVERSTREET Date: 2015.09.24 16:43:42 -0500 Signature: _____ Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA65T-TO182 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Orbital Debris(TO122)

2. Date of Request: 09/10/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m. **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.

n. **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.

o.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Orbital Debris Research

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall perform orbital debris research and provide related documents in accordance with the requirements stated in the ARES Orbital Debris Research & Science Operations Plan (X14-OD-004) and in accordance with applicable documents - controlled per ARES Configuration Control Process. Deliverable products are listed in the Specific Product Requirements section of X14-OD-004. No flight products are provided by this Task Order

5.1.1 Orbital Debris Research Products and Services

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide specialized science, engineering, and technical products for the Orbital Debris Project Office as detailed in the specific product and service requirements and deliverables defined in the Orbital Debris Research and Science Operations Plan, X14-OD-004:

- Readiness (2.0)
- Capabilities and System Development (3.0)
- Products (4.0)
 - Research and Development (4.1)
 - Tools (4.2)
 - Measurement Products (4.3)
 - Operational Products (4.4)
- External Communications (5.0)
- Evolution and Business Development (6.0)
- Product Deliverables and Verification (7.0)

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPR 8621.1	NASA Procedure Requirements for Mishap Reporting, Investigating, and Record Keeping	Rev B Ch7; 07/15/2013
XI-INF-001	ARES Infrastructure Maintenance and Operations	Rev 1, 10/01/2015
XI-WI-001	ARES Master Work Instruction	Orig, 10/2015
XI-WI-002	ARES Configuration Management	Orig, 10/2015
X14-001-CM	ARES Office of Exploration Science Configuration Management Process	Orig, 10/2015
X14-OD-004	ARES Orbital Debris Research & Science Operations Plan	Orig, 09/09/2015

c. Required DRDs

5.1.1 Orbital Debris Research Products and Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Orbital Debris Research Products and Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-OD-004	1/Quarter	Quarterly

e. **Product Verification**

5.1.1 Orbital Debris Research Products and Services	
. Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-OD-004	
. NASA TM and TMR approval of Delivery/Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ15HA66T TO# 183	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Hypervelocity Impact Technology & Risk Assessment (TO123)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,327,462	\$2,327,462

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Signature: ROCHELLE OVERSTREET Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA66T-TO183 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Hypervelocity Impact Technology & Risk Assessment (TO123)

2. Date of Request: 09/08/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m. **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.

n. **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.

o.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Hypervelocity Impact Research

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide hypervelocity impact test and risk analyses, and provide related documents in accordance with the requirements stated in the ARES Hypervelocity Impact Technology (HVIT) Group Work Plan (XI-HVIT-001) and in accordance with applicable documents - controlled per ARES Configuration Control Process. Deliverable products are listed in the Specific Product Requirements section. No flight products are provided by this Task Order.

5.1.1 Hypervelocity Impact Research Products

Project Code:

The contractor shall provide specialized science, engineering, and technical products for the Hypervelocity Impact Technology (HVIT) Group as detailed in the specific product and service requirements and deliverables defined in the ARES Hypervelocity Impact Technology Group Work Plan, XI-HVIT-001:

Readiness (2.0)

Capabilities and Systems Development (3.0)

Products (4.0)

- Hypervelocity Impact Testing (4.1)
- MMOD Impact Risk Assessment (4.2)
- MMOD Risk Assessment Tool Development (4.3)
- Post-Flight MMOD Impact Inspection (4.4)
- Impact Computer Simulation Development (4.5)
- Advanced Research (4.6)
-

External Communications and Public Outreach (5.0)

Evolution and Business Development (6.0)

Product Deliverables and Verification (7.0)

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process. No flight products are required.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPR 8621.1	NASA Procedure Requirements for Mishap Reporting, Investigating, and Record Keeping	Rev B Ch 7; 7/15/2013
XI-HVIT-001	ARES Hypervelocity Impact Technology Group Work Plan	Orig., 09/1/2015
XI-HVIT-002	ARES BUMPER Configuration Management Plan	Orig, 09/08/2015
XI-HVIT-003	ARES BUMPER Micro-Meteoroid and Orbital Debris (MMOD) Risk Assessment Process	Orig., 09/08/2015
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Orig., 05/04/2015
XI-WI-001	ARES Master Work Instruction	Orig.
XI-WI-002	ARES Configuration Management	Orig.

c. Required DRDs

5.1.1 Hypervelocity Impact Research Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. **Products**

5.1.1 Hypervelocity Impact Research Products		
Product(s)	Quantity	Delivery Date
Delivery/Acceptance Report (per DRD TD-12) on products identified in XI-HVIT-001	1/Quarter	Quarterly

e. **Product Verification**

5.1.1 Hypervelocity Impact Research Products	
. Delivery/Acceptance Report (per DRD TD-12) on products identified in XI-HVIT-001	
- NASA TM and TMR approval of Delivery/Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA67T TO# 184	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Image Science and Analysis (TO124)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,470,143	\$2,470,143

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover, st, cn=ROCHELLE OVERSTREET Date: 2015.09.23 20:58:16 -0500 Signature: _____ Date: 9/23/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA67T-TO184 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Image Science and Analysis(TO124)

2. Date of Request: 08/27/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. 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.

f. 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.

g. **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.

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Image Science and Analysis

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide image science and analysis as identified in Section 5.1.1 and in accordance with referenced documents, controlled per ARES Configuration Control Process. The contractor shall provide engineering image analysis services for the International Space Station (ISS), Orion, Commercial Crew and Cargo Program Office (C3PO) programs and other external customers. No flight products will be required. Materials used for conducting image science and analysis as identified under XI-INF-001 shall be authorized in accordance with XI-WI-001 ARES Master Work Instruction.

5.1.1 Image Science and Analysis Services

Project Code:

Perform image science and analysis services as outlined in the categories listed in the following sections of the document XI-IA-002 Image Science and Analysis Group Work Plan:

Readiness - Section 2.0

Capabilities and Systems Developments - Section 3.0

Products and Services - Section 4.0

- International Space Station - Section 4.1
- Commercial Space Flight - Section 4.2
- Orion Multi-Purpose Crew Vehicle - Section 4.3
- Commercial Development through SAAs - Section 4.4

External Communications - Section 5.0

Evolution and Business Development - Section 6.0

Product Deliverables and Verification - Section 7.0

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping	Rev B Ch7; 07/15/2013
SPKA0005	Information Technology Security Plan Image Science and Analysis Laboratory Astromaterials Research and Exploration Science (ARES)	1/25/2013
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Orig., 05/04/2015
XI-WI-001	ARES Master Work Instruction	Orig
XI-WI-002	ARES Configuration Management	Orig
XI4-001-CM	Office of Exploration Science Configuration Management Process	Orig
XI4-IA-001_COFR	JSC Image Science and Analysis Facilities CoFR Plan	Orig
XI4-IA-002	Image Science and Analysis Group Work Plan	Orig., 08/11/2015

c. Required DRDs

5.1.1 Image Science and Analysis Services		
DRD #	DRD Title	Quantity/Frequency
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 Image Science and Analysis Services		
Product(s)	Quantity	Delivery Date
Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-IA-002	1/Quarter	Quarterly

e. Product Verification

5.1.1 Image Science and Analysis Services	
i. Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-IA-002	
- NASA TM and TMR approval of Delivery/Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA68T TO# 185	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Remote Sensing Operations and Science

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,090,517	\$1,090,517

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover st, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/23/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA68T-TO185 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Remote Sensing Operations and Science (TO75)

2. Date of Request: 08/27/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

h. **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.

i. **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.

j. **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.

k.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ARES Remote Sensing Operations & Science Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide Earth Science and Remote Sensing services in accordance with the XI4-RS-001 ARES Remote Sensing Operations & Science Plan. Deliverable Products are listed in section 7.0 of XI4-RS-001. No flight hardware or software services are provided by this Task Order.

5.1.1 Remote Sensing Operations & Science Services and Products

Project Code:

The contractor will perform the services described in XI4-RS-001:

2.0 Readiness

- 2.1 Management
- 2.2 Facility Readiness
- 2.3 Document and Data Readiness
- 2.4 Organizational Readiness

3.0 Capabilities

4.0 Products and Services

- 4.1 ISS Program Science Office Support
- 4.2 Crew Earth Observations Facility
- 4.3 ISS Remote Sensing Team Interface
- 4.4 Regional Remote Sensing

5.0 Communications and Outreach

- 5.1 External Communications
- 5.2 Public Outreach

6.0 Development

7.0 Product Deliverables and Verification

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Orig., 05/04/2015
XI-WI-001	ARES Master Work Instruction	Orig
XI-WI-002	ARES Configuration Management	Orig
XI4-001-CM	ARES Office of Exploration Science Configuration Management Process	Orig.
XI4-RS-001	ARES Remote Sensing Operations & Science Plan	Orig., 10/01/2015

c. Required DRDs

5.1.1 Remote Sensing Operations & Science Services and Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. **Products**

5.1.1 Remote Sensing Operations & Science Services and Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-RS-001	1/Quarter	Quarterly

e. **Product Verification**

5.1.1 Remote Sensing Operations & Science Services and Products	
i. Delivery/Acceptance Report (per DRD TD-12) on products identified in XI4-RS-001	
- NASA TM and TMR approval of Delivery/Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ15HA64T TO# 186	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ARES Infrastructure Maintenance and Operations (TO76)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$4,253,763	\$4,253,763

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover st, cn=ROCHELLE OVERSTREET ROCHELLE OVERSTREET Signature: _____ Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA64T-TO186 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XI) (281) 244-8848

1. Title of Effort: FY16 ARES Infrastructure Maintenance and Operations(TO76)

2. Date of Request: 09/08/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

h. **2.6 Special Projects**

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

i.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ARES Infrastructure Maintenance and Operations

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide ARES Infrastructure Maintenance and Operations services as defined in the ARES Infrastructure Maintenance and Operations Plan, XI-INF-001, outlined in section 5.1.1.

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services

Project Code:

The contractor shall provide ARES Infrastructure Maintenance and Operations products and services as defined in the ARES Infrastructure Maintenance and Operations Plan, XI-INF-001, outlined in the sections below.

1.0 Introduction

2.0 Facility and Organizational Readiness

3.0 Capabilities and Systems Development

4.0 Products and Services

4.1 Facility Management

4.2 Facility Engineering

4.3 Technical Services

4.4 Safety and Occupational Health

4.5 Environmental Services

4.6 Scientific Instrument Service Contracts

4.7 IT Services

4.8 ARES Processes and Document Management

5.0 External Communications and Public Outreach

6.0 Business Development & Special Projects

7.0 Product Deliverables and Verification

All products and services shall be delivered in accordance with applicable documents - controlled per ARES Configuration Control Process. No flight products are required.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011
XI-INF-001	ARES Infrastructure Maintenance and Operations Plan	Rev 1, 10/01/2015

XI-WI-001	ARES Master Work Instruction	Original, 10/2015
XI-WI-002	ARES Configuration Management	Original, 10/2015
XI-WI-003	ARES Management of Research Proposals	Original, 10/2015

c. Required DRDs

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12) on products identified in XI-INF-001	1/Quarter	Quarterly

e. Product Verification

5.1.1 ARES Infrastructure Maintenance and Operations Products and Services	
. Delivery Acceptance Report (per DRD TD-12) on products identified in XI-INF-001	
- NASA TM and TMR/Alternate approval of Delivery Acceptance Report	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA02T TO# 187	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EISD Operational Services (TO168)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$150,399	\$150,399

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Rochelle Overstreet</p> <p>ROCHELLE OVERSTREET</p> <p>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.30 14:50:29 -0500</p> <p>Signature: _____ Date: 9/30/15</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ16HA02T-TO187 BASE

Originator: SUSAN RUNCO (XI) **TMR:** SUSAN RUNCO (XA) (281) 244-8848

1. Title of Effort: FY16 EISD Operational Services (TO168)

2. Date of Request: 09/03/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. 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.

f. **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.

g. **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.

h.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 EISD Operational Services

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide the Exploration Integration and Science (EIS) Directorate operational services for (1) Information Technology (IT) security plans, documentation and services; (2) Engineering and Science Integration Mission Proposal Concept and Development Services, (3) Communication and Outreach Services, and (4) Engineering Visualization Services.

5.1.1 IT Security Services

Project Code:

1. Develop and maintain EISD Security Plans and supporting documentation.
2. Perform duties as the Organizational Computer Security Official Representative (OCSO-R) and coordinate with the Organizational Computer Security Official (OCSO). Write the Plan of Action and Milestones (POA&M) or Risk Acceptances for vulnerabilities that cannot be resolved within the NASA-defined time frame. The Contractor shall be responsible for closing identified vulnerabilities and POA&Ms in a timely manner.
3. Oversee the implementation of IT policy and procedural standards and verify that the application of these standards is consistent with the interests of EISD. Where required, write waivers to policies that cannot be implemented upon specific systems within EISD, track them through the approval process, and verify their continued need on an annual basis.
4. Provide 24/7 on-call support for all security-related incidents which may adversely affect EISD. Upon detection of notification of a potential security issue, notify the JSC IT Security Office.

5.1.2 Engineering and Science Integration Mission Proposal Concept and Development Services

Project Code:

1. Science and analytical services for the Office of the JSC Chief Scientist. Services to include investigations and plan development for NASA Science Mission Directorate science mission opportunities at JSC.
2. Develop and maintain mission proposal development processes, checklists, algorithms, and templates to ensure compliance with the proposal development guidelines and adherence to the proposal schedule requirements.
3. Provide proposal integration services for science and engineering sections, including technical editing, graphics services and development of the proposal master schedule.
4. Science and analytical services to develop mission concepts to address small bodies as strong potential targets for future human exploration. Shall include data analysis from remote sensing of small bodies via ground- and space-based sensors, laboratory analyses of analog small body materials, and resource utilization of small body materials for exploration purposes, presentations of findings at technical interchange meetings and conferences.

5.1.3 Communication and Outreach Services

Project Code:

1. Provide technical editing for newsletters and publications, web content development, and social media content development for EISD internal and external communications.
2. Provide public outreach materials and presentation media for EISD outreach events including JSC, NASA, conference, and community sponsored events.

5.1.4 Engineering Visualization Services

Project Code:

1. Develop visualization products to enable JSC to assess aerospace systems and architecture concepts associated with NASA-defined mission sets and provide products and services

designed to meet the needs of unique analysis teams under the direction of JSC Concept Analysis Team.

2. Develop and provide the analytical methods and software required to analyze, perform trade studies, archive, and visualize these concept and also identify technology performance requirements.
3. Work openly and collaboratively with a team including partners from different organizations, NASA Centers, and disciplines. All work conducted as part of this contract shall carry only the NASA logo unless otherwise negotiated.
4. Assemble models from various sources, including models created within the LaRC Advanced Concepts Lab and parts created by the contractor or imported from another user, for use in both animation and engineering assessments. Part models may be imported from multiple engineering CAD formats such as ProE, Catia, or Unigraphics.
5. Transfer models between animation software and CAD software and export models to other users at LaRC and JSC.
6. Create and maintain existing and future multimedia database digital products, printed media, presentations, and other collateral material utilizing JSC assets. The contractor shall update these as required by the NASA Technical Point of Contact. The contractor shall deliver a list of the available part models within the multimedia database.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
NPR 2810.1	Security of Information Technology	Rev A, Chg 1 May 2011

c. Required DRDs

5.1.1 IT Security Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

5.1.2 Engineering and Science Integration Mission Proposal Concept and Development Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

5.1.3 Communication and Outreach Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

5.1.4 Engineering Visualization Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-12	Delivery Acceptance Report	1/Quarter/Quarterly

d. Products

5.1.1 IT Security Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

5.1.2 Engineering and Science Integration Mission Proposal Concept and Development Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

5.1.3 Communication and Outreach Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

5.1.4 Engineering Visualization Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Delivery Acceptance Report (per DRD TD-12)	1/Quarter	Quarterly

e. Product Verification

5.1.1 IT Security Services		
i. Delivery Acceptance Report (per DRD TD-12)		
- NASA TM and TMR/Alternate of Delivery Acceptance Report		

5.1.2 Engineering and Science Integration Mission Proposal Concept and Development Services		
i. Delivery Acceptance Report (per DRD TD-12)		
- NASA TM and TMR/Alternate of Delivery Acceptance Report		

5.1.3 Communication and Outreach Services		
i. Delivery Acceptance Report (per DRD TD-12)		
- NASA TM and TMR/Alternate of Delivery Acceptance Report		

5.1.4 Engineering Visualization Services		
i. Delivery Acceptance Report (per DRD TD-12)		
- NASA TM and TMR/Alternate of Delivery Acceptance Report		

6. NFS 1852.232-81 – Contract Funding (Jun 1990)
- (a) For purposes of payment of cost, exclusive of fee, in accordance with the Limitation of Funds clause, the total amount allotted by the Government to this contract is \$51,401.87. This allotment is for JSC Engineering, Technology and Science (JETS) efforts at NASA/JSC and covers the following estimated period of performance: May 1, 2013 through January 15, 2016.
- (b) An additional amount of \$3,598.13 is obligated under this contract for payment of fee.

(End of Clause)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA03T TO #188	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 GFE Design & Sustaining Engineering (TO127)

Task Order Contract Type: Cost Plus Award Fee – Completion Form


Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,513,542	\$1,513,542

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=movers t, cn=ROCHELLE OVERSTREET Signature:  Date: 9/23/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA03T-TO188 BASE

Originator: KEITH GRIMM (EV171) **TMR:** CYNTHIA ZAMORA (EV) (281) 483-0313

1. Title of Effort: FY16 GFE Design & Sustaining Engineering (TO127)

2. Date of Request: 07/30/2015

3. Statement of Work Task Description

a. 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 JET S Technical Library and specified on each task order.

b. 2.2.4 Training

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

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 :ISS GFE Sustaining Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall perform sustaining engineering and new development/ certification as applicable related to ISS GFE Sustaining and the EVA Sustaining Engineering task.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web pag

5.1.1 ISS GFE Sustaining

Project Code: Multiple

The contractor shall provide services and products for tasks listed in JSC 63968 Avionic Systems Division Approved Sustaining Engineering Projects Listing Sections 4, 5, and 6 in accordance with JSC 63950 Avionic Systems Division GFE Sustaining Engineering Requirements and with EV-100 Avionic Systems Division Government Furnished Equipment (GFE) Sustaining Engineering Requirements for Extravehicular Activity (EVA).

The contractor shall provide lab management services for the Sustaining Engineering Lab.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-023	Project Management of GFE Flight Projects	G
EA-WI-025	GFE Flight Project Software and Firmware Development	C
EV-100	Avionic Systems Division GFE Sustaining Engineering Requirements for EVA	A
JSC 26549	Manual for the Control of Program Stock (Receiving, Handling, Storage, Packaging, Preservation, and Delivery of Controlled Flight, Non-Flight, and Ground Support Equipment	C
JSC 63950	Avionic Systems Division GFE Sustaining Engineering Requirements for ISS	I
JSC 63968	Avionic Systems Division Approved Sustaining Engineering Projects Listing	F
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	change 5
SSP 30309	Safety Analysis and Risk Assessment Requirements	E
SSP 30559	Structural Design and Verification Requirements	C
SSP 30599	ISS Safety Review Process	A
SSP 41172	Qualification and Acceptance Environmental Test Requirements	AA
SSP 50021	International Space Station Program Safety Requirements Document	Basic
SSP 50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	B

c. Required DRDs

5.1.1 ISS GFE Sustaining		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-01	Project Schedule	1/monthly
RV-02	Regular Status Report/Summary Review	1/monthly

d. Products

5.1.1 ISS GFE Sustaining

Product(s)	Quantity	Delivery Date
Integrated Microsoft Schedule	1	Monthly
Regular Status Report/ Monthly Review	1	Monthly

e. Product Verification

5.1.1 ISS GFE Sustaining
. Integrated Microsoft Schedule
- Product verification will be obtained via Sustaining Engineering concurrence per JSC 63950
i. Regular Status Report/ Monthly Review
- Product verification will be obtained via Sustaining Engineering concurrence per JSC 63950

5.2 MPCV Avionics

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to MPCV Avionics.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.2.1 MPCV Avionics

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide engineering services in support of the MPCV Command and Data handling (C&DH) System Management (SM). The SM function, as specified in CxP-72088, CEV Systems Engineering Management Plan (SEMP), is the single point of contact for oversight and management of the development of a specific system. The C&DH system includes the Vehicle Management Computer, Power Data Unit, Instrumentation and Orion Data Network. The Contractor shall provide the function of the PDU Subsystem Manager and Developmental Flight instrumentation engineering. These functions shall cover the entire life cycle including feasibility assessments, project definition, requirements, design, production, certification and operations. The Contractor shall participate in the development of the CEV System Requirements Document, CEV to other element Interface Requirements Documents (IRDs) and Interface Control document (ICDS), the CEV avionic architecture definition, and related trade studies. In addition, this function monitors development, schedules and risk, and participates in programmatic support activities such as Requirements Assessment Cycle (RAC), Design Analysis Cycle (DAC), mode teams and other system integration activities and forums. The Contractor shall work with an integrated team of stakeholder disciplines throughout the system development lifecycle involved in the oversight of the contractors' activities. The stakeholder disciplines include flight operations, ground operations, flight crew office, and Safety and Mission Assurance (SMA).

The Contractor shall provide engineering analysis of review documents and presentations and present recommended RIDs at the subsystem design reviews (Project Technical Reviews (PTR), PDRs, CDRs) and spacecraft design reviews (PTR, PDRs, CDRs).

The Contractor shall provide engineering services for the MPCV C&DH SM, MPCV flight computer subsystem management, MPCV Power Data Unit Subsystem management, MPCV instrumentation subsystem management and MPCV Communication & Tracking (C&T) systems engineering and analysis.

The Contractor shall:

1. Provide analysis of system and subsystem requirements as pertaining to the areas above.
2. Provide analysis of the requirement maturation process
3. Assess MPCV documents with consideration to these areas. Generate and work RIDs if required.
4. Perform trade studies (1-3 per year)
5. Provide analysis of information provided all meetings, i.e. team technical interface meetings (TIM)
6. Prepare and present briefings.

The Contractor shall provide resources to evaluate COTS instrumentation systems for potential space flight applications. This will include but may not be limited to market research, trade studies, procurement, hardware setup and operation, and technical evaluation in a development lab environment.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CEV RFP	Statement of Work, Attachment J-1	CCO 124, 2010
CxP-72088	CREW ELPLORATION VEHICLE (CEV) SYSTEMS ENGINEERING MANAGMENT PLAN (SEMP)	C
DRD CEV-B-003	CEV INtegrated Master Schedule (IMS) included in CEV Cost Perofrmance Report	Baseline
MPCV 72000	CEV Systems Requirements Document	Baseline

c. Required DRDs

5.2.1 MPCV Avionics		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/monthly
TD-08	Engineering Analysis	1/monthly

d. Products

5.2.1 MPCV Avionics		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Engineering assessment/RID package, with technical review 1 week prior to life cycle reviews	1 set per lifecycle review	per CEV Integrated Master Schedule, DRD CEV-B-003
Activity report	1	Monthly
Change Request (CR) evaluation form	1	per CR delivery date
Regular Status Report / Monthly Review	1	Monthly

e. Product Verification

5.2.1 MPCV Avionics	
. Engineering assessment/RID package, with technical review 1 week prior to life cycle reviews	
- Branch review and acceptance	
i. Activity report	
- Branch review and acceptance	
ii. Change Request (CR) evaluation form	
- Branch review and acceptance	
v. Regular Status Report / Monthly Review	
- Branch review and acceptance	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ16HA04T TO# 189	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EV Specialty Engineering Services (TO128)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,549,163	\$1,549,163

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/29/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA04T-TO189 BASE

Originator: DENISE ROMERO (EV511) **TMR:** CYNTHIA ZAMORA (EV) (281) 483-0313

1. Title of Effort: FY16 EV Specialty Engineering Services (TO128)

2. Date of Request: 09/02/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. **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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Electromagnetic Compatibility Test and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide planning, management, and implementation activities to assure electromagnetic compatibility for various programs, projects, government furnished equipment (GFE), contractor furnished equipment (CFE), and commercial off-the-shelf (COTS) hardware by test and analysis.

Planning shall include preparing for test readiness reviews (TRRs) and the evaluation of EMI test procedures.

The contractor shall provide electromagnetic environmental effects (E3) systems engineering and analysis for various programs, projects, and elements. Analysis shall include design and development review activities including analysis of both new and modified designs. The contractor shall prepare reports in memorandum form that includes a description of the hardware or design reviewed, a description of the analyses performed, and a detailed explanation of all recommendations that includes the likely consequences if the recommendations are not implemented.

The contractor shall evaluate change requests, change request evaluation reports, and EMI test evaluation reports.

The contractor shall provide electromagnetic compatibility technical expertise regarding electrical bonding, EMI, EMC, lightning, magnetic fields, and related topics.

The contractor shall provide services for floating potential studies, including mitigation measures, and prepare assessment reports.

The contractor shall plan, design, and perform EMI tests for a variety of programs, projects, and elements including GFE, CFE, and COTS.

Procure materials and/or equipment as required for EMI testing and analyses with prior NASA approval.

The contractor shall prepare recommended changes or updates to program and project level requirements documents.

The contractor shall provide the necessary services to maintain the test facility including technician support for maintenance items as needed.

The contractor shall provide briefings at technical interchange meetings and shall observe or perform testing at other facilities. Travel may be required for the contractor to perform specification development and participate in design reviews at vendor facilities.

NASA will provide all in-line quality staffing and support.

All products and deliverables will go into DDMS.

Note: RV-02 will be met by submitting technical cost and schedule review (TCSR) charts in a NASA approved format.

5.1.1 E3 Test Data Package

Project Code:

For each test, the contractor shall supply a Test Data Package containing at a minimum:

1. Copies of the data obtained during the test including a comparison of data to specification requirements in graph and table formats, pass or fail status of the equipment under test (if applicable), laboratory ambient measurement data (if applicable), and copies of all related documentation such as TRR proceedings, hazard analyses, pre-test checklists, etc.
2. Lists of equipment utilized during the test including calibration due dates.
3. Photographs of the test setups.
4. Remarks.

5.1.2 Engineering Analyses

Project Code:

For each analysis, the contractor shall supply a report that includes:

1. A description of the hardware or design reviewed.
2. A description of the analyses performed.
3. A detailed explanation of all recommendations made including the likely consequences if the recommendations are not implemented.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
CEV-T-025000A	CEV Electromagnetic Compatibility Control and Verification Document	Rev Change 3, 5/17/2010
COL-ESA-RQ-014A	Columbus EMC and Power Quality Requirements	Rev E 12/2001
EV-021	Procedures for Client Use of Avionic Systems Division Laboratories	Rev I 1/2012
JF-41	EMC Engineering Work Order	
JSC 27773	Avionic Systems Division General Operating Procedures	Rev H 5/1/2012
JWI 8730.4	Quality Assurance Record Center Discrepancy Reporting and Tracking	Change 5 8/2009
MIL-STD-461E	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment	Rev E 8/1999
MIL-STD-461F	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment	Rev F 12/2007
MPCV 70080	Cross-Program Electromagnetic Environmental Effects (E3) Requirements Document	Rev Basic 9/2013
RE3-82-14110	Operator Certification Procedure for Hewlett Packard Model 8582A Automatic Spectrum Analyzer System	1/1/1998
SSP 30237	Space Station Electromagnetic Emissions and Susceptibility Requirements	Rev. T; 2/2010
SSP 30238A	Space Station Electromagnetic Techniques	Rev E 7/2002
SSP 30240	Space Station Grounding Requirements	Rev H 1/2010
SSP 30242	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility	Rev K 1/2010
SSP 30243	Space Station Requirements for Electromagnetic Compatibility	Rev N 1/2010
SSP 30245	Space Station Electrical Bonding Requirements	Rev P 1/2010
SSP 50094	NASA/RSA Joint Specification Standards Document for the ISS Russian Segment	Rev A 3/2000
SSP 52000-IDD-ERP	Expedite the Processing of Experiments to Space Station (EXPRESS) Rack Payloads Interface Definition Document	Rev N 2/2015
SSP 57000	Pressurized Payloads Interface Requirements Document	Rev P 8-2014

c. Required DRDs

5.1.1 E3 Test Data Package		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-11	Test Report	1/test

5.1.2 Engineering Analyses		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-02	Regular Status Report/Summary Review	1/month
TD-08	Engineering Analysis	1/analysis

d. Products

5.1.1 E3 Test Data Package		
Product(s)	Quantity	Delivery Date
E3 Test Data Package	1/Test	Within 5 days of test completion
Status Reports and Summaries	1/month	15th of the month

5.1.2 Engineering Analyses		
Product(s)	Quantity	Delivery Date
Engineering Analysis Reports	1/analysis	Within 5 days of analysis completion
Status Reports and Summaries	1/month	15th of the month

e. Product Verification

5.1.1 E3 Test Data Package	
i. E3 Test Data Package	
- Test data packages will be reviewed and approved by the JSC E3 team lead or their designee	
ii. Status Reports and Summaries	
- - Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	

5.1.2 Engineering Analyses	
i. Engineering Analysis Reports	
- Engineering analyses will be reviewed and approved by the JSC E3 team lead or their designee	
ii. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	

5.2 EEE Parts

- a. Requirement** - In compliance with the above identified SOW(s) the contractor shall provide EEE parts analysis and engineering services for flight hardware development in accordance with EEE Parts CCB procedures. The quantities per Program are interchangeable and managed by the EEE Parts CCB.

The contractor shall provide engineering services to perform the following tasks:

- * Develop and implement JSC EEE parts processes and procedures
- * Prepare and present materials for PDR, CDR, and FCA/PCA as required
- * Prepare memorandums or reports for EEE parts risk/screening/test/inspection recommendations
- * Technical consultation for onsite activities including Center EEE parts, working group, NEPAG/NEPP, data reviews, and weekly CCB reviews
- * Participate on committees that review and revise connector specifications
- * Travel may be required for project technical interchange meeting and audits.
- * Provide materials as required for EEE parts testing with prior NASA approval

All product deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.2.1 EEE Parts

Project Code:

The contractor shall provide EEE parts engineering services associated with the development of hardware in accordance with the applicable documents listing.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 61360	Engineering Directorate Certified Parts Approval Process	Rev. A, July 1998
JSC 49697	EV5 Implementation of the Johnson Space Center (JSC) EEE Parts Approval Process	Rev Basic 5/1993
JSC 61365	Component Engineers Handbook	Rev A 7/1998
MIL-HDBK-0217	Reliability Prediction of Electronic Equipment	Rev F Notice 2 Feb. 1995

c. Required DRDs

5.2.1 EEE Parts		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-15	Electrical, Electronic, and Electromechanical (EEE) Parts List and Analysis Report	1/review

d. Products

5.2.1 EEE Parts		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	1/month	15th of the month
EEE parts analysis and report	1/review	Preliminary report due 4 weeks prior to PDR. Final report due 4 weeks prior to project CDR

e. Product Verification

5.2.1 EEE Parts	
i. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	
ii. EEE parts analysis and report	
- All EEE parts products are delivered to and verified by the EEE Parts CCB or their designee	

5.3 Radiation

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide radiation analysis and test support services for hardware development and assessments. Testing may be proton, neutron or heavy ion testing depending on the Program/Project needs.

The contractor shall provide engineering services to perform the following tasks:

- * Perform MTBF predication and radiation susceptibility assessments
- * Travel is required for radiation testing.

All product deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.3.1 Radiation

Project Code:

The contractor shall provide radiation engineering services associated with the development of hardware in accordance with the applicable documents listing. All resulting analyses and test data will be made available to the EV5 EEE Parts CCB as needed as part of developing hardware in accordance with the applicable documents listing

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 61360	Engineering Directorate Certified Parts Approval Process	Rev. A, July 1998
JSC 49697	EV5 Implementation of the Johnson Space Center (JSC) EEE Parts Approval Process	Rev Basic 5/1993
JSC 61365	Component Engineers Handbook	Rev A 7/1998
MIL-HDBK-0217	Reliability Prediction of Electronic Equipment	Rev F Notice 2 Feb. 1995

c. Required DRDs

5.3.1 Radiation		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-11	Test Report	1/test

d. Products

5.3.1 Radiation		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	1/month	15th of the month
Radiation Test Report	1/test	2 weeks after completion date

e. Product Verification

5.3.1 Radiation	
i. Status Reports and Summaries	
- Status reports and summaries will be delivered to and approved by the EV5 branch chief or their designee	
ii. Radiation Test Report	
- All radiation products are delivered to and verified by the EEE Parts CCB or their designee	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 8
Task Order Number: NNJ16HA05T TO# 190	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Communications & Tracking (C&T) and Electromagnetics Systems Analysis and Spectrum Management (TO129)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$4,242,200	\$4,242,200

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/29/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA05T-TO190 BASE

Originator: DAVID LEE (EV611) **TMR:** CYNTHIA ZAMORA (EV) (281) 483-0313

1. Title of Effort: FY16 Communications & Tracking (C&T) and Electromagnetics Systems Analysis and Spectrum Management (TO129)

2. Date of Request: 08/11/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 2.2.4 Training

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

d. 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.

e. 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.

f. **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.

g. **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.

h. **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.

i. **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.

j.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ISS, Exploration and Commercial Programs and Institutional C&T Test and Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Requirement - In compliance with the above identified SOW(s) the contractor shall perform ISS, Exploration and Commercial Program and Institutional Communications & Tracking and avionics systems analysis tasks including system engineering of conceptual designs/development (including system upgrades), system requirements development & verification, compatibility assessment, interference analysis, communication performance evaluation (including computer simulations), and link analysis. The contractor shall also perform antenna analysis, coverage analysis, test planning and assessment, interface control document development/maintenance/update, anomaly resolution, mission definition and requirements development, and end-to-end communications link viability/security/availability evaluation. The contractor shall perform evaluation and processing of JSC Program/project frequency authorization requests and perform assessment of potential performance impacts to ISS RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall present in Technical Interchange Meetings (TIMs), including International travel, to disseminate analysis results. Contractor shall meet with NASA monthly to provide status and schedule for the project.

Note that "EV TO-190 Communications & Tracking (C&T) Systems Analysis and Spectrum Management, is referenced in the TO as "C&T Master Schedule". Link to current C&T Master Schedule is https://oasis.jsc.nasa.gov/orgs/EV/EV6/C_T_Analysis/master_schedules/default.aspx

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

All deliverable documents shall be stored in DDMS except for the Sensitive But Unclassified (SBU) reports. These reports are stored in a restricted SharePoint site, <https://oasis.jsc.nasa.gov/orgs/EV/EV6/Analysis/Shared%20Documents/Forms/Custom%20View.aspx>

5.1.1 C&T Analysis Project Code:

The contractor shall perform ISS Communications & Tracking and avionics systems analysis tasks including system engineering of conceptual designs/development (including system upgrades), system requirements development & verification, compatibility assessment, interference analysis, communication performance evaluation (including computer simulations), and link analysis. The contractor shall also perform antenna analysis, coverage analysis, test planning and assessment, interface control document development / maintenance / update, anomaly resolution, mission definition and requirements development, and end-to-end communications link viability/security/availability evaluation. The contractor shall perform evaluation and processing of JSC Program/project frequency authorization requests and perform assessment of potential performance impacts to ISS RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall present in Technical Interchange Meetings (TIMs), including International travel, to disseminate analysis results. Contractor shall meet with NASA monthly to provide status and schedule for the project.

The contractor shall develop models for lunar coverage analysis. The contractor shall provide technical assessment of Orion contractor analyses, simulations, proposed system architectures and designs. The contractor shall provide requirements development and verification for SRD, IRDs, ICDs and subsystem specifications. The contractor shall assess the Orion project reviews and provide comments and recommendations. The contractor shall upgrade CSSL models for Orion analysis and simulation. The contractor shall perform evaluation and processing of project frequency authorization requests and perform assessment of potential performance

impacts to Orion RF systems due to external frequency requests and proposed modifications to radio regulations. Contractor shall provide NASA with monthly status and schedule for the project.

The contractor shall provide radio frequency compatibility/interference analyses, spectrum regulation compliance analyses and National Telecommunications & Information Administration (NTIA) spectrum certification data package preparation in support of the Space Launch System (SLS) Program. Specifically the contractor shall (1) provide technical analyses to determine performance integrity of each radio link on the SLS core stage and upper stage rockets during launch and ascent phases with Orion vehicle transmitting RF in the same frequency band, (2) provide power fluxed density and out-of-band/spurious emissions analysis based on the SLS design parameters to determine compliance to the NTIA spectrum utilization requirements, (3) develop data package in NTIA Spectrum Certification format and supplementary analysis reports for Stage 2 experimental license submittal. Contractor shall also document the SLS spectrum and channel selection in the Cross Program Spectrum & Channel Plan. Contractor may be required to travel to support reviews. Contractor shall meet with NASA monthly to provide status and schedule for the project.

The Contractor shall perform communications and tracking analyses to assess NASA program (including ISS, Orion, future exploration, and commercial), project, and Institutional communications and RF systems performance. These analyses shall include link margin analysis, coverage analysis, multi-path, RF hardware performance modeling (Matlab), KOZ analysis, RF masking analysis, and compatibility and interference analysis. The contractor shall develop models for surface coverage analysis. The contractor shall provide technical assessment of Programs, projects, and Institutional contractor analyses, simulations, proposed system architectures and designs. The contractor shall provide requirements development and verification for SRD, IRDs, ICDs and subsystem specifications. The contractor shall assess the Programs, projects, and Institutional reviews and provide comments and recommendations.

The contractor shall upgrade CSSL models for program, project, & institutional analysis and simulation needs as listed in the EV CSSL Product Requirement Document, EV-081. The contractor shall perform evaluation and processing of project frequency authorization requests and perform assessment of potential performance impacts to Program, project, and Institutional RF systems due to external frequency requests and proposed modifications to radio regulations. The contractor shall provide IT maintenance for the EV8 laboratory facilities. The contractor shall provide financial budgeting report and tracking support for this task

Note that "EV TO-130 Communications & Tracking (C&T) Systems Analysis and Spectrum Management, is referenced in the TO as "C&T Master Schedule". Link to current C&T Master Schedule is

[https://oasis.jsc.nasa.gov/orgs/EV/EV6/C T Analysis/master_schedules/default.aspx](https://oasis.jsc.nasa.gov/orgs/EV/EV6/C_T_Analysis/master_schedules/default.aspx)

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EV-022	Radio Frequency Communications Electromagnetic Environmental Effects Analysis Work Instruction	H
EV-081	EV CSSL Product Requirement Document	S

c. **Required DRDs**

5.1.1 C&T Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/month
TD-08	Engineering Analysis	1/analysis

d. **Products**

5.1.1 C&T Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Analysis reports	1/analysis	Per C&T master schedule
Regular Project status	1	monthly
CSSL Projects	1/release	Per EV-081 schedule

e. **Product Verification**

5.1.1 C&T Analysis	
i. Analysis reports	
- Branch review upon delivery	
ii. Regular Project status	
- Branch review upon delivery	
iii. CSSL Projects	
- Product acceptance and inspection by NASA Lab Monitor upon release	

5.2 Wireless Systems, Testing, Analysis, Standards, and Technology

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide engineering services to analyze wireless systems, standards, and technologies. The contractor shall provide testing, analysis and algorithm development services in support of Radio Frequency Identification (RFID) system development. Typical content includes study and recommendation of wireless standards for space and ground operations. The contractor shall provide development services including evaluation of RFID antennas, RFID tags, system and component level testing and analysis in the anechoic chamber, RFID ALM Test-bed, and other JSC analogs.

Engineering services shall also include provisions for the development and maintenance of network protocols, software applications and demonstration of these applications and technologies.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

All deliverable documents shall be stored in DDMS.

5.2.1 Testing, Analysis, Standards and Technology Development
Project Code:

The contractor shall apply wireless and network engineering in the design, services, and implementation of multiple project areas. Technology areas shall include at a minimum Radio Frequency Identification and Detection (RFID), JSC wireless analog system, and wireless sensor instrumentation. They shall demonstrate, modify and maintain the existing wireless test beds, and implement experimental network and systems for program and Intra-Agency communications.

The contractor shall provide test and analysis engineering services for electromagnetic and thermal systems. Typical test systems include antenna and RF measurements and thermal chambers. Analysis includes computational electromagnetic simulation and associated post-processing.

The contractor shall provide Complex Event Processing (CEP) related engineering services. Typical activities related to CEP engineering services are developing statistical, machine-learning, or deterministic models that are used to create contextual information that help identify meaningful events for a complex event processing system; performing low-level embedded device and application specific programming for filtering RFID event streams from RFID readers; developing new or extending existing complex event processing software; integrating both low-level RFID event streams and higher-level event streams (outputs of statistical, machine-learning, or deterministic models) with complex event processing software; and developing user interfaces or visualizations for displaying the results from the complex event processing system and its related models. Additionally, network architecture, network construction, and network troubleshooting services are necessary to support the collection of RFID event streams from networked RFID readers to the CEP system.

In compliance with the above-identified SOW(s) the contractor shall provide board and box assembly and cable fabrication in support of RFID and wireless system development.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ANSI/IEEE Std 149-1979	IEEE Std. Test Procedures for Antenna Testing	R2008

c. Required DRDs

5.2.1 Testing, Analysis, Standards and Technology Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	2/year
SW-04	Software Code	1/software release

d. Products

5.2.1 Testing, Analysis, Standards and Technology Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Summary Review	2/year	March 31 and August 30
Data Package	1/test	within 3 days of test completion
Software Code	1/software release	as required by project plan

e. Product Verification

5.2.1 Testing, Analysis, Standards and Technology Development	
i. Summary Review	
- Branch review upon delivery	
ii. Data Package	
- NASA technical expert will review test data package to verify quality and completeness	

iii. Software Code

- NASA technical expert will review code integrity

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA06T TO# 191	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Avionic Systems Division Services (TO130) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$579,768	\$579,768

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.30 13:03:05 -0500

9/30/15

Date: _____

JSC Engineering, Technology and Science Contract

NNJ16HA06T-TO191 BASE

Originator: CYNTHIA ZAMORA (EV171) **TMR:** DARILYN PEDDIE (EV) (281) 483-8279

1. Title of Effort: FY16 Avionic Systems Division Services (TO130) (LOE)

2. Date of Request: 09/24/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Engineering and Estimating Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and estimating services for project and Division derived work. Contractor shall provide support per the attached LOE spreadsheet.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.2 Project Derived Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide academia services and engineering services for short turnaround requests and requirements development of new products within the Division that support project specific derived objectives and goals. Current projects to be supported include, but not limited to, HERA Electronics Design Support, Personal CO2 Monitor Certification Support, EV2 Software Support, EV2 Instrumentation Support, and Electronics Design Support for DFI. Contractor shall provide support per the attached LOE spreadsheet.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.3 Manufacturing (Electrical, Mechanical, Soft Goods)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technician services to fabricate, assemble and/or repair electronic hardware that may include, but is not limited to, printed circuit boards, cables, electronic assemblies, and subassemblies including all documentation steps and procedures. These tasks may be performed on flight or non-flight hardware. NASA shall provide all facilities for contractor use and in-line quality support as required. Contractor shall provide support per the attached LOE spreadsheet.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

d. Products

e. Product Verification

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA07T TO# 192	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EV C&DH Instrumentation Systems(TO132)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$220,309	\$220,309

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET <small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.21 16:54:45 -05'00'</small> Signature: _____ Date: 9/21/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA07T-TO192 BASE

Originator: TODD HONG (EV171) **TMR:** CYNTHIA ZAMORA (EV) (281) 483-0313

1. Title of Effort: FY16 EV C&DH Instrumentation Systems (TO132)

2. Date of Request: 07/28/2015

3. Statement of Work Task Description

a. 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 JET S Technical Library and specified on each task order.

b. 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.

c. 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.

d. 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

e. **2.2.4 Training**

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

f. **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.

g. **2.3 Analysis and Assessment**

h. **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.

i. **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.

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Wireless Instrumentation System (WIS) Engineering Products & Sustaining Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall perform the sustaining engineering and new development/certification as applicable related to the ISS Wireless Instrumentation System (WIS) Products and Sustaining Engineering.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting. All contract deliverables shall be made into DDMS along with project deliverables placed on the project web page.

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering Project Code: 2S701 & 00109

In compliance with the above identified SOW(s) the contractor shall provide WIS engineering products and sustaining engineering per EV-113A.

b. **Applicable Documents**

Document Number	Document Name	Rev.
EV-113	Wireless Instrumentation Systems (WIS) Engineering Products and Sustaining Engineering	A

c. **Required DRDs**

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	1/month
RV-02	Regular Status Report/Summary Review	1/month

d. **Products**

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering		
Product(s)	Quantity	Delivery Date
Integrated Microsoft Schedule	1	Monthly
Regular Status Report / Monthly Review	1	Monthly

e. **Product Verification**

5.1.1 ISS Wireless Instrumentation System (WIS) Engineering Products and Sustaining Engineering	
i. Integrated Microsoft Schedule	
- Delivered in DDMS	
ii. Regular Status Report / Monthly Review	
- Delivered in DDMS	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA08T TO# 193	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EV Admin, Maintenance & Operations(TO131)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$702,114	\$702,114

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover, st, cn=ROCHELLE OVERSTREET ROCHELLE OVERSTREET Signature: _____ Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA08T-TO193 BASE

Originator: CYNTHIA ZAMORA (EV171) **TMR:** DARILYN PEDDIE (EV) (281) 483-8279

1. Title of Effort: FY16 EV Admin, Maintenance & Operations(TO131)

2. Date of Request: 09/09/2015

3. Statement of Work Task Description

a. **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.

b. **2.6 Special Projects**

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

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 General Division Administration, Maintenance and Operations Requirements

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide day-to-day maintenance and operations activities common to all test facilities, systems and laboratories in the Avionic Systems Division, in accordance with requirements of the Avionic Systems Division Administration, Maintenance and Operations Requirements document, JSC-63524, and the Avionic Systems Division General Operating Procedures for Laboratories and Facilities Document, JSC-27773. A list of ASD facilities is in JSC-63524 Appendix C. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with Avionic Systems Division General Operating Procedures for Laboratories and Facilities Document, JSC-27773. Implementation of savings for required consumables/products/services shall be pursued by utilizing economies of scale for similar requirements of other Directorate divisions.

Standard maintenance & operation tasks that span the division's facilities, laboratories and systems are in the list below.

1. Provide and maintain a personnel certification and training program.
2. Perform work document initiation, review, coordination, in-process control, and close-out actions.
3. Provide storage of and ready access to work documents/records.
4. Identify and maintain a list of equipment that needs to be replaced.
5. Maintain property accounts.
6. Propose revisions to standard operating procedures and documentation to ensure they accurately reflect processes and identify those that could be rescinded.
8. Plan and schedule M&O activities to minimize impacts to product-related TO activities.
9. Ensure Inspection, Testing and Measurement Equipment (ITME) is within calibration during data measurement.
10. Operate database and/or website that tracks maintenance items and property.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS

5.1.1 Division Administrative Services

Project Code:

Division administrative services tasks shall be performed as outlined in section 5.1 of this task order and per JSC-27773, Avionic Systems Division General Operating Procedures for Laboratories and Facilities, and JSC 63524, the Avionic Systems Division Administration, Maintenance and Operations Requirements document. Assist with development of relationships with academia and industry for potential collaboration in accordance with the EV Domain Implementation Plans. Travel could be required for this activity.

b. Applicable Documents

Document Number	Document Name	Rev.
JPR 1281.11	Metrology and Calibration	B
JSC-27773	Avionic Systems Division General Operating Procedures for Laboratories and Facilities	H
JSC-63524	Avionic Systems Division Administration, Maintenance and Operations Requirements	F

c. Required DRDs

5.1.1 Division Administrative Services		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1/Quarterly

d. Products

5.1.1 Division Administrative Services		
Product(s)	Quantity	Delivery Date
Regular Status Report/Review	1	Quarterly

e. **Product Verification**

5.1.1 Division Administrative Services		
. Regular Status Report/Review		
- Reviewed and approved via DDMS		

5.2 Property Administration

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall implement a Property Management Plan for the Avionic Systems Division (ASD) in accordance with JSC-63524.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS

5.2.1 Property Administration and Unit Move Coordination

Project Code:

The contractor shall implement a Property Management Plan for the Avionic Systems Division (ASD) in accordance with JSC-63524, section 3.2.1.1. The contractor shall provide a property administrator and handle move coordinator activities for the division.

Each property administrator shall be responsible for identifying and tracking government property assigned to their area. Each administrator shall maintain property accountability records and conduct property inventories in compliance with established JSC policies and procedures. Property administrators shall be responsible for performing the duties as described in JSC-63524, paragraph 3.2.1.1.

The Unit Move Coordinator (UMC) for ASD shall operate in accordance with the move procedures for the Center Operations Directorate. The UMC shall provide move support for the ASD managed buildings listed in JSC-63524 Appendix B. The UMC shall be responsible for coordinating move requests with the ASD Administrative Officer. The UMC shall be responsible for performing the duties as described in JSC-63524 paragraph 3.2.2.1.

b. **Applicable Documents**

Document Number	Document Name	Rev.
JSC-63524	Avionic Systems Division Administration, Maintenance and Operations Requirements	F
JWI 4200.1	Management of Controlled Equipment	A
JWI 6050.1	Procedures for Processing Shipments from JSC	A

c. **Required DRDs**

5.2.1 Property Administration and Unit Move Coordination		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	1/Quarterly

d. **Products**

5.2.1 Property Administration and Unit Move Coordination		
Product(s)	Quantity	Delivery Date

Regular Status Report/Review	1	Quarterly
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e. **Product Verification**

5.2.1 Property Administration and Unit Move Coordination		
. Regular Status Report/Review		
- Office Review and Approval		

5.3 Safety, Occupational Health and Environment Management

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall ensure the protection of ASD personnel, property, equipment and the environment through implementation of an effective Safety and Environmental Health Program.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Facility Cost and Schedule Review (FCSR)" reporting. Products delivered into DDMS.

**5.3.1 Safety, Occupational Health and Environment Management
Project Code:**

The contractor shall ensure the protection of ASD personnel, property, equipment and the environment through implementation of an effective Safety and Environmental Health Program.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 63524	ASD Administration, Maintenance and Operations Requirements	F

c. **Required DRDs**

5.3.1 Safety, Occupational Health and Environment Management		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1/Quarterly

d. **Products**

5.3.1 Safety, Occupational Health and Environment Management		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Regular Status Report/Review	1	Quarterly

e. **Product Verification**

5.3.1 Safety, Occupational Health and Environment Management		
. Regular Status Report/Review		
- Reviewed and approved via DDMS		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 1
Task Order Number: NNJ15HA69T TO# 194	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Technical Integration Office Support

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$4,909,161	\$4,909,161

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Digitally signed by ROCHELLE OVERSTREET
DN: c=US, o=U.S. Government, ou=NASA,
ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.04 14:57:50 -05'00'

9/4/2015

Signature: _____ Date: _____
Contracting Officer

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 10
Task Order Number: NNJ16HD09T TO# 195	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Propulsion and Power Division Services

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$2,454,546	\$2,454,546

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=movers
t, cn=ROCHELLE OVERSTREET
Date: 2015.09.28 09:50:16 -0500

9/28/15

Date: _____

JSC Engineering, Technology and Science Contract

NNJ16HA09T-TO195 Base

Originator: SANDRA RUTTLE (EP) (281) 244-0339 **TMR:** SANDRA RUTTLE (EP) (281) 244-0339

1. Title of Effort: FY16 Propulsion and Power Division Services (TO154) (LOE)

2. Date of Request: 09/18/2015

3. Statement of Work Task Description

a. **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.

b. **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.

c. **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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Propulsion & Power Division Support Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical services, analysis, and hardware and software design and development for the Propulsion & Power Division on projects specified by the Propulsion & Power Division (PPD). Depending on project life cycle, requirements include conceptual design, feasibility studies, analysis, development, manufacturing, qualification testing, flight certification, safety and risk analysis, operations, sustaining engineering, project management, and property management.

PPD functional areas include:

Propulsion
Batteries and Chargers
Chemical Processing
Power Generation
Fluids Distribution, Storage and On-orbit Transfer
In-Situ Resource Utilization (ISRU)
Energy Conversion & Storage
Power Distribution & Control
Pyrotechnics

5.1.1 Division Management and Operations Support

Project Code: (This is a level of effort task.)

Services provided for Division Management and Operations Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.2 NiMH GFE Battery Sustaining Support

Project Code:

Services provided for ISS NiMH GFE Battery Sustaining Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.3 EVA Li-Ion Battery Upgrades Support

Project Code:

Services provided for EVA Li-Ion Battery Upgrades Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.4 OB Battery Surveillance Support

Project Code:

Services provided for OB Battery Surveillance Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.5 Thermal Runaway Propagation Study Support

Project Code:

Services provided for Thermal Runaway Propagation Study Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.6 SAFER Battery Support

Project Code:

Services provided for SAFER Battery Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.7 Orion Pyro Support

Project Code:

Services provided for Orion Pyrotechnic Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.8 EP Multimedia Support

Project Code:

Services provided for EP Multimedia Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.9 Q-Thruster Support

Project Code:

Services provided for Q-Thruster Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.10 Energy Conversion Systems Support

Project Code:

Services provided for Energy Conversion Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.11 Propulsion Systems Support

Project Code:

Services provided for Propulsion Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.12 Power Systems Support

Project Code:

Services provided for Power Systems Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.13 Fluids/Thermal Analysis Support

Project Code:

Services provided for Fluids/Thermal Analysis Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.14 Dual Frangible Joint Support

Project Code:

Services provided for Dual Frangible Joint Support will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

5.1.15 Technology Development

Project Code:

Services provided for Technology Development will be costed to this sub-CLIN for accounting purposes only. The scope for the services on this sub-CLIN is defined in Section 5.1 par (a) of this Task Order.

(See attached spreadsheet for resources required.)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.1.1 Division Management and Operations Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.2 NiMH GFE Battery Sustaining Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.3 EVA Li-Ion Battery Upgrades Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.4 OB Battery Surveillance Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.5 Thermal Runaway Propagation Study Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.6 SAFER Battery Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.7 Orion Pyro Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.8 EP Multimedia Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.9 Q-Thruster Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.10 Energy Conversion Systems Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.11 Propulsion Systems Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.12 Power Systems Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.13 Fluids/Thermal Analysis Support		
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<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.14 Dual Frangible Joint Support

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

5.1.15 Technology Development

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	LOE

d. Products

5.1.1 Division Management and Operations Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.2 NiMH GFE Battery Sustaining Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.3 EVA Li-Ion Battery Upgrades Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.4 OB Battery Surveillance Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.5 Thermal Runaway Propagation Study Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.6 SAFER Battery Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.7 Orion Pyro Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.8 EP Multimedia Support

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.9 Q-Thruster Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.10 Energy Conversion Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.11 Propulsion Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.12 Power Systems Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.13 Fluids/Thermal Analysis Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.14 Dual Frangible Joint Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.1.15 Technology Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.1.1 Division Management and Operations Support		
i. LOE		
- LOE		

5.1.2 NiMH GFE Battery Sustaining Support		
i. LOE		
- LOE		

5.1.3 EVA Li-Ion Battery Upgrades Support		
i. LOE		
- LOE		

5.1.4 OB Battery Surveillance Support		
i. LOE		
- LOE		

5.1.5 Thermal Runaway Propagation Study Support

i. LOE

- LOE

5.1.6 SAFER Battery Support

i. LOE

- LOE

5.1.7 Orion Pyro Support

i. LOE

- LOE

5.1.8 EP Multimedia Support

i. LOE

- LOE

5.1.9 Q-Thruster Support

i. LOE

- LOE

5.1.10 Energy Conversion Systems Support

i. LOE

- LOE

5.1.11 Propulsion Systems Support

i. LOE

- LOE

5.1.12 Power Systems Support

i. LOE

- LOE

5.1.13 Fluids/Thermal Analysis Support

i. LOE

- LOE

5.1.14 Dual Frangible Joint Support

i. LOE

- LOE

5.1.15 Technology Development
i. LOE
- LOE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA10T TO# 196	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Dynamic Systems Test Branch Services (TO150)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b) (4)		
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,228,577	\$1,228,577

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Rochelle Overstreet</p> <p>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=move rst, cn=ROCHELLE OVERSTREET Date: 2015.09.24 15:41:52 -0500</p> <p>ROCHELLE OVERSTREET</p> <p>Signature: _____ Date: 9/24/15</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ16HA10T-TO196 BASE

Originator: Asher Lieberman (ER) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Dynamic Systems Test Branch Services (TO150)

2. Date of Request: 09/10/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. 2.2.4 Training

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

f. 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.

g. **2.3 Analysis and Assessment**

h. **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.

i. **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.

j. **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.

k. **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.

l.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Dynamic Systems Test Branch Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide engineering services as described in ER5-TM196. All maintenance and operations, mechanical design and design analysis, electrical engineering, services for the design, testing and evaluation of hardware in SR&SD projects as well as training/test operations for several of the Building 9 robotic laboratories and training/test facilities will be done as described in ER5-TM196. Additionally, the contractor shall provide engineering services associated with the systems engineering, design, analysis, general manufacturing, test, and sustaining engineering for Simplified Aid For EVA Rescue (SAFER) project hardware.

Additionally:

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the Integrated Product Team (IPT), the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants, and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management / consultation may be coordinated by NASA with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of TO-196 and its supporting Master Plan and Schedule and may include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow.

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering

Project Code:

The contractor shall provide engineering services necessary to continue the operation of the SAFER and Test Module flight systems in accordance with ER5-TM196, Section I.

5.1.2 SDTS Facility Maintenance and Operations/Test Operations

Project Code:

The contractor shall provide the engineering services necessary to continue facility maintenance and test operations in accordance with ER5-TM196, Section II.

5.1.3 Active Response Gravity Offload System (ARGOS) Engineering Services

Project Code:

The contractor shall provide the engineering services necessary to continue facility maintenance and test operations in accordance with ER5-TM196, Section III.

5.1.4 DMT Maintenance and Operations/Test Operations

Project Code:

The contractor shall provide the engineering services necessary to continue facility maintenance and test operations in accordance with ER5-TM196, Section IV.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-023	Project Management of GFE Flight Projects	G
EA-WI-025	GFE Flight Project Software and Firmware Development	D
ER5-TM196	Master Plan and Schedule	Original

c. Required DRDs

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.2 SDTS Facility Maintenance and Operations/Test Operations		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.3 Active Response Gravity Offload System (ARGOS) Engineering Services		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	15th of each month

5.1.4 DMT Maintenance and Operations/Test Operations		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	15th of each month

d. Products

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering		
Product(s)	Quantity	Delivery Date
Implementation of ER-TM196, Section I	1	9/30/2016

5.1.2 SDTS Facility Maintenance and Operations/Test Operations		
Product(s)	Quantity	Delivery Date
Implementation of ER-TM196, Section II	1	9/30/2016

5.1.3 Active Response Gravity Offload System (ARGOS) Engineering Services		
Product(s)	Quantity	Delivery Date
Implementation of ER-TM196, Section III	1	9/30/2016

5.1.4 DMT Maintenance and Operations/Test Operations		
Product(s)	Quantity	Delivery Date
Implementation of ER-TM196, Section IV	1	9/30/2016

e. Product Verification

5.1.1 SAFER and Test Module Flight Unit Processing and Sustaining Engineering	
i. Implementation of ER-TM196, Section I	
- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM196, Section I.	

5.1.2 SDTS Facility Maintenance and Operations/Test Operations	
i. Implementation of ER-TM196, Section II	
- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM196, Section II.	

5.1.3 Active Response Gravity Offload System (ARGOS) Engineering Services
--

i. Implementation of ER-TM196, Section III
--

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM196, Section III.
--

5.1.4 DMT Maintenance and Operations/Test Operations

i. Implementation of ER-TM196, Section IV

- SR&SD Dynamic Systems Test Branch review, witness, and acceptance of products identified in ER-TM196, Section IV.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA11T TO# 197	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 SOPD Support

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,174,472	\$1,174,472

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/24/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=mover
st, cn=ROCHELLE OVERSTREET
Date: 2015.09.24 15:30:48

JSC Engineering, Technology and Science Contract

NNJ16HA11T-TO197 BASE

Originator: ROBERT VILLARREAL (EA551) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 SOPD Support (TO140)

2. Date of Request: 09/09/2015

3. Statement of Work Task Description

a. **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.

b. **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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Engineering and Administrative Services in Support of the Strategic Partnership (SPO) Office

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical services to the JSC SPO office. This service shall include all work completed on-site in the SPO office as well as work completed off-site, as requested by the Manager of the SPO office. Work off-site may require travel to conferences, events, and other NASA facilities. The following requested structure shown below should be collected and cost shown on 533 on three levels.

5.1.1 Management of JSC Technology Transfer & Commercialization Office Intellectual Property, Licensing, Marketing and Outreach processes and activities.

Project Code:

The contractor shall manage and coordinate all maintenance of official records and use of electronic tools to complete these tasks. Specifically this requirement includes:

- * New Technology Report training (including eNTR)
- * New Technology Evaluation process including New Technology evaluation, evaluation recommendation meeting, agenda management and execution
- * NASA Tech Briefs management including publication process, and status reports
- * Software Usage Agreement (SUA) process management
- * IP documentation, including paper files and Tech Finder/NTTS data management
- * License opportunity development
- * NTTS application specialist
- * JSC contract closeout activities for JSC managed contracts
- * TTCO Standard Operating Procedure (SOP) document management
- * Conference engagement and networking support
- * Quality Management System (QMS) Metrics
- * Performance Management System process management, as a part of the Performance Management Report (PMR) process
- * Outreach to achieve TTCO licensing and partnership objectives
- * Ad Hoc reports
- * The contractor shall provide limited support to Communication Management Planning as follows:

External Communication

Provide communication materials to the TTCO for communications with Headquarters, responding to actions, calls for stories, technology reviews, photography and exhibit support

Provide JSC TTCO presentation/reports to the Innovative Office (IO) Headquarters Office and to the Johnson Space Center Strategic Communications Panel.

Communicate with other directorates regarding technology development, infusion, inventors to improve our products and press releases

Coordinate information dissemination with partner organization communication representatives (SATOP, HTC, etc.)

Coordinate publicity opportunities (inventor luncheon, new technology) with JSC Legal and the newsroom organizations

Materials Production

Continue TTCO Web site strategy, by providing content and coordination of web design. This includes news articles, innovator profiles, business-relevant information and forms, and technology transfer representative contact information

Produce written materials, presentations, web site material, correspondence, executive communication, success stories, coordinate press releases, innovation and inventor features, opportunity sheets, fact sheets, etc.

Provide strategy, graphics, writing and coordination with exhibits for HQ conferences

5.1.2 Management of the JSC Partnership Processes Office Agreements Processes

Project Code:

The contractor shall manage and coordinate all maintenance of official records and use of electronic tools. Specifically, this requirement includes:

- * Partnership Agreement process management
- * SAAM system management
- * SAA agreements and contact management
- * Partnership training including SAA and SAAM training
- * SAA Helpdesk/Consulting
- * Inventory of Partnership (dashboard) management - active and inactive
- * Ad Hoc reports

5.1.3 Management of the JSC Technology Transfer & Commercialization Office SBIR/STTR Processes

Project Code:

The contractor shall manage and coordinate all maintenance of paper files and use of electronic tools. Specifically, this requirement includes:

- * Support to SBIR/STTR program operations/functions
- * JSC SBIR/STTR Technology Infusion process
- * Ad Hoc reports

The contractor shall prepare, submit, and maintain a Management Plan. The Management Plan shall include provisions for implementing Performance Measurement System reports for NASA/JSC Senior

Management, which will provide the TTCO with metrics measuring a summary of planned versus actual accomplishments for each reporting cycle, Quality Management System reports for NASA/JSC Senior Management, which will provide the TTCO with metrics measuring performance against JSC Center QMS metrics; and other quantitative metrics. The Management Plan shall include specific details on the data to be included within the product deliverables. The Management Plan will be maintained and updated to reflect the current status of the contractor's TTCO operations.

Records and documents resulting from the Intellectual Property, Patent License Agreements, and Crosscutting Services, Partnerships and Agreements, and SBIR/STTR process tasks shall be maintained and electronically stored in a secure common database available to NASA (NTTS including Tech Tracs, TechFinder, and SBIR Handbook) and reports generated from NTTS on an Ad-Hoc basis.

The contractor shall provide Metrics data as required for measuring performance in the area of the Intellectual Property / Patent License Process, Crosscutting Services, Partnerships and Agreements Process, and SBIR/STTR/ Process. Performance measurement criteria will include quantitative goals for licenses, new technology disclosures and SUAs, quantitative goals for partnerships, QMS and crosscutting services.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1050.1	JSC Procedural requirements for Space Act Agreements and Cooperative Research and Development Agreements	Current
NPD 1050.1	Authority to Enter Into Space Act Agreements	Current
NPD 2090.6	Authority to Enter Into License Agreements and Implementation of Licensing Authority	Current
NPR 2210.1	External Release of NASA Software	Current
SSPS 2006-1	NASA SBIR/STTR Policy Statement	Current

c. Required DRDs

5.1.1 Management of JSC Technology Transfer & Commercialization Office Intellectual Property, Licensing, Marketing and Outreach processes and activities.

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

5.1.2 Management of the JSC Partnership Processes Office Agreements Processes

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

5.1.3 Management of the JSC Technology Transfer & Commercialization Office SBIR/STTR Processes

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

d. Products

5.1.1 Management of JSC Technology Transfer & Commercialization Office Intellectual Property, Licensing, Marketing and Outreach processes and activities.

<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Performance Management Review Package	12	Last week of Following Month
Assignment List	N/A	As requested

5.1.2 Management of the JSC Partnership Processes Office Agreements Processes		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Performance Management Review Package	12	Last week of Following Month

5.1.3 Management of the JSC Technology Transfer & Commercialization Office SBIR/STTR Processes		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Performance Management Review Package	12	Last week of Following Month

e. Product Verification

5.1.1 Management of JSC Technology Transfer & Commercialization Office Intellectual Property, Licensing, Marketing and Outreach processes and activities.	
i. Monthly Performance Management Review Package	
- Review and Approval by JSC TTCO Manager or Designated Alternate	
ii. Assignment List	
- Review and Approval by JSC TTCO Manager or Designated Alternate	

5.1.2 Management of the JSC Partnership Processes Office Agreements Processes	
i. Monthly Performance Management Review Package	
- Review and Approval by JSC Partnership Processes Office Manager or Designated Alternate	

5.1.3 Management of the JSC Technology Transfer & Commercialization Office SBIR/STTR Processes	
i. Monthly Performance Management Review Package	
- Review and Approval by JSC TTCO Manager or Designated Alternate	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
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Task Order Number: NNJ15HA70T TO# 198	Revision Number: R1	Appropriation Data: Funded at Contract
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SOW WBS: See Item 3	Fiscal Year(s): 2015	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
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Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: <u>NNJ13HA01C</u> .
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Title: FY15 Engineering Services For EA5 (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)
Period of Performance: See Item 4
Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$60,627	\$0	\$60,627

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet ROCHELLE OVERSTREET <small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.21 16:44:39 -05'00'</small> Signature: _____ Date: 9/21/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ15HA70T-TO198 R1

Originator: ROBERT VILLARREAL (EA551) TMR: ROBERT VILLARREAL (EA5) (281) 483-0143

Revision Summary:

Revision cahnges period of performance end date from 9/30/15 to 12/30/15. Rationale - FY15 task order was opened late in FY (September 2015), so extension will allow support to continue thru 1st quarter of FY for FY15 support to complete.

1. FROM Title of Effort: FY15 Engineering Services For EA5 (LOE) Updated R1

1. Title of Effort: FY16/15 Engineering Services For EA5 (LOE)

2. Date of Request: 09/01/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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, Descent, 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.

e. **2.6 Special Projects**

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

f. **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.

g.

4. Period of Performance Updated R1

The period of performance does not commence until the CO has granted authorization to proceed.

FROM:

This task order period of performance starts 08/17/2015 and ends 09/30/2015.

TO:

This task order period of performance starts 08/17/2015 and ends 12/30/2015.

5. Product Requirements

5.1 Estimating Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide estimating services for EA5 project and Division planned work as requested by the EA5 TMR.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Requirement	

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.2 EA Electronic Workflow Tool Development

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical expertise to address issues and make minor modifications to the EA Test Facility Electronic Workflow (TFeW) Tool. Minor modifications to Oasis-based TFeW tool will include enabling multiple individuals to be assigned to specific roles identified in the Testing Organization Role and Requesting Organization Roles Lists; and the creation of a new role to be known as the Scheduler. Contractor shall provide support per the attached LOE spreadsheet of standard labor categories.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	B

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.3 Proposal Support Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide proposal development support services for EA5 project and Division planned work as requested by the EA5 TMR. Contractor shall provide support per the attached LOE spreadsheet of standard labor categories.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Requirement	

c. Required DRDs

d. Products

e. Product Verification

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 23
Task Order Number: NNJ16HA12T TO# 199	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ES Structural Engineering Services(TO148)(Hybrid CF)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$6,447,352	\$6,447,352

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/29/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA12T-TO199 BASE

Originator: SHIRLEY HOLLAND-HUNT (ES18) **TMR:** SHIRLEY HOLLAND-HUNT (ES) (281) 483-3254

1. Title of Effort: FY16 ES Structural Engineering Services (TO148) (Hybrid CF)

2. Date of Request: 09/15/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. 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.

f. 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

g. **2.2.4 Training**

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

h. **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.

i. **2.3 Analysis and Assessment**

j. **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.

k. **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.

l. **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.

m. **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.

n. **2.4 Facilities**

o. **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.

p. **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.

q. **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.

r. **2.5 Research and Development**

s. **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, Descent, 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.

t. **2.6 Special Projects**

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

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4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ES18 Managment Integration Office Serv ices (INACTIVE)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide:
Inactive

5.1.1 ES18 Managment Integration Office Serv ices (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirement for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. **Required DRDs**

5.1.1 ES18 Managment Integration Office Serv ices (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. **Products**

5.1.1 ES18 Managment Integration Office Serv ices (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. **Product Verification**

5.1.1 ES18 Managment Integration Office Serv ices (INACTIVE)	
. Hybrid	
- Hybrid	

5.2 ES2 Structural Branch Serv ices (INACTIVE)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide:
Review of structural engineering estimates
Review of performance of trade studies
Review of performance of structural engineering assessments and analysis
Safety assessments
Development of anomaly resolution recommendations
Participation in GFE project technical reviews

Related to:

Spacecraft payloads

ISS, Orion, GFE projects

Technology Development projects

Representative of:

Engineering requirements analysis reports for ISS Program projects

Orion Project Stress Analysis Summary reports

GFE Technology Development projects

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.2.1 Orion CSM (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.2.2 PSRP/GCAR Review (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.2.3 GFE Core Team (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34241)JSC-STD-3080	JSC Design and Procedural Standard	Oct. 2006
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware	Baseline
NSTS 08307	Criteria for Pre-Loaded Bolts	Rev A
NSTS 13830	Payload Safety Review and Data Submittal Requirements for Payloads Using the Shuttle and ISS	Rev C, Change 4 01-02
NSTS 14046	Payload Verification Requirements	Rev E, Change 3 08-02
NSTS 1700.7B ISS	Safety Policy and Requirements for Payloads Using the ISS	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. Required DRDs

5.2.1 Orion CSM (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.2.2 PSRP/GCAR Review (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

None		Hybrid
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5.2.3 GFE Core Team (INACTIVE)		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

d. Products

5.2.1 Orion CSM (INACTIVE)		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

5.2.2 PSRP/GCAR Review (INACTIVE)		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

5.2.3 GFE Core Team (INACTIVE)		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

e. Product Verification

5.2.1 Orion CSM (INACTIVE)		
. Hybrid		
- Hybrid		

5.2.2 PSRP/GCAR Review (INACTIVE)		
. Hybrid		
- Hybrid		

5.2.3 GFE Core Team (INACTIVE)		
. Hybrid		
- Hybrid		

5.3 Thermal Design Branch Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Thermal Analysis Support and Reports
Contractor shall add Engineering Services to develop software to automate execution of multiple CHAR simulation runs.

Related to:
International Space Station Program
Orion MPCV Program
Commercial Crew Integrated Capability (CCiCap) Program

Representative of:
On-orbit thermal analyses
Entry thermal analysis
Thermal test simulation

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES3 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.3.1 ES3 Thermal Design Branch Services

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	Current

c. Required DRDs

5.3.1 ES3 Thermal Design Branch Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.3.1 ES3 Thermal Design Branch Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.3.1 ES3 Thermal Design Branch Services	
. Hybrid	
- Hybrid	

5.4 ES4 Materials and Processes Branch Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Assessments
Support for technology development projects for fracture and materials
Support for technology development projects for fracture mechanics
Prepare releases of the fracture mechanics software NASGRO, including but not limited to alpha, beta, and production releases, with maintenance and user support as required
Develop new features in NASGRO.
Attend two annual program meetings and shall prepare and deliver presentations at those two annual meetings.
Develop models to improve understanding of crack instability formation and grow
Travel for inspection and certification of program hardware.

Related to:

ISS Program
Orion Program
Technology Development projects

Representative of:
Life cycle reviews
Safety Data Package Reviews
Problem Resolutions
Certifications
Hardware design support
Oversight activities
OCCPs
Payload TRR Reviews
Hardware inspections
Drawing reviews
NDE development tasks

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
Standard of excellence: 50% of excess capacity utilized
Minimum Requirement: > 35% of excess capacity utilized

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.2 ISS EVA Materials/Fracture

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.3 ISS Materials/Fracture Control

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.4 NASGRO

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.5 Ellington Aircraft**Project Code:** See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.6 NDE Projects**Project Code:** See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.7 ORION Materials/Fracture Control**Project Code:** See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.8 Fracture Mechanics Crack Instability Modeling**Project Code:** See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

Document Number	Document Name	Rev.
AOD 33890	WB-57 Users Guide	Baseline/Feb 2002
EA-WI-025	GFE Flight Project Software and Firmware Development	Rev A 11-01
JSC 22267	Fatigue Crack Growth Computer Program NASGRO V 3.0	A
JSC 25863	Fracture Control Plan for JSC Spaceflight Hardware	B/April 2009
JSC 27301	Materials Control Plan for JSC Flight Hardware	F/August 2009
MIL-HDBK-6870A	Inspection Program Requirements Nondestructive for Aircraft and Missile Materials and Parts	Current
MSFC-HDBK-527/JSC 09604	Materials Selection List for Space Hardware Systems	F/09-88
NASA-STD-5003	Fracture Control Requirements for Payloads Using the Space Shuttle	10-96
NASA-STD-5009	Nondestructive Evaluation Requirements for Fracture Control Programs	Current
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware	Baseline/Jan 2008
NASA-STD-6016	Standard Materials and Processes Requirements for Spacecraft	Baseline/July 2008
NASA/SP-2007-3105	NASA Systems Engineering Handbook	1/12-07
NSTS 14046	Payload Verification Requirements	Rev E Change 3 08-02
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System	Change 13 08-02
NSTS 1700.7B ISS Addendum	Safety Policy and Requirements for Payloads Using the International Space Station	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current

SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-007.5	Materials and Processes Drawing Approval	D/July 2009
SOP-007.6	Materials and Fracture Control Certification	C/July 2009
SOP-009.98	Preparation of an Operation & Configuration Control Plan (OCCP) for Category B Pressure Vessels/Systems (PV/S)	Baseline/Jan 2010
SSP 30233	Space Station Requirements for Materials and Processes	G/November 2004
SSP 30558	Fracture Control Requirements for Space Station	Rev C 11-01
SSP 52005	ISS Payload Flight Equipment Requirements for Safety Critical Structures	C/December 2002

c. Required DRDs

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.2 ISS EVA Materials/Fracture		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.3 ISS Materials/Fracture Control		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.4 NASGRO		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.5 Ellington Aircraft		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.6 NDE Projects		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.7 ORION Materials/Fracture Control		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.4.8 Fracture Mechanics Crack Instability Modeling		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

d. Products

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
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<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.2 ISS EVA Materials/Fracture		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.3 ISS Materials/Fracture Control		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.4 NASGRO		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.5 Ellington Aircraft		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.6 NDE Projects		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.7 ORION Materials/Fracture Control		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.4.8 Fracture Mechanics Crack Instability Modeling		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.4.1 ISS Fracture/Materials Payload Safety (PSRP)		
. Hybrid		
- Hybrid		

5.4.2 ISS EVA Materials/Fracture		
. Hybrid		
- Hybrid		

5.4.3 ISS Materials/Fracture Control		
. Hybrid		
- Hybrid		

5.4.4 NASGRO

. Hybrid

- Hybrid

5.4.5 Ellington Aircraft

. Hybrid

- Hybrid

5.4.6 NDE Projects

. Hybrid

- Hybrid

5.4.7 ORION Materials/Fracture Control

. Hybrid

- Hybrid

5.4.8 Fracture Mechanics Crack Instability Modeling

. Hybrid

- Hybrid

5.5 ES5 Mechanical Design and Analysis Branch Services (INACTIVE)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Mechanical system safety assessments
Design and analysis of structures and mechanisms
Design, analysis, testing, planning, components, prototypes, training, and technical review for the development mechanical system technologies and projects

Related to:

ISS Program

Orion Program

Technology Development projects

Representative of:

PSRP and SRP document package reviews representative of those for flight safety reviews of spacecraft systems, payloads, and experiments

Orion mechanism motion and separation analyses

Half-year design activity for a prototype mechanism or concept development planned and delivered

In accordance with:

SOP-001.31

SOP-001.32

Under the governance of:

The ES5 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

5.5.1 Orion Mechanical System Assessments (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)

See PD for all charge code and reporting requests

5.5.2 Mechanical System Safety Reviews (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)

See PD for all charge code and reporting requests

5.5.3 Mechanical Technology Development (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
MA2-00-057	Mechanical System Safety	Sept 2000
NASA-STD-5017	Design & Development Requirements for Mechanisms	Current
NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements	Rev B
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP 30599	Safety Review Process International Space Station	Current
SSP 50021	ISS Safety Requirements Documents	Current

c. Required DRDs

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.5.3 Mechanical Technology Development (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.5.3 Mechanical Technology Development (INACTIVE)		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

e. **Product Verification**

5.5.1 Orion Mechanical System Assessments (INACTIVE)		
. Hybrid		
- Hybrid		

5.5.2 Mechanical System Safety Reviews (INACTIVE)		
. Hybrid		
- Hybrid		

5.5.3 Mechanical Technology Development (INACTIVE)		
. Hybrid		
- Hybrid		

5.6 Loads and Dynamics Branch Services (INACTIVE)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall loads and dynamics engineering and testing of aerospace systems (i.e. launch vehicle, spacecraft, payloads, GFE, and extraterrestrial vehicles)

Related to:

ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:

Linear and non-linear analyses
Assessments
Model development
Prototype model development
Mission flight rules
Missions support
Software tool development
Test support
Processes

In accordance with:

SOP-001.31
SOP-001.32

Under the governance of:

The ES6 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.6.1 Extraction and Berthing Integration (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)
See PD for all charge code and reporting requests

5.6.2 Orion Loads & Dynamics (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)
See PD for all charge code and reporting requests

5.6.3 Technology Development (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)
See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP-41000	International Space Station System Specification	Current
SSP-50808	ISS to COTS IRD	Current

c. Required DRDs

5.6.1 Extraction and Berthing Integration (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.6.2 Orion Loads & Dynamics (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

5.6.3 Technology Development (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.6.1 Extraction and Berthing Integration (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.6.2 Orion Loads & Dynamics (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

5.6.3 Technology Development (INACTIVE)		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

e. **Product Verification**

5.6.1 Extraction and Berthing Integration (INACTIVE)		
i. Hybrid		
- Hybrid		

5.6.2 Orion Loads & Dynamics (INACTIVE)		
i. Hybrid		
- Hybrid		

5.6.3 Technology Development (INACTIVE)		
i. Hybrid		
- Hybrid		

5.7 ES Static and Dynamic Test Facility (SDTF)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Test execution
Day-to-day maintenance and operations
Lab upgrades
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:
Static Testing
Dynamic Testing
Fracture Testing

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief, ES6 Branch Chief and/or SDTF Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero

unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.7.1 ES Static and Dynamic Test Facility Testing

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34417)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.7.1 ES Static and Dynamic Test Facility Testing		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.7.1 ES Static and Dynamic Test Facility Testing		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.7.1 ES Static and Dynamic Test Facility Testing	
. Hybrid	
- Hybrid	

5.8 ES Radiant Heat Test Facility

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Day-to-day maintenance and operations
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Radiant Heat Testing

In accordance with:
 SOP-001.24
 SOP-001.31
 SOP-001.32

Under the governance of:
 The RHTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
 -The contractor shall provide skills that produce quality products
 Standard of Excellence: Products receive zero customer (either ES or Program) complaints
 Minimum Requirement: Products receive
 -The contractor shall ensure laboratory and support team availability
 Standard of excellence: Contractor support team availability of >97%
 Minimum Requirement: Contractor support team availability of >95%
 -The contractor shall ensure safety regulation compliance and passage of safety audits
 Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
 Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
 -The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
 Standard of excellence: 50% of excess capacity utilized
 Minimum Requirement: > 35% of excess capacity utilized

5.8.1 ES Radiant Heat Test Facility

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.8.1 ES Radiant Heat Test Facility		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.8.1 ES Radiant Heat Test Facility		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.8.1 ES Radiant Heat Test Facility

. Hybrid
- Hybrid

5.9 ES Materials and Evaluation Laboratory

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Day-to-day maintenance and operations
Lab upgrades and Welding
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
ISS Program
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Material Analysis Request

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The MEL Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
Standard of excellence: 50% of excess capacity utilized

5.9.1 ES Materials and Evaluation Laboratory

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.9.2 Composites

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

b. Applicable Documents

Document Number	Document Name	Rev.
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011

EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.9.1 ES Materials and Evaluation Laboratory		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

5.9.2 Composites		
DRD #	DRD Title	Quantity/Frequency
None		Hybrid

d. Products

5.9.1 ES Materials and Evaluation Laboratory		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

5.9.2 Composites		
Product(s)	Quantity	Delivery Date
Hybrid	Hybrid	Hybrid

e. Product Verification

5.9.1 ES Materials and Evaluation Laboratory	
. Hybrid	
- Hybrid	

5.9.2 Composites	
. Hybrid	
- Hybrid	

5.10 ES Additive Manufacturing Lab (AML) (INACTIVE)

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall Part Fabrication Day-to-day maintenance and operations Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate/Divisions.

Related to:
ISS Program
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Plastic Parts and Plastic Scale Models

In accordance with:
 SOP-001.24
 SOP-001.31
 SOP-001.32

Under the governance of:
 The AML Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
 -The contractor shall provide skills that produce quality products
 Standard of Excellence: Products receive zero customer (either ES or Program) complaints
 -The contractor shall ensure laboratory and support team availability
 Standard of excellence: Lab availability of >97%
 Minimum Requirement: Lab availability of >95%
 -The contractor shall ensure safety regulation compliance and passage of safety audits
 Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
 Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure

5.10.1 ES Additive Manufacturing Lab (AML)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Most current
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JWI 4200.1	Management of Controlled Equipment	Most current
NPR 4200.2	Equipment Management Manual for Property Custodian	Most current

c. Required DRDs

5.10.1 ES Additive Manufacturing Lab (AML)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

d. Products

5.10.1 ES Additive Manufacturing Lab (AML)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

e. Product Verification

5.10.1 ES Additive Manufacturing Lab (AML)	
. Hybrid	
- Hybrid	

5.11 ES Manufacturing Services (INACTIVE)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Inactive

5.11.1 Manufacturing Services (INACTIVE)

Project Code: See PD for all charge code and reporting requests (INACTIVE)

See PD for all charge code and reporting requests

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

- c. **Required DRDs**

5.11.1 Manufacturing Services (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		Hybrid

- d. **Products**

5.11.1 Manufacturing Services (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hybrid	Hybrid	Hybrid

- e. **Product Verification**

5.11.1 Manufacturing Services (INACTIVE)	
. Hybrid	
- Hybrid	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 24
Task Order Number: NNJ16HA13T TO# 200	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 ES Structural Engineering Services (TO110) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$4,096,148	\$4,096,148

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **9/28/15**
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rnoverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.28 11:36:38 -0500

JSC Engineering, Technology and Science Contract

NNJ16HA13T-TO200 BASE

Originator: SHIRLEY HOLLAND-HUNT (ES18) **TMR:** SHIRLEY HOLLAND-HUNT (ES) (281) 483-3254

1. Title of Effort: FY16 ES Structural Engineering Services (TO110) (LOE)

2. Date of Request: 09/16/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. 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.

f. 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

g. **2.2.4 Training**

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

h. **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.

i. **2.3 Analysis and Assessment**

j. **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.

k. **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.

l. **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.

m. **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.

n. **2.4 Facilities**

o. **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.

p. **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.

q. **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.

r. **2.5 Research and Development**

s. **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, Descent, 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.

t. **2.6 Special Projects**

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

u.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ES18 Managment Integration Office Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall INACTIVE

5.1.1 INACTIVE

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirement for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. **Required DRDs**

5.1.1 INACTIVE		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. **Products**

5.1.1 INACTIVE		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.1.1 INACTIVE	
i. LOE	
- LOE	

5.2 ES2 Structural Branch Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Review of structural engineering estimates
Review of performance of trade studies
Review of performance of structural engineering assessments and analysis
Safety assessments
Development of anomaly resolution recommendations
Participation in GFE project technical reviews
Travel to support Orion PDRs and TIMs
Structural design services including outer mold line definition, structural layout, and subsystem/payload placement for advanced vehicle studies

Related to:

Spacecraft payloads

ISS, Orion, GFE projects

Technology Development projects

Representative of:

Engineering requirements analysis reports for ISS Program projects

Orion Project Stress Analysis Summary reports
GFE Technology Development projects

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.2.1 Orion CSM

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.2.2 PSRP/GCAR Review

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.2.3 GFE Core Team

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.2.4 Structural Technologies Development

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34241)JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware	Baseline
NSTS 08307	Criteria for Pre-Loaded Bolts	Rev A
NSTS 13830	Payload Safety Review and Data Submittal Requirements for Payloads Using the Shuttle and ISS	Rev C, Change 4 01-02
NSTS 14046	Payload Verification Requirements	Rev E, Change 3 08-02
NSTS 1700.7B ISS	Safety Policy and Requirements for Payloads Using the ISS	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current

c. Required DRDs

5.2.1 Orion CSM		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.2 PSRP/GCAR Review		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.3 GFE Core Team		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.2.4 Structural Technologies Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.2.1 Orion CSM			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOE		LOE	LOE

5.2.2 PSRP/GCAR Review			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOPE		LOE	LOE

5.2.3 GFE Core Team			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOE		LOE	LOE

5.2.4 Structural Technologies Development			
<u>Product(s)</u>		<u>Quantity</u>	<u>Delivery Date</u>
LOE		LOE	LOE

e. Product Verification

5.2.1 Orion CSM	
i. LOE	
- LOE	

5.2.2 PSRP/GCAR Review	
i. LOPE	
- LOE	

5.2.3 GFE Core Team	
---------------------	--

i. LOE
- LOE

5.2.4 Structural Technologies Development
i. LOE
- LOE

5.3 Thermal Design Branch Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide:
Thermal Analysis Support and Reports
System management activities
Travel to support System management activities

Related to:
International Space Station Program
Orion MPCV Program
Commercial Crew Integrated Capability (CCiCap) Program

Representative of:
On-orbit thermal analyses
Entry thermal analysis
Thermal test simulation

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES3 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive

5.3.1 ES3 Thermal Design Branch Services

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	Current

c. Required DRDs

5.3.1 ES3 Thermal Design Branch Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.3.1 ES3 Thermal Design Branch Services		
Product(s)	Quantity	Delivery Date
LOE	LOE	LKOE

e. **Product Verification**

5.3.1 ES3 Thermal Design Branch Services
i. LOE
- LOE

5.4 Materials and Processes Branch Services (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide:
- Assessments
 - Support for technology development projects for fracture and materials
 - Support for technology development projects for fracture mechanics
 - Prepare releases of the fracture mechanics software NASGRO, including but not limited to alpha, beta, and production releases, with maintenance and user support as required
 - Develop new features in NASGRO.
 - Attend two annual program meetings and shall prepare and deliver presentations at those two annual meetings.

Related to:
ISS Program
Orion Program
Technology Development projects

Representative of:
Life cycle reviews
Safety Data Package Reviews
Problem Resolutions
Certifications
Hardware design support
Oversight activities
OCCPs
Payload TRR Reviews
Hardware inspections
Drawing reviews
NDE development tasks

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products received

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.4.2 ISS EVA Materials/Fracture (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.3 ISS Materials/Fracture Control (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.4 NASGRO (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.5 Ellington Aircraft (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.4.6 NDE Projects (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
AOD 33890	WB-57 Users Guide	Baseline/Feb 2002
EA-WI-025	GFE Flight Project Software and Firmware Development	Rev A 11-01
JSC 22267	Fatigue Crack Growth Computer Program NASGRO V 3.0	A
JSC 25863	Fracture Control Plan for JSC Spaceflight Hardware	B/April 2009
JSC 27301	Materials Control Plan for JSC Flight Hardware	F/August 2009
MIL-HDBK-6870A	Inspection Program Requirements Nondestructive for Aircraft and Missile Materials and Parts	Current
MSFC-HDBK-527/JSC 09604	Materials Selection List for Space Hardware Systems	F/09-88
NASA-STD-5003	Fracture Control Requirements for Payloads Using the Space Shuttle	10-96
NASA-STD-5009	Nondestructive Evaluation Requirements for Fracture Control Programs	Current
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware	Baseline/Jan 2008
NASA-STD-6016	Standard Materials and Processes Requirements for Spacecraft	Baseline/July 2008
NASA/SP-2007-6105	NASA Systems Engineering Handbook	1/12-07
NSTS 14046	Payload Verification Requirements	Rev E Change 3 08-02
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System	Change 13 08-02

NSTS 1700.7B ISS Addendum	Safety Policy and Requirements for Payloads Using the International Space Station	Rev S 01-03
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-007.5	Materials and Processes Drawing Approval	D/July 2009
SOP-007.6	Materials and Fracture Control Certification	C/July 2009
SOP-009.98	Preparation of an Operation & Configuration Control Plan (OCCP) for Category B Pressure Vessels/Systems (PV/S)	Baseline/Jan 2010
SSP 30233	Space Station Requirements for Materials and Processes	G/November 2004
SSP 30558	Fracture Control Requirements for Space Station	Rev C 11-01
SSP 52005	ISS Payload Flight Equipment Requirements for Safety Critical Structures	C/December 2002

c. Required DRDs

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.4 NASGRO (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.5 Ellington Aircraft (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.4.6 NDE Projects (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.4 NASGRO (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.5 Ellington Aircraft (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.4.6 NDE Projects (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.4.1 ISS Fracture/Materials Payload Safety (PSRP) (INACTIVE)		
i. LOE		
- LOE		

5.4.2 ISS EVA Materials/Fracture (INACTIVE)		
i. LOE		
- LOE		

5.4.3 ISS Materials/Fracture Control (INACTIVE)		
i. LOE		
- LOE		

5.4.4 NASGRO (INACTIVE)		
i. LOE		
- LOE		

5.4.5 Ellington Aircraft (INACTIVE)		
i. LOE		
- LOE		

5.4.6 NDE Projects (INACTIVE)		
i. LOE		
- LOE		

5.5 ES5 Mechanical Design and Analysis Branch Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide:
- Mechanical system safety assessments
 - Design and analysis of structures and mechanisms
 - Design, analysis, testing, planning, components, prototypes, training, and technical review for the development mechanical system technologies and projects
 - Engineering Services for technical lab tasks

Related to:

ISS Program

Orion Program

Technology Development projects

Representative of:

PSRP and SRP document package reviews representative of those for flight safety reviews of spacecraft systems, payloads, and experiments

Orion mechanism motion and separation analyses

Half-year design activity for a prototype mechanism or concept development planned and delivered

In accordance with:

SOP-001.31

SOP-001.32

Under the governance of:

The ES5 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products received

5.5.1 Orion Mechanical System Assessments

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.5.2 Mechanical System Safety Reviews

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.5.3 Mechanical Technology Development

Project Code:

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
MA2-00-057	Mechanical System Safety	Sept 2000
NASA-STD-5017	Design & Development Requirements for Mechanisms	Current
NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements	Rev B
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP 30599	Safety Review Process International Space Station	Current
SSP 50021	ISS Safety Requirements Documents	Current

c. Required DRDs

5.5.1 Orion Mechanical System Assessments		
DRD #	DRD Title	Quantity/Frequency
None		LOE

5.5.2 Mechanical System Safety Reviews		
DRD #	DRD Title	Quantity/Frequency
None		LOE

5.5.3 Mechanical Technology Development		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.5.1 Orion Mechanical System Assessments		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

5.5.2 Mechanical System Safety Reviews		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

5.5.3 Mechanical Technology Development		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.5.1 Orion Mechanical System Assessments	
i. LOE	
- LOE	

5.5.2 Mechanical System Safety Reviews	
i. LOE	
- LOE	

5.5.3 Mechanical Technology Development	
i. LOE	
- LOE	

5.6 Loads and Dynamics Branch Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide:
loads and dynamics engineering and testing of aerospace systems (i.e. launch vehicle, spacecraft, payloads, GFE, and extraterrestrial vehicles)

Related to:
ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:
Linear and non-linear analyses
Assessments
Model development
Prototype model development
Mission flight rules
Missions support
Software tool development
Test support
Processes

In accordance with:
SOP-001.31
SOP-001.32

Under the governance of:
The ES6 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products received

5.6.1 Extraction and Berthing Integration

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.6.2 Orion Loads & Dynamics

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

5.6.3 Other Engineering Services

Project Code: See PD for all charge code and reporting requests
See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SSP-41000	International Space Station System Specification	Current
SSP-50808	ISS to COTS IRD	Current

c. Required DRDs

5.6.1 Extraction and Berthing Integration		
DRD #	DRD Title	Quantity/Frequency
None		LOE

5.6.2 Orion Loads & Dynamics		
DRD #	DRD Title	Quantity/Frequency
None		LOE

5.6.3 Other Engineering Services		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.6.1 Extraction and Berthing Integration			
Product(s)	Quantity	Delivery Date	
LOE	LOE	LOE	

5.6.2 Orion Loads & Dynamics			
Product(s)	Quantity	Delivery Date	
LOE	LOE	LOE	

5.6.3 Other Engineering Services			
Product(s)	Quantity	Delivery Date	
LOE	LOE	LOE	

e. Product Verification

5.6.1 Extraction and Berthing Integration	
i. LOE	
- LOE	

5.6.2 Orion Loads & Dynamics	
i. LOE	
- LOE	

5.6.3 Other Engineering Services	
i. LOE	
- LOE	

5.7 ES Static and Dynamic Test Facility (SDTF) (INACTIVE)

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide:
- Test execution
 - Day-to-day maintenance and operations
 - Lab upgrades
 - Savings for required consumables/products/services by utilizing economies of scale for similar requirements

of other Directorate divisions.

Related to:
ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements

Representative of:
Static Testing
Dynamic Testing
Fracture Testing

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The ES2 Branch Chief, ES6 Branch Chief and/or SDTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products receive
-The contractor shall ensure laboratory and support team availability
Standard of excellence: Contractor support team availability of >97%
Minimum Requirement: Contractor support team availability of >95%
-The contractor shall ensure safety regulation compliance and passage of safety audits
Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
Standard of excellence: 50% of excess capacity utilized
Minimum Requirement: > 35% of excess capacity utilized

5.7.1 ES Static and Dynamic Test Facility (SDTF) Testing (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34417)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.7.1 ES Static and Dynamic Test Facility (SDTF) Testing (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

None		LOE
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d. Products

5.7.1 ES Static and Dynamic Test Facility (SDTF) Testing (INACTIVE)		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.7.1 ES Static and Dynamic Test Facility (SDTF) Testing (INACTIVE)		
i. LOE		
- LOE		

5.8 ES Radiant Heat Test Facility (INACTIVE)

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide:
 Test execution
 Day-to-day maintenance and operations
 Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
 Orion Program
 CC Program
 Technology Development projects
 Space Act Agreements

Representative of:
 Radiant Heat Testing

In accordance with:
 SOP-001.24
 SOP-001.31
 SOP-001.32

Under the governance of:
 The RHTF Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:
 -The contractor shall provide skills that produce quality products
 Standard of Excellence: Products receive zero customer (either ES or Program) complaints
 Minimum Requirement: Products receive
 -The contractor shall ensure laboratory and support team availability
 Standard of excellence: Contractor support team availability of >97%
 Minimum Requirement: Contractor support team availability of >95%
 -The contractor shall ensure safety regulation compliance and passage of safety audits
 Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.
 Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.
 -The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost
 Standard of excellence: 50% of excess capacity utilized
 Minimum Requirement: > 35% of excess capacity utilized

5.8.1 ES Radiant Heat Test Facility (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.8.1 ES Radiant Heat Test Facility (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.8.1 ES Radiant Heat Test Facility (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.8.1 ES Radiant Heat Test Facility (INACTIVE)	
i. LOE	
- LOE	

5.9 Materials and Evaluation Laboratory (INACTIVE)

a. Requirement - In compliance with the above identified SOW(s) the contractor shall provide:

Test execution
Day-to-day maintenance and operations
Lab upgrades and Welding
Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate divisions.

Related to:
ISS Program
Orion Program
CC Program
Technology Development projects
Space Act Agreements

Representative of:
Material Analysis Request

In accordance with:
SOP-001.24
SOP-001.31
SOP-001.32

Under the governance of:
The MEL Lab Manager(or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

Minimum Requirement: Products receive

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Contractor support team availability of >97%

Minimum Requirement: Contractor support team availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure.

-The contractor shall identify and utilize excess capacity, on a non-interference basis, to offset staffing cost

Standard of excellence: 50% of excess capacity utilized

Minimum Requirement: > 35% of excess capacity utilized

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
(34779)JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Baseline
SOP-001.24	M&O Requirements for Structural Engineering Division Facilities and Laboratories	A
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-002.8	General Operating Procedures for Structural Engineering Division	D

c. Required DRDs

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.9.1 ES Materials and Evaluation Laboratory (INACTIVE)	
i. LOE	
- LOE	

5.10 ES Additive Manufacturing Lab (AML)

a. Requirement - In compliance with the above identified SOW(s) the contractor shall provide:

Part Fabrication

Day-to-day maintenance and operations

Savings for required consumables/products/services by utilizing economies of scale for similar requirements of other Directorate/Divisions.

Related to:

ISS Program

Orion Program

CC Program

Technology Development projects

Space Act Agreements

Representative of:

Plastic Parts and Plastic Scale Models

In accordance with:

SOP-001.24

SOP-001.31

SOP-001.32

Under the governance of:

The AML Lab Manager (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products

Standard of Excellence: Products receive zero customer (either ES or Program) complaints

-The contractor shall ensure laboratory and support team availability

Standard of excellence: Lab availability of >97%

Minimum Requirement: Lab availability of >95%

-The contractor shall ensure safety regulation compliance and passage of safety audits

Standard of Excellence: No minor and no major findings per external audit, with zero unresolved findings by external audit closure.

Minimum Requirement: No more than two minor and no major findings per external audit, with zero unresolved findings by external audit closure

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Most current
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 4200.1	Management of Controlled Equipment	Most current
NPR 4200.2	Equipment Management Manual for Property Custodian	Most current

c. Required DRDs

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. **Product Verification**

5.10.1 ES Additive Manufacturing Lab (AML) (INACTIVE)		
i. LOE		
- LOE		

5.11 ES Manufacturing Services

a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide:

Machining and fabrication
Cleaning
Welding

Related to:

ISS Program
Orion Program
SLS Program
Commercial Crew Program
GFE
Technology Development projects
Space Act Agreements
Spacecraft payloads

Representative of:

Fabrication, cleaning and welding services including a broad scope of functions from providing rapid turnaround of simple parts and modifications to hardware, to the development of products, prototypes and space flight hardware.

In accordance with:

SOP-001.31
SOP-001.32

Under the governance of:

The ES4 Branch Chief (or delegated authority) and Structural Engineering Division Change Control Board (CCB).

Metrics:

-The contractor shall provide skills that produce quality products
Standard of Excellence: Products receive zero customer (either ES or Program) complaints
Minimum Requirement: Products received

5.11.1 Management and Administration

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.11.2 EA (Internal) Customers

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

5.11.3 Non-EA (External) Customers

Project Code: See PD for all charge code and reporting requests

See PD for all charge code and reporting requests

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPD1280.1A	JSC QUALITY POLICY	Current
JPR 1280.2	JSC QUALITY MANUAL	Current
JPR 1281.8	Product Identification and Traceability	Change 3, Jan. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
SOP-001.31	Technical Requirements for Structural Engineering	Current
SOP-001.32	Operating Plan for Structural Engineering	Current
SOP-003.29	Material Handling Operations in Buildings 9S and 10	Current
SOP-005.21	Self-Verification Program	Current

c. Required DRDs

5.11.1 Management and Administration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.11.2 EA (Internal) Customers		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

5.11.3 Non-EA (External) Customers		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.11.1 Management and Administration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.11.2 EA (Internal) Customers		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

5.11.3 Non-EA (External) Customers		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.11.1 Management and Administration		
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i. LOE
- LOE

5.11.2 EA (Internal) Customers
i. LOE
- LOE

5.11.3 Non-EA (External) Customers
i. LOE
- LOE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ16HA14T TO# 201	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Propulsion and Power Division Development and Test Operations Support (TO142)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b) (4)		
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,203,339	\$3,203,339

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET <small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.23 16:01:33 -05'00'</small> Signature: _____ Date: 9/23/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA14T-TO201 BASE

Originator: MARTIN MCCLEAN (EP6) **TMR:** SANDRA RUTTLE (EP) (281) 244-0339

1. Title of Effort: FY16 Propulsion and Power Division Development and Test Operations Support (TO142)

2. Date of Request: 09/02/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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 JET S Technical Library and specified on each task order.

c. 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.

d. 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

e. 2.4 Facilities

f. **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.

g. **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.

h.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ESTA Development and Test Support Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall support test operations, hardware and software development and production, capability maintenance and capability projects for NASA flight and advanced development programs. The primary technical disciplines supported are electrical power distribution and control, batteries, pyrotechnics, in-space vehicle propulsion, fuel cells, and in-situ resource utilization (chemical processing).

Test Operations:

Test operations gather data on product performance, safety, life, and anomaly resolution in laboratory or simulated ground and space environments. Environments supported include thermal, vacuum, thermal-vacuum, elevated external pressure, varying atmospheric oxygen levels, vibration, classical shock, pyrotechnic shock, and power quality. Test operations may be applied to materials, components, subassemblies, and complete assemblies. Test support ranges from early development and demonstration through flight equipment production (acceptance, qualification, and certification) and sustaining engineering.

The contractor shall support test operations as defined by individual test requirements which may include the development and execution of plans, hazard analyses, and procedures, the estimation of labor, procurements, and schedule, the creation or modification of mechanical, electrical, and data acquisition and control systems, the demonstration of test readiness, the conduct of test operations, the generation and analysis of data, and creation of reports which document the performance of the product under test.

Hardware and Software Products:

Hardware and software products support NASA flight and advanced programs for development, ground test, ground support, and spaceflight.

The contractor shall support production of ground and flight hardware and software products as defined by individual project requirements which may include the estimation of labor, procurements, and schedule, the design, fabrication, test, maintenance, repair, hardware and software integration, the pre and post use processing, the development of 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 for all assigned product support.

Capability Maintenance:

Capability maintenance serves to keep the capabilities for performing test operations and producing hardware and software products within the Propulsion and Power Division available in a working and ready state.

The contractor shall support maintenance of the following capabilities.

- Environmental testing including thermal, vacuum, thermal-vacuum, vibration, shock, pyroshock, power quality, elevated external pressure, and varying atmospheric oxygen levels
- Chemical laboratory analysis and processing (FTIR, GC, etc)
- Fluid component and system pressure testing
- Battery testing including physical examination (weights, dimensions, imagery), performance (capacity, rate capability, life), and safety (external short circuit, internal short circuit, heat-to-vent, vent/burst, drop) testing
- Fuel cell testing
- In-situ Resource Utilization chemical processing
- Pyrotechnics testing
- Electrical power component and system testing
- In space vehicle propulsion testing up to nominal 200 lbf thrust

The contractor shall support maintenance of the following types of facility test support systems and equipment.

- Pressure and fluid handling systems
- Data acquisition and control systems including calibrated transducers and certified signal conditioning and data recording
- Electrical power and control systems
- Hazard containment systems and equipment
- Environmental test systems

The contractor shall support the following as assigned.

- Hazardous chemical inventories
- Periodic safety reviews by external parties
- Periodic verifications of systems and equipment
- Work control and logging of work authorizing documents
- Certifications of lifting equipment

- Administrative activities including processing of test and project requests, test and project estimates, and test and project files
- Procurement of consumable and test specific materials
- Logistics activities including material inventories and store stock operations

Capability Projects:

Capability projects serve to create, modify, or remove capabilities for performing test operations and producing hardware and software products within the Propulsion and Power Division.

The contractor shall support capability projects as defined by individual project requirements which may include the development and execution of project plans, hazard analyses, and procedures, the creation or modification of mechanical, electrical, and data acquisition and control systems, the demonstration of capability readiness, the validation of capability performance, and creation of reports which document the performance of the capability.

The contractor shall maintain document and system configuration control for all assigned support that comply with applicable JSC requirements in the General Operating Procedures Manual for EA Testing Facilities (EA-WI-024), the ESTA General Operating Procedures Manual (EP-WI-004), JSC Safety and Health Handbook (JPR1700.1), and individual test/project requirements. The contractor shall coordinate schedules and workforce for all assigned support.

ESTA Facility and Test System Upgrades and Spares:

The contractor shall identify and procure equipment upgrades and spares for facility and test systems that will increase availability.

The contractor shall provide supplemental labor data relating hours and roles to each test or project identified

5.1.1 ESTA Development and Test Operations

Project Code:

Tests, projects, and maintenance are defined in a Task Database maintained by NASA on an organizational file server.

A nominal test or project is based on the requirements for the Next Generation Ultrasound (NGU) System Battery Certification. Test and capability project quantities are based on the complexity of this nominal test having a weighted value of 1. Test and projects typically range in complexity from 0.1 to 10.0 times this complexity. Complexity of test, specified in the Task Database, shall be used by the contractor in estimating resources and schedule for actual tests, including capability projects.

In performing ESTA Development and Test Operations, the contractor shall

- provide a skilled workforce and leadership with the appropriate mentoring, training, and technical expert oversight that ensures the delivery of quality EP products.
- apply best practices across the contract for lean operations
- provide a safe work environment in ESTA hazardous operations
- provide accurate business reporting on actuals and projected expenditures
- provide partnership opportunities that take advantage of unused capacity or create new work
- provide fast turnaround for surge or destaffing of personnel with the appropriate skill levels – including reach-back expertise
- provide timely and readily available test capacity across EP facilities
- provide support for four development and test operations at locations remote from the NASA JSC site

Metrics:

Required Service: Provide operational facilities to support ESTA Development and Test Operations

Standard of Excellence: 100% availability and functionality to support scheduled operations due to factors within the scope of the SOW.

Minimum Requirement: 95% availability and functionality to support scheduled operations due to factors within the scope of the SOW.

Required Service: Ensure ESTA customer satisfaction

Standard of Excellence: Zero tests have complaints about impacts to customer.

Minimum Requirement: Less than 5% of tests have complaints about impacts to customer.

Required Service: Ensure availability of required skills:

Standard of Excellence: Required skills available 100% of time.

Minimum Requirement: Required skills available greater than 95% of the time

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Current
EP-WI-004	ESTA General Operating Procedures Manual	Current

c. Required DRDs

5.1.1 ESTA Development and Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	1 per assigned test

d. Products

5.1.1 ESTA Development and Test Operations		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Tests and Projects, Weighted	73	Per Task Database
Monthly Status Report	12	At work group reviews
Test and Product Schedules (contractor maintains or provides input via Task Database)	12	At work group reviews

e. Product Verification

5.1.1 ESTA Development and Test Operations	
. Tests and Projects, Weighted	
. Test and project products shall be verified through Task Database review at scheduled periodic status meetings and review of test reports with NASA EP6 branch personnel	

i. Monthly Status Report

- The periodic status reports shall be verified by review with NASA EP6 branch personnel.

ii. Test and Product Schedules (contractor maintains or provides input via Task Database)

- Schedules shall be verified through Task Database review at scheduled periodic status meetings with NASA EP6 branch personnel.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 10
Task Order Number: NNJ16HA15T TO# 202	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Aerosciences and GN&C R&D Engineering Services

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,281,138	\$1,281,138

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Lawrence Miller <div style="text-align: center;"> LAWRENCE MILLER </div> Signature: _____ Date: 9/15/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA15T-TO202 BASE

Originator: DENA HAYNES (EG1) **TMR:** DENA HAYNES (EG) (281) 244-5122

1. Title of Effort: FY16 Aerosciences and GN&C R&D Engineering Services (TO141) (LOE)

2. Date of Request: 09/01/2015

3. Statement of Work Task Description

a. 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.

b. 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, Descent, 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.

c. 2.6 Special Projects

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

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Aerosciences Flight Mechanics Division Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide Aerosciences Flight Mechanics Division indirect support in the areas of property management, general IT, IT security and system administration. Provide Advanced Spacecraft Guid and Nav technical expertise consulting.

5.1.1 Aerosciences Flight Mechanics Division Services

Project Code:

Provide Aerosciences Flight Mechanics Division indirect support in the areas of property management, general IT, IT security and system administration. Provide Advanced Spacecraft Guid and Nav technical expertise consulting.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. **Required DRDs**

5.1.1 Aerosciences Flight Mechanics Division Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. **Products**

5.1.1 Aerosciences Flight Mechanics Division Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.1.1 Aerosciences Flight Mechanics Division Services	
. LOE	
. LOE	

5.2 Aerosciences R&D Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall shall provide engineering and technical services directed at modeling and analysis of the aerosciences for advanced exploration systems. Tasks include development of analysis methods, analytical tools, and application of these methods & tools for conducting vehicle aerodynamics and aerothermodynamics performance trades.

5.2.1 Aerosciences R&D Engineering Services

Project Code:

The Contractor shall provide engineering and technical services directed at modeling and analysis of the aerosciences for advanced exploration systems. Tasks include development of analysis methods, analytical tools, and application of these methods & tools for conducting vehicle aerodynamics and aerothermodynamics performance trades.

Actions to perform specific tasks shall be assigned by the technical manager through action items.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.2.1 Aerosciences R&D Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.2.1 Aerosciences R&D Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.2.1 Aerosciences R&D Engineering Services	
. LOE	
. LOE	

5.3 GN&C Lab Sustaining & Maintenance

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at GN&C Lab sustaining and for maintaining high fidelity 6 DOF GN&C simulations, visualization capabilities, real-time human in the loop simulations, and GN&C analytic tools. Provide technical services directed at Integrated Power Avionics & Software (iPAS) network and system administration support

5.3.1 GN&C Lab Sustaining & Maintenance

Project Code:

provide engineering and technical services directed at GN&C Lab sustaining and for maintaining high fidelity 6 DOF GN&C simulations, visualization capabilities, real-time human in the loop simulations, and GN&C analytic tools. Provide technical services directed at Integrated Power Avionics & Software (iPAS) network and system administration support

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.3.1 GN&C Lab Sustaining & Maintenance		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.3.1 GN&C Lab Sustaining & Maintenance		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.3.1 GN&C Lab Sustaining & Maintenance		
. LOE		
- LOE		

5.4 PDT Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Propulsive Descent Technology (PDT) project directed at FY14 and FY15 implementation cost, content and schedule. As necessary, the contractor shall also provide planning for new FY15 and FY16 content including engineering and technical services directed at establishing integrated cost, content and schedule baseline.

5.4.1 PDT Engineering Services

Project Code:

In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Propulsive Descent Technology (PDT) project directed FY15 implementation cost, content and schedule. As necessary, the contractor shall also provide planning for new FY15 and FY16 content including engineering and technical services directed at establishing integrated cost, content and schedule baseline, expert support to PDT reviews, expert input on a mid L/D vehicle development activity. Additionally, the contractor shall provide engineering and technical services directed at SpaceX Falcon vehicle aerodynamic flight data reconstruction, generation of aerodynamic and aerothermal databases for the SpaceX Red Dragon capsule, and an SRP vehicle design study

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.4.1 PDT Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-11	Flight Products Qualification Plan	LOE

d. Products

5.4.1 PDT Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.4.1 PDT Engineering Services		
. LOE		

- LOE

5.5 International Docking Adapters Rendezvous & Prox Ops Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering services for the Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA). and also provide IDA testing and verification support.

5.5.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services

Project Code:

The contractor shall provide engineering services for the Autonomous Rendezvous and Docking systems requirements analysis and engineering assessments for the International Docking Adapters (IDA). and also provide IDA testing and verification support.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

- c. **Required DRDs**

5.5.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

- d. **Products**

5.5.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

- e. **Product Verification**

5.5.1 International Docking Adapters Rendezvous & Prox Ops Engineering Services	
. LOE	
- LOE	

5.6 Halliburton Capping Stack Toolset Engineering Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services directed at developing a toolset that will allow for the design and certification of deep ocean blow out recoveries including near field dynamics of capping stack installation caused by the blow out jet hydrodynamics, capping stack geometry design trades, operational procedure development, and critical response team certification.

5.6.1 Halliburton Capping Stack Toolset Engineering Services

Project Code:

The Contractor shall provide engineering and technical services directed at developing a toolset that will allow for the design and certification of deep ocean blow out recoveries including near field dynamics of capping stack installation caused by the blow out jet hydrodynamics, capping stack geometry design trades, operational procedure development, and critical response team certification.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
LOE	LOE	LOE

c. Required DRDs

5.6.1 Halliburton Capping Stack Toolset Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		LOE

d. Products

5.6.1 Halliburton Capping Stack Toolset Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.6.1 Halliburton Capping Stack Toolset Engineering Services	
. LOE	
- LOE	

5.7 SpaceX CCP Aerosciences Engineering Services

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall Conduct aerodynamic and aerothermodynamic analyses of the SpaceX Dragon vehicle during ascent, abort, reentry, and landing flight phases. Tasks will include calculating aerodynamic forces and moments, aerothermodynamic heat flux loads, and jet efficiency of the Draco and Super Draco engines in different power-on configurations.

5.7.1 SpaceX CCP Aerosciences Engineering Services
Project Code:

Conduct aerodynamic and aerothermodynamic analyses of the SpaceX Dragon vehicle during ascent, abort, reentry, and landing flight phases. Tasks will include calculating aerodynamic forces and moments, aerothermodynamic heat flux loads, and jet efficiency of the Draco and Super Draco engines in different power-on configurations.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
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LOE	LOE	LOE
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c. Required DRDs

5.7.1 SpaceX CCP Aerosciences Engineering Services		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.7.1 SpaceX CCP Aerosciences Engineering Services		
Product(s)	Quantity	Delivery Date
LOE	LOE	LOE

e. Product Verification

5.7.1 SpaceX CCP Aerosciences Engineering Services	
. LOE	
- LOE	

5.8 Guidance Navigation & Control ISS OD System Management

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services as they relate to ISS System Management. System Management is defined as technical oversight/insight of the design, development, test, certification, verification, sustaining engineering, real time on-orbit system performance assessments (US and International element interfaces), problem resolution, requirements change initiation/evaluation, visiting vehicle integrated reviews, and payload assessments and integration with the system.

5.8.1 Guidance Navigation & Control ISS OD System Management

Project Code:

provide engineering services as they relate to Guidance Navigation & Control ISS System Management. System Management is defined as technical oversight/insight of the design, development, test, certification, verification, sustaining engineering, real time on-orbit system performance assessments (US and International element interfaces), problem resolution, requirements change initiation/evaluation, visiting vehicle integrated reviews, and payload assessments and integration with the system.

b. Applicable Documents

Document Number	Document Name	Rev.
LOE	LOE	LOE

c. Required DRDs

5.8.1 Guidance Navigation & Control ISS OD System Management		
DRD #	DRD Title	Quantity/Frequency
None		LOE

d. Products

5.8.1 Guidance Navigation & Control ISS OD System Management		
Product(s)	Quantity	Delivery Date

LOE	LOE	LOE
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e. Product Verification

5.8.1 Guidance Navigation & Control ISS OD System Management
. LOE
. LOE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA16T TO# 203	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Spacecraft Software Engineering Services(TO144)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

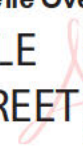
Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cos			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,419,758	\$1,419,758

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet  ROCHELLE OVERSTREET <small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnoverst, cn=ROCHELLE OVERSTREET Date: 2015.09.23 16:22:00 -05'00'</small> Signature: _____ Date: 9/23/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA16T-TO203 BASE

Originator: PEDRO MARTINEZ (ER6) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Spacecraft Software Engineering Services (TO144)

2. Date of Request: 08/24/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ISS Countermeasures System (CMS) Software Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) software for on-orbit operations and ground operations as defined in the subsequent paragraphs. The contractor shall provide software sustaining engineering products and services for the Countermeasures System Software (CMSS) applications as follows:

a) Perform engineering analyses as part of on-orbit anomaly investigations.

This activity includes renewal of software licenses originally purchased through JETS.

ER6 will supply the tools necessary for the contractor to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. ER6 will supply laboratory space and development systems required by the contractor to accomplish the tasks.

5.1.1 ISS Countermeasures System (CMS) Software Engineering

Project Code:

The contractor shall develop and sustain the International Space Station (ISS) Crew HealthCare System (CHeCS) software for on-orbit operations and ground operations.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-025	GFE Flight Project Software and Firmware Development Work Instruction	D
ER6-TM203	ER6 TO-203 Master Plan and Schedule	Original

c. Required DRDs

5.1.1 ISS Countermeasures System (CMS) Software Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.1.1 ISS Countermeasures System (CMS) Software Engineering		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	Per ER6-TM203	Per ER6-TM203

e. Product Verification

5.1.1 ISS Countermeasures System (CMS) Software Engineering	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	

5.2 MPCV Software Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide software engineering services for the Orion Multi-Purpose Crew Vehicle (MPCV). The contractor shall evaluate requirements, architecture, processes, designs, and configuration management. Additionally, the contractor will foster a collaborative environment with the Orion prime contractor to create an open forum that allows for the exchange of information that will allow the NASA Orion team to assess the prime contractor's software development activities for the entire software life cycle.

The contractor shall perform the following:

- a) Evaluate Orion Communications & Tracking (C&T) flight and flight support software plans, metrics, concepts, requirements, design, integration, verification, validation, certification and acceptance, implementation, operations, maintenance, decommissioning and overall life cycle, as follows:
 - a1. Evaluate Type 1 and Type 2 documents and provide approval recommendations.
 - a2. Review Type 3-5 documents for impact on Orion Software.
 - a3. Assess Orion Software Change Requests (CRs) and Discrepancy Reports (DRs) and provide closure recommendations.
 - a4. Perform conceptual design trades consistent with subsystem requirements.
 - a5. Perform testability analysis of subsystem instrumentation design using system modeling tools.
 - a6. Provide technical reporting to the Software System Manager and Orion Software System Manager in programmatic level reviews, technical meetings, and control boards.
 - a7. Participate in C&T meetings at other NASA centers and Orion contractor facilities.
- b) Evaluate Orion Displays and Controls (DAC) flight and flight support software plans, metrics, concepts, requirements, design, integration, verification, validation, certification and acceptance, implementation, operations, maintenance, decommissioning and overall life cycle, as follows:
 - b1. Evaluate Type 1 and Type 2 documents and provide approval recommendations.
 - b2. Review Type 3-5 documents for impact on Orion Software.
 - b3. Assess Orion Software Change Requests (CRs) and Discrepancy Reports (DRs) and provide closure recommendations.
 - b4. Perform conceptual design trades consistent with subsystem requirements.
 - b5. Perform testability analysis of subsystem instrumentation design using system modeling tools.
 - b6. Provide technical reporting to the Software System Manager and Orion Software System Manager in programmatic level reviews, technical meetings, and control boards.
 - b7. Participate in C&T meetings at other NASA centers and Orion contractor facilities.
- c) Process Documentation and Document Control Oversight - Perform development, integration, and operation tasks associated with the Orion Software Tool Chain and the JSC instance of the Orion Software Collaborative Environment (SCE-lite), as follows:
 - c1. Assist in equipment selection, procurements, hardware and software integration, test coordination, planning, set up, system administration, and overall development of the Orion Software Tool Chain.
 - c2. Develop and maintain the JSC SCE-lite environment including integration of required SCE-lite software packages, development of capabilities to accept, distribute, and exchange Orion software product deliveries, and maintenance of the environment.
 - c3. Track, maintain, and ensure correct configuration of required software capabilities in the JSC SCE-lite node.
 - c4. Participate in software planning and development meetings at other NASA centers and Orion contractor facilities.
- d) Software Tool Implementation Oversight - Perform system engineering insight/oversight tasks, as follows:
 - d1. Evaluate Orion tool chain interfaces and systems engineering activities, including tool plug-in and script development.
 - d2. Provide technical reporting to the Software System Manager and Orion Software System Manager in programmatic level reviews, technical meetings, and control boards.
 - d3. Participate in software planning and development meetings at other NASA centers and Orion contractor facilities.
- e) Flight Software Mission Integration Trains - Perform system engineering insight/oversight tasks, as follows:
 - e1. Assess Orion software development train performance.
 - e2. Provide technical reporting to the Software System Manager and Orion Software System Manager in programmatic level reviews, technical meetings, and control boards.
 - e3. Participate in software planning and development meetings at other NASA centers and Orion contractor facilities.
- f) Perform development, integration and operations of the Kedalion Software Engineering Environment, as follows:
 - f1. Assist in equipment selection, procurements, hardware and software integration, test coordination, planning, set up, system administration, and overall development of the environment.
 - f2. Maintain and track environment hardware inventory and configuration, software tool versions and

configuration, development environment, and software deliveries. Maintain Configuration Management (CM) documentation within the environment CM system and perform property custodian duties.

f3. Develop, maintain and operate the facility through the Orion lifecycle.

f4. Integrate and maintain Orion Data Services (ODS) databases.

f5. Perform property custodian duties to develop, maintain, and operate the facility through the Orion lifecycle.

The contractor will use ER6 products necessary to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. The contractor will use ER6 laboratory space, and development systems required to accomplish Orion Software Engineering Services tasks.

5.2.1 MPCV Software Engineering

Project Code:

The contractor shall provide software engineering services for the Multi-Purpose Crew Vehicle (MPCV).

b. Applicable Documents

Document Number	Document Name	Rev.
CxP-72099	Crew Exploration Vehicle Software Management Plan	Basic, Sept 18 2007
ER6-TM203	ER6 TO-203 Master Plan and Schedule	Original

c. Required DRDs

5.2.1 MPCV Software Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.2.1 MPCV Software Engineering		
Product(s)	Quantity	Delivery Date
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	Per ER6-TM203	Per ER6-TM203

e. Product Verification

5.2.1 MPCV Software Engineering	
i. Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	

5.3 JSC SEPG (Software Engineering and Process Group) Engineering Services

a. Requirement - In compliance with the above identified SOW(s) the contractor shall provide JSC SEPG engineering services, including the following:

- a) Analysis of NPR 7150.2A, JPR 7150.2 and related Agency, JSC and Industry software process artifacts, and provide engineering recommendations related to JSC software process compliance and improvement.
- b) Cost estimation for software projects.

- c) Analysis and study for development of content for proposals for new projects.
- d) Prototyping and development of content for planning and scheduling products for new projects.

5.3.1 JSC SEPG (Software Engineering and Process Group) Engineering Services
Project Code:

The contractor shall provide JSC SEPG engineering services.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
NPR 7150.2	NASA Software Engineering Requirements	Rev. A, Oct. 2009
ER6-TM203	ER6 TO-203 Master Plan and Schedule	Original
JPR 7150.2	JSC Software Engineering Requirements	Latest

c. Required DRDs

5.3.1 JSC SEPG (Software Engineering and Process Group) Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly
TD-08	Engineering Analysis	One per analysis

d. Products

5.3.1 JSC SEPG (Software Engineering and Process Group) Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	Per ER6-TM203	Per ER6-TM203

e. Product Verification

5.3.1 JSC SEPG (Software Engineering and Process Group) Engineering Services	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in ER6-TM203, ER6 TO 203 Master Plan and Schedule	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA17T TO# 204	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Systems Engineering Simulator (SES) Engineering Services (TO152)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$2,530,763	\$2,530,763

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Date: 2015.09.24 15:10:30 -0500 Signature: _____ Date: 9/24/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA17T-TO204 BASE

Originator: MICHAEL MCFARLANE (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Systems Engineering Simulator (SES) Engineering Services (TO152)

2. Date of Request: 09/02/2015

3. Statement of Work Task Description

a. 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.

b. 2.2.4 Training

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

c. 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.

d. 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.

e. 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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Systems Engineering Simulator (SES) Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s), the contractor shall provide engineering services associated with the Systems Engineering Simulator (SES) in accordance with ER7-TM204 (SES FY16) under the technical authority of the Simulation and Graphics Branch of the Software, Robotics and Simulation Division (SRSD). All design, development, integration and validation of hardware and software will be done in accordance with SES WI 1005 (SES Project Life Cycle Process).

5.1.1 Engineering Services Development

Project Code: The contractor shall provide engineering services necessary to conduct simulation development in accordance with ER7-TM204 (SES FY16)

The contractor shall provide systems engineering design services for all facility and non-program specific software efforts in the SES, assist with high level design of new additions to the SES, and review drawings and designs that involve both hardware and software from outside organizations and vendors in accordance with ER7-TM204 (SES FY16) and under the technical authority of the Simulation and Graphics Branch of the Software, Robotics, and Simulation Division.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER7-TM204 (SES FY16)	SES Master Plan and Schedule Requirements	Original
SES WI	1005	5

c. **Required DRDs**

5.1.1 Engineering Services Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	bi-monthly

d. **Products**

5.1.1 Engineering Services Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER7-TM204 (SES FY16)	1	September 30, 2016

e. **Product Verification**

5.1.1 Engineering Services Development	
. Implementation of ER7-TM204 (SES FY16)	
- SRSD Simulation and Graphics Branch review, witness and acceptance of simulation engineering data	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ16HA18T TO# 205	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EVAGFE Tools & Equipment & Habitability Systems Projects (EC7) (TO31)

Task Order Contract Type: Cost Plus Award Fee – Completion Form


Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$933,723	\$933,723

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet  Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=roverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/28/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA18T-TO205 BASE

Originator: CURTIS NEWMAN (EC7) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 EVA GFE Tools & Equipment & Habitability Systems Projects (EC7) (TO31)

2. Date of Request: 09/15/2015

3. Statement of Work Task Description

a. 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.

b. 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 JET S Technical Library and specified on each task order.

c. 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.

d. 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.

e. 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

f. **2.2.4 Training**

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

g. **2.3 Analysis and Assessment**

h. **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.

i.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 EVA GFE Tools and Equipment Projects

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering, design, analysis, fabrication, assembly, test and delivery of unique space flight hardware associated with extravehicular activity. Typical activities include but are not limited to requirements development, design, manufacturing/fabrication, certification, and acceptance activities.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

5.1.1 EVA GFE Tools and Equipment Projects

Project Code: Multiple

Provide engineering, design, analysis, fabrication, assembly, test and delivery of unique space flight hardware associated with extravehicular activity. Typical activities include but are not limited to requirements development, design, manufacturing/fabrication, certification, and acceptance activities.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
SSP 30695	Acceptance Data Package (ADP) Requirements Specification	Rev. C, Aug. 2010
EA-023	Project Management for the Engineering Directorate	Basic
JPD 7120.9	Experimental Flight Hardware (Class I-E) Development Policy	Basic Admin Ch1
JSC-26626	EVA Generic Design Requirements Document	A
SSP-30223	Problem Reporting and Corrective Action for the Space Station Program	L
SSP-50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	D

c. Required DRDs

5.1.1 EVA GFE Tools and Equipment Projects		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-05	Certification and Acceptance Requirements Document (CARD)	as required per PD
RV-08	Engineering Drawings and Model Files	as required per PD
TD-03	Flight Product Critical Design Review (CDR) Data Package	as required per PD
TD-04	Acceptance Data Package (ADP)	as required per PD
TD-06	Certification Data Package	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-16	Space Station Hardware Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)	as required per PD
TD-19	Space Station Hazard Reports (HRs)	as required per PD

TD-19	Risk Assessment Executive Summary Report	as required per PD
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d. **Products**

5.1.1 EVA GFE Tools and Equipment Projects		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
EVA Hardware Projects	3	per PD
EVA Engineering Tasks	Per PD	per PD

e. **Product Verification**

5.1.1 EVA GFE Tools and Equipment Projects	
. EVA Hardware Projects	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	
i. EVA Engineering Tasks	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	

5.2 EVA Development & Verification Testing

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall perform all aspects relating to the conducting of the ISSEVA development testing including test planning, test objective development, test performance and post test data documentation and reporting. Develop test plans for verifying EVA translation and worksite analyses and conduct tests using JSC facilities such as the Neutral Buoyancy Lab, air bearing floor, vacuum chambers, and glove boxes. Design and fabricate mockups and models of hardware needed to conduct tests. The contractor shall also provide unique test hardware inclusive of design, fabrication, assembly and integration, coordination and performance of test readiness reviews and the preparation of hazard reports and analysis.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

5.2.1 EVA Development & Verification Testing

Project Code: Multiple

Perform all aspects relating to the conducting of the ISS EVA development testing including test planning, test objective development, test performance and post test data documentation and reporting. Develop test plans for verifying EVA translation and worksite analyses and conduct tests using JSC facilities such as the Neutral Buoyancy Lab, air bearing floor, vacuum chambers, and glove boxes. Design and fabricate mockups and models of hardware needed to conduct tests. The contractor shall also provide unique test hardware inclusive of design, fabrication, assembly and integration, coordination and performance of test readiness reviews and the preparation of hazard reports and analysis.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
CX-007	CX Safety Review/Test Readiness Review Process	C
CX12-POL0002	Neutral Buoyancy Laboratory Standard Operating Plan	E
CX12-SLP0014	Neutral Buoyancy Laboratory Mockup and Training Hardware Requirements	C

EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	B
SSP-50005	ISS Flight Crew Integration STD (NASA-STD-3000/T)	F

c. Required DRDs

5.2.1 EVA Development & Verification Testing		
DRD #	DRD Title	Quantity/Frequency
RV-08	Engineering Drawings and Model Files	as required per PD
TD-08	Engineering Analysis	as required per PD
TD-11	Test Report	as required per PD

d. Products

5.2.1 EVA Development & Verification Testing		
Product(s)	Quantity	Delivery Date
EVA Development & Verification Testing Projects	2	per PD

e. Product Verification

5.2.1 EVA Development & Verification Testing	
. EVA Development & Verification Testing Projects	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	

5.3 Potable Water Dispenser Sustaining Engineering

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide sustaining engineering, design, analysis, fabrication, assembly, test and delivery of the Potable Water Dispenser (PWD). Activities include ORU Filter manufacturing and testing and delivery, PWD -304 bi-annual disinfection, and overall sustaining engineering activities.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

5.3.1 Potable Water Dispenser Sustaining Engineering
Project Code: 00049

Provide sustaining engineering, design, analysis, fabrication, assembly, test and delivery of the Potable Water Dispenser (PWD). Activities include ORU Filter manufacturing and testing and delivery, PWD -304 bi-annual disinfection, and overall sustaining engineering activities.

Project Directives will be used to define tasks including milestones and process tailoring, etc. Project Directives (PDs) will be approved by the EC7 CCB chair.

b. Applicable Documents

Document Number	Document Name	Rev.
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
JSC-STD-8080	JSC Design and Procedural Standard	Oct. 2006
SSP 30695	Acceptance Data Package (ADP) Requirements Specification	Rev. C, Aug. 2010
EA-023	Project Management for the Engineering Directorate	Basic

SSP-30223	Problem Reporting and Corrective Action for the Space Station Program	L
SSP-50835	ISS Pressurized Volume Hardware Common Interface Requirements Document	D

c. Required DRDs

5.3.1 Potable Water Dispenser Sustaining Engineering		
DRD #	DRD Title	Quantity/Frequency
RV-08	Engineering Drawings and Model Files	as required per PD
TD-04	Acceptance Data Package (ADP)	as required per PD
TD-08	Engineering Analysis	as required per PD

d. Products

5.3.1 Potable Water Dispenser Sustaining Engineering		
Product(s)	Quantity	Delivery Date
PWD (-304) disinfection	2	per PD
PWD ORU Filter	2	per PD
PWD Sustaining Engineering	1	per PD

e. Product Verification

5.3.1 Potable Water Dispenser Sustaining Engineering	
i. PWD (-304) disinfection	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	
ii. PWD ORU Filter	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	
iii. PWD Sustaining Engineering	
- Completed upon verification and acceptance by the EC7 Branch Chief or designee	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ16HA19T TO# 206	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Advanced EMU Technology Development (EC5)(TO133)(LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$3,969,199	\$3,969,199

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/23/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.23 21:41:51 -0400

JSC Engineering, Technology and Science Contract

NNJ16HA19T-TO206 BP1

Originator: LINDSAY AITCHISON (EC5) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 Advanced EMU Technology Development (EC5) (TO133) (LOE)

2. Date of Request: 09/15/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Project Management

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide project management services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU systems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services include preparation and oversight of JETS PDs; regular reporting on technical, cost, and schedule performance; coordination of NASA technical meetings; preparation of project weekly status reports; management of project risks database; maintenance of project SharePoint site; and maintenance of project master schedule.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

- d. **Products**

- e. **Product Verification**

5.2 Systems engineering and Integration

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall Provide systems engineering and integration services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU systems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services include preparation of project systems engineering documents such as operational concepts, environmental definitions, and interface controls; conducting or supporting systems engineering trade studies such as the life support umbilical trade and display and control module trade; and support hardware test preparations such as development of test plans for the Display and Control Unit test.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

- c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.3 EMU SWME

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall Provide engineering and technical services to accomplish the research and development objectives needed to advance key technologies for the EMU Suit Water Membrane Evaporator (SWME) and its flight experiment.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of EMU SWME technologies in accordance with AEMU development work plans as assigned by Project Directives.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. **Required DRDs**

d. **Products**

e. **Product Verification**

5.4 Advanced EMU Subsystems

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall Provide engineering and technical services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU subsystems.

The WBS for this activity shall be organized as follows:

4 AEMU Subsystems

4.1 Pressure Garment Subsystem (PGS)

4.2 Portable Life Support Subsystem (PLSS)

4.3 Power, Avionics & Software (PAS)

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. Content will be allocated to sub-CLINS by PD. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

Examples of services under WBS 4.1 include identification and documentation of PLSS, PAS, vehicle and facility interfaces to the PGS; providing technical oversight of mockup development; developing and documenting procedures for the handling of controlled suit hardware; and leading or supporting test planning for suit testing such as CO₂ washout, human vacuum chamber, display and control module evaluations which may include preparation of test plan, test procedures, hazard analysis, and post-test reports.

Examples of services under WBS 4.2 include performing systems engineering and integration tasks such as tracking of mass and power and defining interfaces to other subsystems; performing thermal/fluids analyses such as defining thermal sink temperatures for possible suit destinations and evaluating the performance of PLSS thermal loop components; performing computational fluid dynamics modeling; performing analyses for sizing of the feedwater supply assembly; updating the PLSS Thermal Desktop Model; planning for and analyzing results of Liquid Cooling and Ventilation Garment testing; fabrication of tubing, panels, and brackets for test system build-up; supporting development, assessment, and testing of LabVIEW modules for

use in PLSS testing; support testing of PLSS 2.0 including test operation, trouble shooting, facility systems operation, and data acquisition support; design, build, and evaluate successive generations of Suit Water Membrane Evaporator hardware; perform test buildup and testing of the Rapid Cycle Amine and the Suited Manikin Test Apparatus; and assembly, maintenance, testing, servicing, and calibrating test rigs in support of Variable Oxygen Regulator testing.

Examples of services under WBS 4.3 include performing systems engineering and integration tasks such as tracking of mass and power and defining interfaces to other subsystems and performing thermal/fluids analyses such as defining thermal sink temperatures for possible suit destinations.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

5.5 Reserved

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall hold this CLIN in reserve until a later date.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

5.6 Safety and Mission Assurance (S&MA)

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide safety and mission assurance services to accomplish the research and development objectives needed to advance key technologies for Advanced EMU Systems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide engineering services related to the development and demonstration of AEMU technologies in accordance with AEMU development work plans as assigned by Project Directives.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

5.7 Education and Public Outreach

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide education and public outreach services to related to Advanced EMU subsystems.

Project Directives (PDs) will be used to incrementally identify tasks during project implementation. The contractor shall provide services related to AEMU education and outreach as assigned by Project Directives.

Examples of services include supporting the NASA Engineering Network knowledge capture (KC) effort by providing an administrator to stream KC events, prepare reports on KC efforts, and identify and secure technical expert speakers.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. Required DRDs

d. Products

e. Product Verification

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 11
Task Order Number: NNJ16HA20T TO# 207	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EC Division Services(EC)(TO134)(LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$4,544,464	\$4,544,464

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/23/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=moverst
, cn=ROCHELLE OVERSTREET
Date: 2015.09.23 21:51:15 -0500

JSC Engineering, Technology and Science Contract

NNJ16HA20T-TO207 BASE

Originator: MARIE KOWAL (EC1) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 EC Division Services(EC) (TO134) (LOE)

2. Date of Request: 09/03/2015

3. Statement of Work Task Description

a. 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 JET S Technical Library and specified on each task order.

b. 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 sub system 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.

c. 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

d. 2.3 Analysis and Assessment

e. 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.

f. **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.

g. **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.

h. **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.

i. **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.

j. **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, Descent, 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.

k.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Miscellaneous Engineering and Technical Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Crew and Thermal Systems Division (CTSD) in support of the various programs including ISS, AES/OCT, and Orion. These include short turnaround, ancillary tasks outside the original project scope.

Contractor is authorized to expend travel and material resources, within the authorized limits, and only as required to complete TMR assigned action items.

5.1.1 Miscellaneous Engineering and Technical Services

Project Code:

See above 5.1 a. Requirement

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

- c. **Required DRDs**

5.1.1 Miscellaneous Engineering and Technical Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

- d. **Products**

5.1.1 Miscellaneous Engineering and Technical Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

- e. **Product Verification**

5.1.1 Miscellaneous Engineering and Technical Services	
. None	
- NA	

5.2 EC Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide technical services for the CTSD projects including but not limited to EVA and suit subsystem management, NGLS project management services, division project coordination and oversight, documentation support, graphics development, business development, and other tasks as assigned by the division chief. The WBS for this task shall be organized as follows:

2 EC Services

2.1 EVA/Suit SSM

2.2 Division Technical Manager Services

2.3 Division Graphical Services

2.4 NGLS Project Management

5.2.1 EC Services

Project Code:

See above: 5.2 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.2.1 EC Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.2.1 EC Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.2.1 EC Services	
. None	
- NA	

5.3 EC2 Services

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the Design and Analysis Branch (EC2) for the CTSD Materials Development Lab and the CTSD Softgoods Laboratory. The contractor shall also provide engineering services for the development of preliminary designs to meet the objectives and requirements of CTSD projects. The WBS for this task shall be organized as follows:
- 3 EC2 Services
 - 3.1 Materials Lab
 - 3.2 Softgoods Lab
 - 3.3 Mechanical Systems Design

5.3.1 EC2 Services

Project Code:

See above: 5.3 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.3.1 EC2 Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

None		NA
------	--	----

d. **Products**

5.3.1 EC2 Services		
Product(s)	Quantity	Delivery Date
None	NA	NA

e. **Product Verification**

5.3.1 EC2 Services	
. None	
- NA	

5.4 WRS and Water Lab

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide chemistry analysis and testing services for advanced Water Recovery Systems (WRS) technologies in the facilities located in building 7B, rooms 1300, 1300A, 1300B, 1300C, building 7 room 2010, B29 Rm 142 and other facilities under development in building 29. This includes development and testing services for ISS, AES, Next Generation Life Support (NGLS), commercial cargo and other advanced technology development programs. NASA will set the priorities of the tasks and engineering services.

5.4.1 WRS and Water Lab
Project Code:

See above: 5.4 a. Requirement

b. **Applicable Documents**

Document Number	Document Name	Rev.
None	No title Entered	

c. **Required DRDs**

5.4.1 WRS and Water Lab		
DRD #	DRD Title	Quantity/Frequency
None		NA

d. **Products**

5.4.1 WRS and Water Lab		
Product(s)	Quantity	Delivery Date
None	NA	NA

e. **Product Verification**

5.4.1 WRS and Water Lab	
. None	
- NA	

5.5 ARS and Gas Lab

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide planning, integration, testing, reporting, and data analysis services supporting the development of Atmosphere Revitalization Systems (ARS) process technologies including operation of the ARTD test articles and equipment in the Air Revitalization Technology Evaluation Facility (ARTEF) located in Building 7B, room 1302 and the CTSD Gas Lab located in Building 7, room 1023 and facilities under development in B29. The contractor shall also provide, under direction from EC3 ARTD personnel in conjunction with the CTSD Systems Test Branch planning, design, buildup, integration, and testing for development of advanced Air Revitalization Systems (ARS) technologies by facilitating operation of ARS test articles in CTSD managed test facilities. NASA will set the priorities of the tasks and engineering services.

5.5.1 ARS and Gas Lab

Project Code:

See above: 5.5 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. **Required DRDs**

5.5.1 ARS and Gas Lab		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.5.1 ARS and Gas Lab		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.5.1 ARS and Gas Lab	
. None	
- NA	

5.6 Orion ECLSS Systems Engineering

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide systems engineering services for the Environmental Control and Life Support Systems (ECLSS) for Orion, including but not limited to the following: monitoring of technical status of development activities, testing, and operations planning; identifying and/or evaluating technical issues, changes, or concerns; analyzing technical information; formulating responses and presentations; and presenting to the appropriate boards, panels, or technical/status meetings.

5.6.1 Orion ECLSS Systems Engineering

Project Code:

See above: 5.4 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.6.1 Orion ECLSS Systems Engineering		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.6.1 Orion ECLSS Systems Engineering		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.6.1 Orion ECLSS Systems Engineering	
. None	
- NA	

5.7 Commercial Crew ECLSS Subsystem Management

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide systems engineering services for the Environmental Control and Life Support Systems (ECLSS) for Commercial Crew, including but not limited to the following: monitoring of technical status of development activities, testing, and operations planning of Boeing and Space-X; identifying and/or evaluating technical issues, changes, or concerns; analyzing technical information; and formulating responses and presentations.

5.7.1 Commercial Crew ECLSS Subsystem Management
Project Code:

See above: 5.7 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.7.1 Commercial Crew ECLSS Subsystem Management		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.7.1 Commercial Crew ECLSS Subsystem Management		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.7.1 Commercial Crew ECLSS Subsystem Management	
i. None	
- NA	

5.8 Carbon Dioxide Removal SAA Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and air laboratory services for EC3 for the development of carbon dioxide removal technologies for Space Act Agreement work.

5.8.1 Carbon Dioxide Removal SAA Services

Project Code:

See above 5.8 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. **Required DRDs**

5.8.1 Carbon Dioxide Removal SAA Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.8.1 Carbon Dioxide Removal SAA Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.8.1 Carbon Dioxide Removal SAA Services	
i. None	
- NA	

5.9 EC6 Lab and Test Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering and technical services for the development of Thermal Control Systems specifically in the areas of radiators, heat transport fluids, heat pumps, and evaporative heat. This includes providing engineering services for the development of the heat exchanger payload.

5.9.1 EC6 Lab and Test Services

Project Code:

See above: 5.9 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.9.1 EC6 Lab and Test Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.9.1 EC6 Lab and Test Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.9.1 EC6 Lab and Test Services	
. None	
- NA	

5.10 EC7 Services

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services for EC7 including technical representative services for EVA Bilateral Tools to resolve issues from the following: engineering review panels, test readiness boards, hardware anomalies and resolution for flight and trainer hardware, PIRN/ICD resolution, management reviews, and DR/FIAR disposition/resolution. The contractor shall provide technician services for the EC7 lab including the assembly and test of R&D and flight hardware. The contractor shall also provide engineering analysis services for ISS EVA activities. The WBS of this task shall be organized as follows:
- 10 EC7 Services
 - 10.1 EVA GFE Hardware SSM
 - 10.2 EC7 Lab Services
 - 10.3 ISS EVA Analysis

5.10.1 EC7 Services

Project Code:

See above: 5.10 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.10.1 EC7 Services

<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.10.1 EC7 Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.10.1 EC7 Services	
i. None	
- NA	

5.11 Habitation Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering services for Habitation Engineering including the development of critical need habitation technologies.

5.11.1 Habitation Engineering Services
Project Code:

See above 5.11 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. **Required DRDs**

5.11.1 Habitation Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.11.1 Habitation Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.11.1 Habitation Engineering Services	
i. None	
- NA	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 9
Task Order Number: NNJ16HA21T TO# 208	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations (EC4) (TO151)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b) (4)		
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$9,284,415	\$9,284,415

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet ROCHELLE OVERSTREET Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnoverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/30/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA21T-TO208 BASE

Originator: MICHAEL MONTZ (EC4) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations (EC4) (TO151)

2. Date of Request: 09/17/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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 JET S Technical Library and specified on each task order.

d. 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.

e. 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.

f. 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

g. 2.2.4 Training

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

h. 2.3 Analysis and Assessment

i. 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.

j. 2.4 Facilities

k. 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.

l. 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.

m. 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.

n.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Systems Test Branch Maintenance, Facility Capability Enhancement, and Test Operations

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall Provide day-to-day preventative and reparative maintenance and test operations activities common to all test facilities, systems and laboratories in the Crew and Thermal Systems Division.

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)

Project Code:

This work shall be performed, in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document, CTSD-SS-3057. This document defines the metrics by which the maintenance effort is monitored; the operational readiness levels that are expected, and contains comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

The contractor shall also perform projects required to retain current facility capabilities as well as enhance their capabilities with improvements in vacuum chamber, instrumentation, and data collection technology. The number of projects conducted per year changes as the systems age and with changes in customer needs but two projects are expected in FY16. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and operational verification of the final product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.2 EVA Test Operations

Project Code:

The contractor shall provide test data and quicklook reports for EVA testing performed in the Crew and Thermal Systems Laboratory test chambers. Testing shall include crew training events performed in the SSATA as well as unmanned and manned EMU testing performed in the Eight Foot and Eleven Foot Chambers respectively. Crew Training events simulate flight conditions, and provide the crewmembers with experience in performing ISS Airlock EVA prep and post procedures under de-pressurization, vacuum, and re-pressurization conditions expected on-orbit. Each crew training activity will include a power functional and dry run. Altitude runs will be performed when requested. Eight Foot chamber testing consists of three 8-hour EVA simulations. The PLSS and SEMU are checked out with all facility interfaces during a sea-level power functional. The contractor will also perform testing in the Eleven Foot Chamber to verify the performance of the PLSS for flight certification. The Eleven Foot Chamber test is human rated, and consists of a power functional, a dry run, and an altitude run. Approximately six crew training events, three simulated EVAs in the Eight Foot Chamber, and one manned run in the Eleven Foot chamber are expected during FY16.

Test Data will be identified, reviewed, and archived as specified in STF-F-413, Management and Archival Storage of Original Test Data Media, and STB-F-616, Reduction of Test Data. Specific test requirements relative to each test will be indicated on the Form 90, Test Request. The contractor will perform testing according to the requirements of the test requestor, STB-E-554, STB Test Operations Guidelines and referenced documents.

5.1.3 Diversified Testing

Project Code:

The contractor shall provide test data and quicklook reports for tests performed in the Building 7 Vacuum Chambers, Building 32 Chamber B Thermal Vacuum Chamber and Building 33 Special Chambers Complex.

Once a customer's Form 90, Test Request, has been received, the contractor will perform humidity, thermal, or thermal vacuum testing on a wide variety of test articles in the CTSD test facilities. Specific test articles have not been identified, however the capability of the facilities cover a range from high-fidelity space simulation to simple thermal, thermal vacuum, humidity tests, and bench top testing. The JETs

contractor will choose the proper facility based on the test requirements. Approximately 50 tests will be conducted in CTSD facilities during fiscal 2016.

5.1.4 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)

Project Code:

This work shall be performed in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document. This document defines the metrics by which the maintenance effort is monitored; the operational readiness levels that are expected, and contains comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

The contractor shall also perform projects required to retain current facility capabilities as well as enhance their capabilities with improvements in vacuum chamber, instrumentation, and data collection technology. The number of projects conducted per year changes as the systems age and with changes in customer needs but ten projects are expected in FY16. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and verification of the project product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.5 Division Safety, Information Technology, and Special Project Support

Project Code:

The contractor shall Provide engineering, technical, and clerical support for the safe and efficient operation of the Crew and Thermal Systems Division facilities.

All EC Data System IT maintenance and operations requirements are identified in CTSD-SS-3055, CTSD IT Program Requirements document. Facility Safety Representatives conduct the facility safety inspections, brief contractor and subcontractor personnel about on-site safety practices, and work to correct and close any "Close Call" or "Incident Reports". Failure Modes and Effects Analysis and Integrated Hazards Analysis are developed as a critical portion of the review processes that ensure safe operations in both facilities maintenance and test operations. The CTSD Safety Engineer investigates all CTSD-related mishaps. The CTSD Safety Engineer also investigates close calls when directed. The CTSD Safety Engineer is the primary Emergency Preparedness Representative for CTSD responsible for maintaining emergency response documents, coordinating implementation of emergency responses, and communicating with Division Management.

Specific projects in support of EC division goals are identified periodically and will be negotiated, and approved at the EC4 Branch Level with contractor concurrence. Approximately two projects are expected in fiscal 2016. Project work may include: requirements definition, design documentation, calculations and mathematical modeling, trade studies, authoring Statements of Work and work authorizing documents, buildup of equipment and systems and verification of the project product. The contractor will add the required capabilities to existing facilities per STB-E-557, STB Facility and Major Test Buildup.

5.1.6 Laboratory Operations

Project Code:

The contractor shall Provide day-to-day laboratory operations support activities common to all test facilities, systems and laboratories in the Crew and Thermal Systems Division, in accordance with the requirements of the Systems Test Branch Facilities and Laboratories M&O Requirements Document. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with CTSD-SS-3057.

Special Purpose Maintenance required in the general CTSD laboratory areas is performed as directed in CTSD-SS-3057. That document contains the EC Specific list of Maintenance and Operations Requirements. It defines the metrics by which the maintenance effort is monitored; the operational

readiness levels that are expected, and contain comprehensive lists of the reference TPS's and Work Orders included in the maintenance recall system.

This task will also cover the many routine activities that support every maintenance action and tests required to keep CTSD facilities operational. these activities include, but are not limited to:

- Drafting and design required for configuration control
- Document development and maintenance for checklists, procedures, and personnel certification
- Customer service representatives for test customer support
- Property custodian services
- Tool crib operators
- administrative services
- Budget analyst services
- Facility data acquisition recording and control system maintenance and operations

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
NPD 7100.8	Protection of Human Research Subjects	Rev. E, May 2002 Revalidated Jun. 2007
CTSD-SS-3055	CTSD IT Program Requirements Document	Basic
CTSD-SS-3057	CTSD List of Facilities, Systems, Laboratories and M&O Requirements Document	B
EA-WI-024	General Operating Procedures for EA Testing Facilities	B
STB-E-084	CTSD STB Drawing System and Configuration Control Procedure	F
STB-E-367	Safety Analysis Techniques and Preparation Procedure	E
STB-E-493	CTSD STB Training and Certification Plan	I
STB-E-554	STB Test Operations Guideline	H
STB-E-557	STB Facility and Major Test Buildup Guidelines	F
STB-F-001	CTSD STB General Operating Procedures Manual	P
STB-F-413	Management and Archival of Original Test Data Media	J
STB-F-616	Reduction of Test Data	M

c. Required DRDs

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.2 EVA Test Operations		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

TD-11	Test Report	One per completed test
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5.1.3 Diversified Testing		
DRD #	DRD Title	Quantity/Frequency
TD-11	Test Report	One per completed test

5.1.4 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)		
DRD #	DRD Title	Quantity/Frequency
None		NA

5.1.5 Division Safety, Information Technology, and Special Project Support		
DRD #	DRD Title	Quantity/Frequency
None		NA

5.1.6 Laboratory Operations		
DRD #	DRD Title	Quantity/Frequency
None		NA

d. Products

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)		
Product(s)	Quantity	Delivery Date
Perform maintenance tasks in accordance with CTSD-SS-3057	per CTSD-SS-3057	9/30/2016
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2016

5.1.2 EVA Test Operations		
Product(s)	Quantity	Delivery Date
Test Requirements Reviews, Test Schedules, Test Team and Crewmember Briefings, Test Readiness Review Packages, Test Data, and QuickLook Reports	One set per test	9/30/2016

5.1.3 Diversified Testing		
Product(s)	Quantity	Delivery Date
Test Requirements Reviews, Test Schedules, Test Readiness Review Packages, Test Data, and QuickLook Reports	One set per test	9/30/2016

5.1.4 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)		
Product(s)	Quantity	Delivery Date
Perform maintenance tasks in accordance with CTSD-SS-3057	Per CTSD-SS-3057	9/30/2016
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2016

5.1.5 Division Safety, Information Technology, and Special Project Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Facility and Test HA and FMEA Documents	Per CTSD-SS-3057	9/30/2016
Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	One set per project	9/30/2016

5.1.6 Laboratory Operations		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Facility Operation Procedures and Policies	Per CTSD-SS-3057	9/30/2016

e. Product Verification

5.1.1 EVA Facility Maintenance and Projects (Buildings 7 and 33)	
. Perform maintenance tasks in accordance with CTSD-SS-3057	
- NASA EC4 Branch management periodically reviews the Maintenance Database	
i. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	
- NASA EC4 Branch management will sign URR acceptance form to indicate acceptance of project completion..	

5.1.2 EVA Test Operations	
. Test Requirements Reviews, Test Schedules, Test Team and Crewmember Briefings, Test Readiness Review Packages, Test Data, and Quick Look Reports	
- NASA EC4 Branch management signs the test quick look to indicate acceptance of test completion	

5.1.3 Diversified Testing	
. Test Requirements Reviews, Test Schedules, Test Readiness Review Packages, Test Data, and Quick Look Reports	
- NASA EC4 Branch management signs the test quick look to indicate acceptance of test completion	

5.1.4 Shared Capabilities Assets Program Maintenance and Projects (Bldg. 32)	
. Perform maintenance tasks in accordance with CTSD-SS-3057	
- NASA EC4 Branch management periodically reviews the Maintenance Database	
i. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	
- NASA EC4 branch management will sign URR acceptance form to indicate acceptance of project completion	

5.1.5 Division Safety, Information Technology, and Special Project Support	
. Facility and Test HA and FMEA Documents	
- NASA EC4 Branch management will sign HA and FMEA documents to indicate their acceptance	
i. Project Cost Estimates, Project Schedules, Detailed Designs, Design Review Packages and, User Readiness Review Package	
- NASA EC4 Branch management will sign URR acceptance form to indicate acceptance of project completion..	

5.1.6 Laboratory Operations	
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. Facility Operation Procedures and Policies
- NASA EC4 Branch management periodically reviews the Maintenance and Calibration Database

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA22T TO# 209	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 James Webb Space Telescope Project Support (EC4) (TO160) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$2,689,899	\$2,689,899

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **9/28/15**
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rover
erst, cn=ROCHELLE OVERSTREET
Date: 2015.09.28 10:39:57 -05'00'

JSC Engineering, Technology and Science Contract

NNJ16HA22T-TO209 BASE

Originator: MICHAEL MONTZ (EC4) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 James Webb Space Telescope Project Support (EC4) (TO160) (LOE)

2. Date of Request: 09/17/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. 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~~ ~~Thermal Vacuum~~ ~~Shock and Vibration~~ ~~Acoustics~~ ~~Oxygen Acceptance and initial wetting~~ ~~Electromagnetic Interference/Electromagnetic Compatibility~~ ~~Ionizing~~

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

f. **2.2.4 Training**

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

g. **2.3 Analysis and Assessment**

h. **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.

i. **2.4 Facilities**

j. **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.

k. **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.

l. **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.

m.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 James Webb Space Telescope Project Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide highly specialized engineering and technical services to accomplish the preparation and checkout of Chamber A in support of the James Webb Space Telescope program.

5.1.1 James Webb Space Telescope Project Support

Project Code:

The contractor shall assist with program specific GSE and GFE operations as specified in JWST-IRCD-003577 conducted within the Crew and Thermal Systems Division. Operation of the facility during 30 to 40 day Optical Ground Support Test 2 and the 30 to 40 day Thermal Pathfinder Test will be required.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JSC 17773	Instructions for Preparation of Hazard Analysis for JSC Ground Operations	Rev. C, Dec. 2001
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
EA-WI-024	General Operating Procedures for EA Testing Facilities	B
JWST-IRCD-003577	James Webb Space Telescope Project Observatory to NASA JSC Test Facility Interface Requirements and Control Document	E
STB-E-084	CTSD STB Drawing System and Configuration Control Procedure	F
STB-E-367	Safety Analysis Techniques and Preparation Procedure	E
STB-E-493	CTSD STB Training and Certification Plan	I
STB-E-554	STB Test Operations Guideline	H
STB-E-557	STB Facility and Major Test Buildup Guidelines	F
STB-E-574	Systems Test Branch Facility Maintenance Guidelines	Basic
STB-F-001	CTSD STB General Operating Procedures Manual	P
STB-F-413	Management and Archival of Original Test Data Media	J
STB-F-616	Reduction of Test Data	M

c. Required DRDs

5.1.1 James Webb Space Telescope Project Support		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.1.1 James Webb Space Telescope Project Support		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
NA	NA	NA

e. Product Verification

5.1.1 James Webb Space Telescope Project Support
i. NA
- NA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ16HA23T TO# 210	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Life Support Systems (EC3)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$374,853	\$374,853

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnovers t, cn=ROCHELLE OVERSTREET Date: 2015.09.30 11:09:23 -0400 Signature: _____ Date: 9/30/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA23T-TO210 BASE

Originator: COY KOUBA (EV171) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 Life Support Systems (EC3) (TO155)

2. Date of Request: 09/03/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 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.

c. 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.

d. 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.

e. 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.

f. 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~~

g. 2.3 Analysis and Assessment

h. 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.

i. 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.

j. 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.

k. 2.4 Facilities

l. 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.

m. 2.5 Research and Development

n. 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.

o.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Internal Thermal Control Systems (ITCS) Sustaining Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall a. Perform all sustaining activities as related to hardware being sustained (listed below). This includes, but may not be limited to delivering hardware for flight (performing builds, calibration, pre-delivery tests), tracking of limited life items, updating certifications when required due to ops scenario changes, obsolescence of parts, etc, performing and supporting both ground and on-orbit failure investigations, supporting operations and needs of other systems/groups by maintaining detailed knowledge of hardware and answering questions related to the hardware. Specific tasks and schedules within this scope will be defined by Project Directive (PD). Deliverables will be uploaded to the EC3 ITCS share folder and Design and Data Management System (DDMS).
- b. The contractor shall perform transition activities associated with transitioning hardware responsibilities to other contractors. Specific tasks and schedules within this scope will be defined by Project Directive (PD).
- c. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

5.1.1 ITCS Sustaining Engineering Hardware

Project Code: 02196

Note: Per current ISS manifest needs, there are no planned ITCS flight hardware deliveries or any shelf-life extension testing planned in FY16.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of Government Furnished Equipment (GFE) Flight Projects	Latest version

c. Required DRDs

5.1.1 ITCS Sustaining Engineering Hardware		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-04	Acceptance Data Package (ADP)	AR
TD-06	Certification Data Package	AR

d. Products

5.1.1 ITCS Sustaining Engineering Hardware		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Sustaining Engineering (FY15)	1	Per PD
Limited Life Tracking Spreadsheet	4	Quarterly
Monthly Project Status of Technical and Costs	12	Monthly
TPS/DR/FIAR Tracking Spreadsheet	4	Quarterly

e. Product Verification

5.1.1 ITCS Sustaining Engineering Hardware
--

i. Sustaining Engineering (FY15)
- Review by EC3 PM
ii. Limited Life Tracking Spreadsheet
- Review by EC3 PM
iii. Monthly Project Status of Technical and Costs
- Review by EC3 PM
iv. TPS/DR/FIAR Tracking Spreadsheet
- Review by EC3 PM

5.2 Environmental Control and Life Support Systems (ECLSS) Sustaining Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall a. Perform all sustaining activities as related to hardware being sustained (listed below). This includes, but may not be limited to delivering hardware for flight (performing builds, calibration, pre-delivery tests), tracking of limited life items, updating certifications when required due to ops scenario changes, obsolescence of parts, etc, performing and supporting both ground and on-orbit failure investigations, supporting operations and needs of other systems/groups by maintaining detailed knowledge of hardware and answering questions related to the hardware. Specific tasks and schedules within this scope will be defined by Project Directive (PD). Deliverables will be uploaded to the EC3 ECLSS share folder and DDMS.
- b. The contractor shall perform transition activities associated with transitioning hardware responsibilities to other contractors. Specific tasks and schedules within this scope will be defined by Project Directive (PD).
- c. Project Directives (PDs) will be used to identify specific work and schedules within the scope listed above and within current approved contract authorization. PDs will be maintained under configuration control. The PD will be signed by the EC3 branch chief or delegate.

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware

Project Code: See Below

Hardware:

- i. Fire Cartridges: project code 00110
- ii. Velocicalc and Operations Hardware: project code 00065
- iii. Ammonia Measurement Kit (AMK): project code 02236
- iv. Ammonia Respirator/Cartridges: project code 2C902
- v. Emergency Response Mask (EM): project code 00110

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of Government Furnished Equipment (GFE) Flight Projects	Latest version

c. Required DRDs

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-04	Acceptance Data Package (ADP)	AR
TD-06	Certification Data Package	AR

d. **Products**

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Hardware delivery per flight manifests	3 Flights	Per PD
Sustaining Engineering (FY15)	1	Per PD
Monthly Project status of Technical and Costs	12	Monthly
Limited Life Tracking Spreadsheet	4	Quarterly
Fire Cartridge Surveillance Test Report	1	Per PD
Emergency Mask Surveillance Test Report	1	Per PD
AMK Life Extension Test Data Spreadsheet	7	Monthly
TPS/DR/FIAR Tracking Spreadsheet	4	Quarterly

e. **Product Verification**

5.2.1 Environmental Control Life Support Systems (ECLSS) Sustaining Engineering Hardware	
i. Hardware delivery per flight manifests	
- Review by EC3 PM	
ii. Sustaining Engineering (FY15)	
- Review by EC3 PM	
iii. Monthly Project status of Technical and Costs	
- Review by EC3 PM	
iv. Limited Life Tracking Spreadsheet	
- Review by EC3 PM	
v. Fire Cartridge Surveillance Test Report	
- Review by EC3 PM	
vi. Emergency Mask Surveillance Test Report	
- Review by EC3 PM	
vii. AMK Life Extension Test Data Spreadsheet	
- Review by EC3 PM	
viii. TPS/DR/FIAR Tracking Spreadsheet	
- Review by EC3 PM	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA24T TO# 211	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EC2 Design & Analysis Services(EC2)(TO162)(LOE)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,697,500	\$1,697,500

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rroverst, cn=ROCHELLE OVERSTREET Signature: _____ Date: 9/24/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA24T-TO211 BASE

Originator: VICTORIANO UNTALAN (EC2) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 EC2 Design & Analysis Services (EC2) (TO162) (LOE)

2. Date of Request: 09/03/2015

3. Statement of Work Task Description

a. 2.0 Ordered Products

b. 2.3 Analysis and Assessment

c. 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.

d. 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.

e. 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.

f. 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, Descent, 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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Analysis Tools Maintenance and Development

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide analytical tools and evaluation services in areas of ECLSS, ATCS, and EVA systems. This includes maintaining and enhancing the capabilities of the existing ECLSS, ATCS and EVA systems analysis tools and performing the engineering analyses and studies. NASA will define analysis tasks to be performed and prioritize the systems and capabilities maintenance and enhancements.

5.1.1 Analysis Tools Maintenance and Development

Project Code: Multiple

See above: 5.1 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. **Required DRDs**

5.1.1 Analysis Tools Maintenance and Development		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.1.1 Analysis Tools Maintenance and Development		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. **Product Verification**

5.1.1 Analysis Tools Maintenance and Development	
. None	
- NA	

5.2 ISS Gap Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall perform ISS thermal, EVA, and life support analyses and general thermal, EVA, and life support evaluations of existing and potential ISS hardware. NASA will define and prioritize the analyses and assessment services.

5.2.1 ISS Gap Analysis

Project Code: Multiple

See above 5.2 a. Requirement

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
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None	No Title Entered	
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c. Required DRDs

5.2.1 ISS Gap Analysis		
DRD #	DRD Title	Quantity/Frequency
None		NA

d. Products

5.2.1 ISS Gap Analysis		
Product(s)	Quantity	Delivery Date
None	NA	NA

e. Product Verification

5.2.1 ISS Gap Analysis	
i. None	
- NA	

5.3 Environmental Control & Life Support Systems (ECLSS) Project Analysis

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide engineering analysis and evaluation services for various ECLSS project. The contractor shall provide evaluations of Life Support (LS) technology development progress, LS requirements, and baseline values and assumptions for LS studies. This will include computer modeling and simulations of LS fluid processing and solids handling systems and components to evaluate developments in the LS technologies. It will also include trade-off studies and developing LS design database. NASA will define and prioritize the analyses and evaluation services.

The WBS structure shall be:

- 5.3.1 AES Water Architecture Analysis
- 5.3.2 NGLS Project Analysis
- 5.3.3 AES Logistics SE&I
- 5.3.4 AES Modeling

5.3.1 Environmental Control & Life Support Systems (ECLSS) Project Analysis

Project Code:

See above 5.3 a. Requirement

b. Applicable Documents

Document Number	Document Name	Rev.
None	No Title Entered	

c. Required DRDs

5.3.1 Environmental Control & Life Support Systems (ECLSS) Project Analysis		
DRD #	DRD Title	Quantity/Frequency
None		NA

d. Products

5.3.1 Environmental Control & Life Support Systems (ECLSS) Project Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.3.1 Environmental Control & Life Support Systems (ECLSS) Project Analysis	
i. None	
- NA	

5.4 Orion ECLSS Analysis

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide analyses and evaluation services of Orion ECLSS processes and hardware. These analyses and evaluations include detailed modeling of Orion life support technologies including air revitalization, water processing, and waste collection and processing hardware. Analyses also include trade studies of competing technologies that can perform specific life support functions and life support architecture evaluations that can evaluate advantages and disadvantages that these architectures can have in terms of mass, power, volume, crew time, performance and human thermal comfort characteristics. NASA will define and prioritize the analyses and evaluation services.

5.4.1 Orion ECLSS Analysis

Project Code: various

See above 5.4 a. Requirement

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	No Title Entered	

c. Required DRDs

5.4.1 Orion ECLSS Analysis		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.4.1 Orion ECLSS Analysis		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
None	NA	NA

e. Product Verification

5.4.1 Orion ECLSS Analysis	
. None	
- NA	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA25T TO# 212	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 JamesWebb Space Telescope Project Support (Materials-CF) (EC4) (TO160)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$925,643	\$925,643

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle Overstreet Signature: _____ Date: _____ Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA25T-TO212 BASE

Originator: JONATHAN HOMAN (EC4) **TMR:** MARIE KOWAL (EC) (281) 483-8875

1. Title of Effort: FY16 James Webb Space Telescope Project Support (Materials-CF) (EC4) (TO160)

2. Date of Request: 10/07/2015

3. Statement of Work Task Description

a. 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 JET S Technical Library and specified on each task order.

b.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Procurements Supporting JWST Testing

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall provide all related hardware and software to support preparing the chamber for JWST flight OTIS testing. This includes, but is not limited to the following activities:
Refurbishing the B32 roughing system, providing emergency power for the B32 roughing system, providing a backup air system to the cleanroom Make-up Air Unit (MAU), provide a backup air system to the chamber Air Flow Management System (AFMS) MAU, competent vendor inspections of roughing system blowers, back-up facility air system for test operations (rental), a Residual Gas Analyzer for chamber A.

5.1.1 JWST Procurements

Project Code:

- Roughing System Refurbishment / Upgrades
- Roughing System Emergency Power - Generators and Power Distribution Unit
- Cleanroom Back-up Air System
- Ch-A Air Flow Management System - Backup system
- Roughing System - Vendor Inspections
- Building 32 Back-Up Compressed Air System
- Residual Gas Analyzer

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JWI 8730.6	Task Performance Sheet	Aug. 18, 2011
EA-WI-024	General Operating Procedure for EA Testing Facilities	B
JWST-IRCD-003577	JWST Observatory to NASA JSC Test Facility Interface Requirements and Control Document	E
STB-E-084	CTSD STB Drawing System and Configuration Control Procedure	F
STB-E-367	Safety Analysis Techniques and Preparation Procedure	E
STB-E-493	CTSD STB Training and Certification Plan	I
STB-E-553	STB Document Preparation and Control Procedure	G
STB-E-554	STB Test Operation Guidelines	H
STB-E-574	STB Facility Maintenance Guidelines	Basic
STB-F-001	CTSD STB General Operating Procedures Manual	P

c. Required DRDs

5.1.1 JWST Procurements		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. Products

5.1.1 JWST Procurements		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Roughing System Refurbishment/Upgrades	1	6/15/2016
Roughing System Emergency Power and Generators and Power Distribution Unit	1	6/30/2016

Cleanroom Back-up Air System	1	1/15/2016
Ch-A Air Flow Management System â€" Back-up system	1	1/15/2016
Roughing System â€" Vendor Inspections	1	3/15/2016
Building 32 Back-up Compressed Air System	1	6/30/2016
Residual Gas Analyzer	1	2/15/2016

e. Product Verification

5.1.1 JWST Procurements
. Roughing System Refurbishment/Upgrades
- Hardware Delivery
i. Roughing System Emergency Power â€" Generators and Power Distribution Unit
- Hardware Delivery
ii. Cleanroom Back-up Air System
- Hardware Delivery
v. Ch-A Air Flow Management System â€" Back-up system
- Hardware Delivery
v. Roughing System â€" Vendor Inspections
- Hardware Delivery
vi. Building 32 Back-up Compressed Air System
- Hardware Delivery
vii. Residual Gas Analyzer
- Hardware Delivery

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 1
Task Order Number: NNJ16HA27T TO# 213	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Robotics Technology Branch Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$3,192,960	\$3,192,960

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Rochelle N. Overstreet</p> <p>ROCHELLE OVERSTREET</p> <p><small>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.23 15:17:41 -05'00'</small></p> <p>Signature: _____ Date: _____</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

RFP-TO213 BP1

Originator: VI TRUONG (ER3) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Flight Robotics System Service (TO 158)

2. Date of Request: 09/01/2015

3. Statement of Work Task Description

a. **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.

b. **2.3 Analysis and Assessment**

c. **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.

d. **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.

e. **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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Flight Robotics System Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide robotics flight engineering products and system services.

The Software, Robotics and Simulation Division's projects are often executed through Integrated Project Teams (IPT). As part of the IPT, the contractor shall provide technical services for the projects listed below. The IPT is made up of civil servants and contractor employees. Overall project management is provided by a cognizant ER civil servant. Technical leadership and management/consultation may be coordinated by NASA civil servant with contract management personnel based on the expertise required.

Services to be provided are detailed in the body of TO-213 and its Master Plan and Schedule ER3-TM158. Efforts include: flight hardware testing and processing, robotic facility maintenance and operation, and other as specified in the requirements which follow

5.1.1 SSRMS Analysis Task (Robotic Support to SSRMS Integration Team)

Project Code:

The contractor shall perform robotic analyses for the capture and release of the JAXA H-II vehicle, the Space-X Dragon vehicle, and the Orbital Cygnus vehicle using the SSRMS on the International Space Station (ISS), in accordance with ER3-TM213.

The contractor shall perform sim integration and data processing, including organizing berthing analysis data, expanding the SSRMS digital error database, integrating and testing simulation models to be used for the capture and release analyses, in accordance with ER3-TM213.

5.1.2 Mobile Servicing System (MSS) and Subsystem Management

Project Code:

The contractor shall provide system and subsystem management engineering services for the MSS in accordance with ER3-TM213.

The contractor shall provide sustaining engineering services required for the Centerline Berthing Camera System (CBCS) implementation on the ISS Commercial Visiting Vehicles and other ISS elements utilizing the Common Berthing Mechanism (CBM) interface in accordance with ER3-TM213.

5.1.3 ISS Robotics Software Integration

Project Code:

The contractor shall provide services to support the ISS Robotics Software Integration including MSS Software documentation configuration management, Simulated Robotic Work Station (SRWS) lab sustaining engineering, MSS Portable Computer System (PCS) Graphical User Interface (GUI) engineering analysis, MSS software testing in the Software Development and Integration Lab (SDIL), and Robotics Workstation (RWS) Overlay updates and testing to support the Visiting Vehicle mission in accordance with ER3-TM213.

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
E.O 12600	Freedom of Information Act	Jun. 1987
ER3-TM213	FY16 SRSD Master Plan and Schedule	Original
JPR 1700.1	JSC Safety & Health Handbook	Rev K (Nov 2013)
NPR 2810.1	Security of Information Technology	Rev A (May16, 2006)

- c. **Required DRDs**

5.1.1 SSRMS Analysis Task (Robotic Support to SSRMS Integration Team)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-01	Project Schedule	Monthly
RV-02	Regular Status Report/Summary Review	Monthly

5.1.2 Mobile Servicing System (MSS) and Subsystem Management		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	Monthly
RV-02	Regular Status Report/Summary Review	Monthly

5.1.3 ISS Robotics Software Integration		
DRD #	DRD Title	Quantity/Frequency
RV-01	Project Schedule	Monthly
RV-02	Regular Status Report/Summary Review	Monthly

d. **Products**

5.1.1 SSRMS Analysis Task (Robotic Support to SSRMS Integration Team)		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM213	Per ER3-TM213	Per ER3-TM213

5.1.2 Mobile Servicing System (MSS) and Subsystem Management		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM213	Per ER3-TM213	Per ER3-TM213

5.1.3 ISS Robotics Software Integration		
Product(s)	Quantity	Delivery Date
Implementation of ER3-TM213	Per ER3-TM213	Per ER3-TM213

e. **Product Verification**

5.1.1 SSRMS Analysis Task (Robotic Support to SSRMS Integration Team)	
. Implementation of ER3-TM213	
- Flight systems Branch (ER3) monthly review of status report/project schedule	

5.1.2 Mobile Servicing System (MSS) and Subsystem Management	
. Implementation of ER3-TM213	
- Flight systems Branch (ER3) monthly review of status report/project schedule	

5.1.3 ISS Robotics Software Integration	
. Implementation of ER3-TM213	
- Flight systems Branch (ER3) monthly review of status report/project schedule	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA27T TO# 214	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Robotics Technology Branch Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$1,282,498	\$1,282,498

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

<p>Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer.</p> <p>Name: _____</p> <p>Signature: _____ Date: _____</p>	<p>Name: Rochelle N. Overstreet</p> <p>ROCHELLE OVERSTREET</p> <p>Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=moverst, cn=ROCHELLE OVERSTREET Date: 2015.09.23 15:12:02 -05'00'</p> <p>Signature: _____ Date: 9/23/2015</p> <p>Contracting Officer</p>
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JSC Engineering, Technology and Science Contract

NNJ16HA27T-TO214 BASE

Originator: JARED WOODFILL (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Robotics Technology Branch (ER4) Services (TO159)

2. Date of Request: 08/21/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d. 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.

e. 2.3 Analysis and Assessment

f. 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.

g. **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.

h. **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.

i. **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.

j.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 FY16 Robotics Technology Branch (ER4) Technical Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide technical services as described in ER4-TM214 and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD). All technology development will be done as described in ER4-TM214.

5.1.1 Manipulation and Wearables Services (GY2016)

Project Code: 34507

The contractor shall provide engineering and technical services as directed by the NASA PM (Project Manager) of the Manipulation and Wearables Robotics Group (MWRG), in accordance with ER4-TM214, Section I.

Projects in the MWRG include, but are not limited to, Robonaut, Exo Skeleton Technology, X-Force shoes and other wearable technology, Roboglove, Robocannon, and Tendril.

5.1.2 Robotic Mobility Technologies (GFY 2016)

Project Code: NA

The contractor shall provide engineering services as directed by the NASA PM for the Robotic Mobility Group (RMG), in accordance with ER4-TM214, Section II.

Projects in the MWRG include, but are not limited to, Centaur, MRV, Chariots, SEV, MMSEV, SuperNature, EVA Scout Drone, and Lunar Prospector Rover.

5.1.3 Robotics Shared Services and Management (GFY 2016)

Project Code: NA

The contractor shall provide the TO management and control, administrative, and other technical services to satisfy the requirements as described in accordance with ER4-TM214, Section III.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER4-TM214	FY16 Robotics Technology Branch (ER4) Technical Services	Original

c. Required DRDs

5.1.1 Manipulation and Wearables Services (GY2016)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

5.1.2 Robotic Mobility Technologies (GFY 2016)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

5.1.3 Robotics Shared Services and Management (GFY 2016)		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	Monthly

d. **Products**

5.1.1 Manipulation and Wearables Services (GY2016)		
Product(s)	Quantity	Delivery Date
Implementation of ER4-TM214, Section I	1	09/30/2016

5.1.2 Robotic Mobility Technologies (GFY 2016)		
Product(s)	Quantity	Delivery Date
Implementation of ER4-TM214, Section II	1	09/30/2016

5.1.3 Robotics Shared Services and Management (GFY 2016)		
Product(s)	Quantity	Delivery Date
Implementation of ER4-TM214, Section III	1	09/30/2016

e. **Product Verification**

5.1.1 Manipulation and Wearables Services (GY2016)	
i. Implementation of ER4-TM214, Section I	
- SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM214, Section I	

5.1.2 Robotic Mobility Technologies (GFY 2016)	
i. Implementation of ER4-TM214, Section II	
- SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM214, Section II	

5.1.3 Robotics Shared Services and Management (GFY 2016)	
i. Implementation of ER4-TM214, Section III	
- SR&SD Robotics Technology Branch review, witness, and acceptance of products identified in ER4-TM214, Section III	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA28T TO# 215	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Advanced Docking System (TO136) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$1,216,484	\$1,216,484

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover, st, cn=ROCHELLE OVERSTREET Date: 2015.09.28 10:09:10 -0500 Signature: _____ Date: 9/28/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA28T-TO215 BASE

Originator: RICHARD HARDY (EA329) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 Advanced Docking System (TO136) (LOE)

2. Date of Request: 09/09/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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~~

d. 2.3 Analysis and Assessment

e. 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.

f. **2.4 Facilities**

g. **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.

h.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Advanced Docking System (ADS) Support

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide Level of Effort (LOE) products and services as directed by the NASA Advanced Docking System (ADS) Project Manager in support of NDS dynamic modeling, NDS testing support and engineering analysis and support for the Six degree of Freedom Dynamic Test System (SDTS) facility tests and maintenance. The contractor shall also provide LOE products and services in support of the NASA Docking System Block 2 (NDSB2) study effort. The contractor shall provide support per the attached LOE spreadsheet of standard labor categories.

A limited amount of materials may be purchased up to the limit allowed in this TO, as approved by the NASA ADS Project Manager or Deputy Project Manager. The materials may include, but are not limited to, articles required for the maintenance and operation of the SDTS and SDTS test article hardware.

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility

Project Code:

NDS Dynamic Modeling and Testing support tasks to be performed include but are not limited to:

- Support development of the NASA Docking System (NDS) block 1 simplified dynamics model.
- Support the development of dynamic models that will provide an integrated performance analysis when different user(s) models are provided.
- Support the correlation of Docking System and SDTS facility test models.
- Support planning and the completion of SDTS testing activities.
- Support activities leading to a certified facility ready to support docking system qualification testing.

Engineering analysis and support for SDTS Facility tasks to be performed include but are not limited to:

- Structures and Mechanism design and drafting
- Structural analysis
- Fabrication and assembly of hardware and equipment for the SDTS Facility

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort

Project Code:

- Engineering analysis and support tasks to be performed include but are not limited to:
 - Structures and Mechanism design and drafting
 - Structural and Electrical analysis
 - Fabrication and assembly NDSB2 Study Hardware

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test

Project Code:

- Support planning, execution and completion of the SpaceX Docking System SDTS test activities and reporting.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	Monthly

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	Monthly

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test		
DRD #	DRD Title	Quantity/Frequency
RV-02	Regular Status Report/Summary Review	Monthly

d. Products

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility		
Product(s)	Quantity	Delivery Date
Monthly Status Report	1	Monthly

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort		
Product(s)	Quantity	Delivery Date
Monthly Status Report	1	Monthly

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test		
Product(s)	Quantity	Delivery Date
Monthly Status Report	1	Monthly

e. Product Verification

5.1.1 Provide NDS Dynamic Modeling and Testing Support and Engineering Analysis and Support for SDTS Facility	
i. Monthly Status Report	
- As approved by ADS Project Manager or Deputy Project Manager	

5.1.2 Provide engineering analysis and support of the NDSB2 Study Effort	
i. Monthly Status Report	
- As approved by ADS Project Manager or Deputy Project Manager	

5.1.3 Provide NDS Dynamic Modeling and Testing Support for the SpaceX Docking System Test	
i. Monthly Status Report	
- As approved by ADS Project Manager or Deputy Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 6
Task Order Number: NNJ16HA29T TO# 216	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 DDMS, MCAD, ECAD SERVICES (TO126)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$657,016	\$657,016

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=movers, t, cn=ROCHELLE OVERSTREET Date: 2015.09.24 10:59:14 -0500 Signature: _____ Date: 9/24/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA29T-TO216 BASE

Originator: PAUL COLLIER (EA4) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 DDMS, MCAD, ECAD SERVICES (TO126)

2. Date of Request: 09/03/2015

3. Statement of Work Task Description

a. 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 JET S Technical Library and specified on each task order.

b. 2.2.4 Training

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

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 DDMS Support

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall In compliance with the above identified SOW(s) the contractor shall assist NASA with the definition, creation, and release of a model-based engineering release process;

assist NASA in support of projects with the use of non-Pro/E CAD platforms;

provide user adoption and training support;

provide DDMS project management through project planning, execution, monitoring, control, and outreach to the user community.

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.1.1 DDMS

Project Code: 0038

The contractor shall:

* Develop Plans and Solution Architecture to move JSC Engineering toward Model-based Release, including MCAD and ECAD (Solution Architect)

* Assists JSC Engineering with the transition of DDMS to the PTC managed private cloud for Windchill as SaaS (Software as a Service)

* Assists JSC Engineering and external orgs with the proper use of DDMS, specifically focused on engineering best practices (Solution Architect & PM)

* Assists NASA PM/JSC PLM Lead with visionary and roadmap tasks for Product Lifecycle Management (PLM) and DDMS (PM)

* Assures DDMS User Registration and NAMS processes are working and assists users into DDMS (Solution Architect and/or PM)

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
EA-WI-023	Project Management of GFE Flight Projects	D

c. Required DRDs

5.1.1 DDMS		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	12

d. Products

5.1.1 DDMS		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>

Status Reports and Summaries	12	1 per month (TCSR Status)
Baseline Architecture Document for Model Based Release	1	June 2016
Baseline Deployment Strategy for Model Based Release	1	June 2016
Final Deployment & Communication Plan for DDMS Cloud	1	October 30, 2015

e. Product Verification

5.1.1 DDMS
. Status Reports and Summaries
- Delivered to and verified by Project Manager
i. Baseline Architecture Document for Model Based Release
- Delivered to and verified by Project Manager
ii. Baseline Deployment Strategy for Model Based Release
- Delivered to and verified by Project Manager
v. Final Deployment & Communication Plan for DDMS Cloud
- Delivered to and verified by Project Manager

5.2 Mechanical Computer Aided Design

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall the contractor shall provide engineering services for MCAD tools used for hardware development by the Johnson Space Center Engineering Directorate.

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.2.1 MCAD

Project Code:

The contractor shall provide MCAD tools engineering services associated with the development of mechanical hardware in accordance with the Applicable Documents Listing.

The contractor shall provide engineering services to perform the following tasks for all Space Programs supported at the Johnson Space Center:

- * Establish and develop MCAD Best Practices and present to CAE Team
- * Help remedy MCAD related issues experienced by the JSC Engineering Community and NASA PM approved external users
- * Assist JSC Engineers and NASA PM approved external users with MCAD tool usage
- * Assist NASA PM with license recommendations during license renewals
- * Identify need for additional MCAD licenses and/or deletions of licenses no longer needed
- * Assist DDMS Solution Architect with Model-promotion and release solution development (Model-based Release)
- * Initiate and organize vendor-supplied training for MCAD tools; assists NASA HR in training planning
- * Participate in the CAE Team meetings

* Travel (one domestic trip) may be required to enhance MCAD Tool Products currently used or planned for use at JSC. The purpose for travel would include tool training and/or MCAD related conferences.

* Materials purchases will be required for MCAD Services with prior NASA approval.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
(38075)JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
EA-WI-023	Project Management of GFE Flight Projects	

c. Required DRDs

5.2.1 MCAD		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	12

d. Products

5.2.1 MCAD		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	12	1 per month (TC SR Status)
License Renewal and Purchasing Plan	4	Quarterly

e. Product Verification

5.2.1 MCAD	
i. Status Reports and Summaries	
- Delivered to DDMS Project Manager	
ii. License Renewal and Purchasing Plan	
- Delivered to DDMS Project Manager	

5.3 Electronic Computer Aided Design

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall the contractor shall provide engineering services for ECAD tools used for hardware development by the Johnson Space Center Engineering Directorate.

The contractor shall provide engineering services to perform the following tasks for all Programs supported at the Johnson Space Center:

- * Coordinate purchasing of annual license renewals
- * Identify need for additional licenses as necessary
- * Identify ECAD tools no longer needed/used
- * Present tool licensing needs to EV5 management and NASA ECAD lead
- * Establish a database interface process to DDM for finalized designs
- * Initiate and organize vendor supplied training for ECAD tools
- * Participate in ECAD tool team meetings
- * Assist members in ECAD tool usage

- * Travel may be required to enhance ECAD tool products currently used or planned for use at JSC. The purpose for travel would include tool training and/or ECAD related conferences.
- * Materials purchases will be required for ECAD services with prior NASA approval

All products and deliverables will go into DDMS.

Note: RV-02 for all specific product requirements will be met by submission of NASA format "Technical Cost and Schedule Review (TCSR)" reporting.

5.3.1 ECAD

Project Code:

The contractor shall provide ECAD tools engineering services associated with the development of electronic hardware in accordance with the applicable document listing.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
(38075)JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010
(38414)IPC-2221	Generic Standard on Printed Board Design	Rev A, May 2003
(38415)IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards	Feb. 1998
(38416)IPC-6011	Generic Performance Specification for Printed Boards	Jul. 1996
(38417)IPC-6012	Qualification and Performance Specification for Rigid Printed Boards	Rev C, Apr. 2010
EA-WI-023	Project Management of GFE Flight Projects	

c. Required DRDs

5.3.1 ECAD		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	12

d. Products

5.3.1 ECAD		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Reports and Summaries	12	1 per month (TCSR status)
License Renewal and Purchasing Plan	4	Quarterly

e. Product Verification

5.3.1 ECAD	
i. Status Reports and Summaries	
- delivered to DDMS Project Manager	
ii. License Renewal and Purchasing Plan	
- delivered to DDMS Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 7
Task Order Number: NNJ16HA30T TO# 217	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Orion Ascent Abort 2 (AA2) Flight Test (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,705,118	\$1,705,118

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/30/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=mover
st, cn=ROCHELLE OVERSTREET
Date: 2015.09.30 13:06:41

JSC Engineering, Technology and Science Contract

NNJ16HA30T-TO217 BASE

Originator: WILLIAM HARRIS (EA2) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 Orion Ascent Abort 2 (AA2) Flight Test (LOE)

2. Date of Request: 09/16/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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

d. 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.

e. **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.

f. **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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Orion AA2 Flight Test - CSR Project Management and System Engineering

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall Provide Level of Effort project management and systems engineering products and services associated with the Crew Module and Service Ring (CSR) design, integration, and test activities assigned to the JSC CSR Integrated Product Team (IPT). All products and services shall be conducted in compliance with the Orion AA2 project Plan (TBD) under the authority of the AA2 CSR Project Manager. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.1.1 Technical and Financial Reporting

Project Code:

Provide various PM/SEI products and services, comensurate and intergated with CSR IPT activities.

Provide monthly financial reporting/summary

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
none	none	none

- c. **Required DRDs**

5.1.1 Technical and Financial Reporting		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As Needed

- d. **Products**

5.1.1 Technical and Financial Reporting		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As Needed

- e. **Product Verification**

5.1.1 Technical and Financial Reporting	
i. LOE	
- As approved by the AA2 Project Manager	

5.2 Orion AA2 Flight Test - Avionics Engineering Products

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of AA2 Avionics design, development and test. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.2.1 Avionics Engineering Products

Project Code:

Provide design, analysis, procurements, fabrication, logistics, assembly, test planning, and testing associated with the AA2 Avionics and associated test equipment.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
none	none	none

c. Required DRDs

5.2.1 Avionics Engineering Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As Needed

d. Products

5.2.1 Avionics Engineering Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. Product Verification

5.2.1 Avionics Engineering Products	
i. LOE	
- As approved by the AA2 Avionics Lead or AA2 Project Manager	

5.3 Orion AA2 Flight Test - Harnessing Engineering Products

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of AA2 Harness design, development and test. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.3.1 Harness Engineering Products

Project Code:

Provide design, analysis, procurements, fabrication, logistics, assembly, test planning, and testing associated with AA2 harnesses.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
none	none	none

c. Required DRDs

5.3.1 Harness Engineering Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>

RV-02	Regular Status Report/Summary Review	As Needed
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d. **Products**

5.3.1 Harness Engineering Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.3.1 Harness Engineering Products		
i. LOE		
- As approved by the AA2 Harness Lead or AA2 Project Manager		

5.4 Orion AA2 Flight Test - Power Engineering Products

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of AA2 Power system design, development and test. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.4.1 Power Engineering Products

Project Code:

Provide design, analysis, procurements, fabrication, logistics, assembly, test planning, and testing associated with the AA2 Power System.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
none	none	none

c. **Required DRDs**

5.4.1 Power Engineering Products		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As Needed

d. **Products**

5.4.1 Power Engineering Products		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	LOE

e. **Product Verification**

5.4.1 Power Engineering Products		
i. LOE		
- As approved by the AA2 Power System Lead or Project Manager		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 10
Task Order Number: NNJ16HA31T TO# 218	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 EA Directorate Facility Management, Safety and Maintenance and Operations(TO119&172)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$1,995,205	\$1,995,205

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover st, cn=ROCHELLE OVERSTREET Date: 2015.09.29 20:25:10 ROCHELLE OVERSTREET Signature: _____ Date: 9/29/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA31T-TO218 BASE

Originator: SAMUEL DAUGHERTY (EA2) **TMR:** ROBERT VILLARREAL (EA) (281) 483-0143

1. Title of Effort: FY16 EA Directorate Facility Management, Safety and Maintenance and Operations (TO119&172)

2. Date of Request: 09/14/2015

3. Statement of Work Task Description

a. 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.

b. 2.4 Facilities

c. 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.

d. 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.

e. 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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Facility Management Requirements

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide day-to-day facility management for all EA Directorate facilities identified in attachment A per the facility management requirements in JWI 8831.1 and JPR 1700.1, and the additional requirements identified in this TO. This includes all utilities, building envelope, mechanical rooms, engineering research facilities, labs, machine shops, offices, working high bay overhead cranes and forklifts, controlled access areas and storage facilities. Consumables, equipment and other products required to accomplish these activities shall be coordinated with the Divisions that are responsible for the affected building/area. In addition, the contractor shall provide facility management using a zonal approach and provide cross training to maximize efficiency across all EA Directorate facilities identified in this TO. The contractor shall implement common processes and approaches across multiple facilities to enhance the efficiencies and capabilities of facilities. Tasks may also include configuration management of facility documentation and systems, including pressure vessel compliance.

5.1.1 Facility Management Tasks

Project Code:

Standard facility management tasks, that span the EA Directorate facilities, are included but not limited to the list below.

1. Ensure buildings are maintained in a safe, comfortable and productive environment and ensure safety and health information is communicated to all building occupants. Ensure daily occupant safety during construction activities, asbestos work, utility outages, radiation test, etc. Respond to chemical spills and blood borne pathogens, investigate, contact appropriate authorities and provide clean-up oversight as necessary. Coordinate with building occupants, Center Institutional and industrial Safety and Health and Center Operations Directorate (COD), as required, to resolve building related safety and health issues.
2. Ensure regular safety inspections are performed per the requirements of JWI 8831.1 and JPR 1700.1. Ensure inspection schedules are developed, in coordination with the Division(s) that are responsible for the building or facility being inspected, and provide inspection schedules to the responsible Directorate Safety contact for development of a Directorate wide inspection schedule. Correct findings immediately, submit appropriate work orders or develop and implement corrective actions. Enter room/area inspections into the Building Inspection Tracking System (BITS) database and submit items to the Hazard Action Tracking System (HATS) that cannot be corrected within 30 days or lack sufficient funding.
3. Serve as the building Chief Fire Warden, coordinate with other building Fire Wardens, respond to fire alarms, maintain fire alarm reports, and train building occupants in safe evacuation procedures. Stay informed and keep other Fire Wardens informed of modifications, constraints, fire alarm outages and or any activity that might affect the

evacuation of the building. Accompany Fire Technicians on annual fire protection audits, as notified.

4. Ensure Emergency Action Plans (EAPs), Hurricane and Severe Weather Plans and building Fire Evacuation Plans (FEPs) are in-place, updated as required and used.

5. Maintain training in the maintenance and use of the building AEDs. Coordinate to have AED operators in designated buildings. Perform weekly inspection of AEDs, record inspections and report discrepancies to the JSC AED Coordinator.

6. Review and concur, if required, Building, Lab and Shop Hazard Analysis for risk to employees and visitors, including physical hazards, chemical locations, utilities, OSHA compliance, fire safety, etc.

7. Investigate and provide resolution to close calls and mishaps, as requested by Division Management.

8. Coordinate preparations for VPP audits and attend/support OSHA VPP inspections upon notification.

9. Ensure hazardous material storage and disposal are maintained per the requirements and quarterly inventories are accurately and timely maintained.

10. Coordinate and approve, when required, Lock-out Tag-out (LOTO), Do Not Use, Hot Work, and Confined Space Entry permits. Ensure OSHA-permit required confined spaces and JSC-permit required confined spaces in buildings are properly identified and labeled. Maintain records as required.

11. Ensure crane, forklift, pallet jack and other equipment is maintained and has the proper certifications for use.

12. Ensure eye wash stations are inspected and flushed as required.

13. Review electrical panel schedules, floor plans, air handler floor plans and project and test schedules and coordinate/negotiate planned electrical or utility outages with center operations directorate, project and test personnel and inform building occupants of upcoming outages.

14. Maintain awareness of building asbestos containing material and inform maintenance personnel and building occupants when necessary to prevent employee exposure. Request air sampling as needed, receive notifications of findings and recommendations after indoor air quality investigations and submit appropriate work orders to fix indoor air

quality issues.

15. Periodically have potable water tested for bacteria and heavy metals, review reports and take action if needed.

16. Attend audits and maintain records for inspections, Environmental Audits, Occupational Health Audits, Fire Evacuations, Etc.

17. Serve as the building point of contact regarding disability accommodation requests and coordinate with the JSC Facility Manager Coordinator and the Office Equal Opportunity and Diversity.

18. Participate in all User Readiness Reviews (URRs) and Test Readiness Reviews (TRRs) that have impacts to the building facility manager's area of responsibility.

19. Perform work document initiation, review, coordination, in-process control, and close-out actions (Includes WAD coordination for the EA Directorate Office). Review and approve cost estimates, plans, safety requirements and environmental concerns, prior to initiation of work. Coordinate with Division funding authorization manager to ensure proper funds are used and authorized.

20. Schedule projects and coordinate work with contractors and building occupants to ensure job completion and personnel safety.

21. Ensure/maintain environmental compliance.

22. Be available 24-hours a day, 7 days a week by cell phone or alternate means of communication to help resolve emergency conditions that may arise in the building.

23. Approve/provide access to facility off-hours. Ensure building security access requirements are in-place and used. If requested by the respective Division, address key requests, cipher lock code approvals/distribution/change needs and provide building zoning and ID Max card reader authorizations.

24. Maintain awareness of pest control activity and inform building occupants when necessary.

25. Serve as the POC between Division/Directorate and the facilities contractor for building custodial and grounds issues

26. Serve as the POC between Division/Directorate and facilities contractor for energy conservation issues (lighting schedules, air handler schedules, etc.)

27. Support other audits, walkthroughs, inspections, as directed by Division/Directorate Management (Environmental Functional Review (EFR); Institutional Facility and Operational (IFO) audits; Deferred Maintenance walkthroughs, etc.
28. Assist the Division Emergency Planning Representative and Damage Assessment Team Member (DATM), as requested.
29. Develop Lab/Conference Room floor plans as directed by Division Management and manage and oversee implementation.
30. Serve as POC between Division/Directorate and Riggers for rigging support in building.
31. Serve as Division/Directorate POC for special events in the building.
32. Notify the responsible Division Management by email, within 8 hours, of all incidents in buildings occupied by their employees/contractors. Email shall contain time, location, and a brief description of the incident and the current status.
33. Coordinate tour requests as requested by the respective Division point of contact.
34. If requested by a Division, coordinate bike repairs, maintain bike inventory, look for missing bikes as appropriate and file reports with security when needed.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011
JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
Attachment A	EA Directorate Facility Management Coverage Matrix	August 2015
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JWI-8831.1	Facility Manager Program	Rev A, Sept 2014

c. Required DRDs

5.1.1 Facility Management Tasks		
DRD #	DRD Title	Quantity/Frequency
None		N/A

d. **Products**

5.1.1 Facility Management Tasks		
Product(s)	Quantity	Delivery Date
Monthly Status Reports addressing accomplishment, one month lookahead and list of incidents	12	10th of each month

e. **Product Verification**

5.1.1 Facility Management Tasks		
. Monthly Status Reports addressing accomplishment, one month lookahead and list of incidents		
- The above stated products shall be verified through review at scheduled periodic status meetings with NASA Division and Directorate personnel		

5.2 EA Directorate Maintenance and Operations Integration

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide EA Directorate level integration in the areas of Maintenance, Pressure Systems, Facility Configuration Management and Safety Support.
The contractor shall provide integration for all facilities and test equipment for which the contractor is given the responsibility of performing maintenance in operations in a JETS TO

5.2.1 EA Directorate Maintenance and Operations Integration
Project Code:

Maintenance:

- Monthly Metric reporting
- Maximo administration (CMMS)
- Ladder Inspections Program
- Oversight of Fall Protection Program
- MSCL reduction reporting
- Weekly EA Safety Walk Through's
- Manage SDRS Safety Discrepancy Tracking
- Special Studies or Safety Inspections
- Conduct Incident/Issue investigation and resolution
- Provide JETS related input to NASA/EA Directives
- Personnel certifications/training for M&R (i.e. CMRP, recurring annual)
- Oversight of maintenance sub-contracts (i.e. annual forklift maintenance and certifications)
- Facility related maintenance of a generalized nature (not Division specific) including but not limited to, preventive, reparative and predictive maintenance, calibration; as well as Health, Safety and Environmental actions

Pressure Systems Maintenance

- Monthly Metric reporting
- Monitor PSMO database to ensure systems are not used with past due inspections
- Pressure system inspection tracking, reminders, and metrics
- Compliance reviews (current goal is 10% of new/ modified/ reactivated/ inactivated systems)
- PSMO POC (Coordinate resolution of issues between PSMO and JETS)
- Provide JETS related input to NASA/EA Directives
- Conduct pressure system related Incident/Issue investigation and resolution
- Maintain training program to ensure continued education of the pressure system personnel
- General administration: PSP maintains license for PV Elite, an ASME code calculation software package, with cost of \$1296 per year. PSP is also responsible for printer maintenance, with estimated cost of \$1300 per 2 year for supplies
- Program Administration PSP documents including a plan, standard operating procedure, and 4 work instructions
- Pressure systems technical expert support to all JETS pressure systems personnel for design, maintenance, and operation of pressure vessels and systems

Configuration Management Support

- Facility asbuilt condition (drawings/reports) of current configuration, supporting audits and investigations
- Facility configuration requirement compliance assessments/reports for EA-WI-024, JPR 1700.1, and applicable industry standards (i.e. ASME, API, NFPA)
- CM Noncompliance action item closures
- Assist pressure systems engineer with data collection for evidence of pressure systems compliance with JPR 1710.13
- Training and monthly reporting (Administrative)

Directorate Facilities Strategic and Tactical Usage Planning

- Maintain EA Directorate Facility Master Plan (update twice per year)
 - Develop and oversee completion of Division level strategic and tactical facility usage and move plans (8 per year)
- [Note: Personnel moves will be implemented by a separate contractor]

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev. B, April 2014
JPR 1710.13	Design Inspection, and Certification of Pressure Vessels and Pressurized Systems	Rev F, August 2012

c. Required DRDs

5.2.1 EA Directorate Maintenance and Operations Integration		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		N/A

d. Products

5.2.1 EA Directorate Maintenance and Operations Integration		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Monthly Status Report	12	10th of each month

e. Product Verification

5.2.1 EA Directorate Maintenance and Operations Integration	
. Monthly Status Report	
- The above stated product shall be verified by NASA personnel when compiling the information for the Quarterly Technical, Cost, and Schedule Review (TCSR)	

5.3 EA5 General Facility M&O Requirements, Safety and Environmental and Property

- a. Requirement -** In compliance with the above identified SOW(s) the contractor shall provide day-to-day maintenance and operations activities common to all test facilities, systems and laboratories in the EA5 Project Management and Integration Office. Consumables, equipment and other products required to accomplish these activities shall be planned, procured and delivered in accordance with requirements of this task order.

**5.3.1 EA5 General Facility M&O Requirements, Safety and Environmental and Property
Project Code:
EA5 Maintenance and Operations**

Standard maintenance & operations tasks that span the EA5 Office facilities, laboratories and systems are included but not limited to the list below.

1. Perform preventative, routine and reparative maintenance of facility equipment.
2. Provide and maintain a personnel certification and training program.
3. Perform work document initiation, review, coordination, in-process control, and close-out actions (Includes WAD coordination for the EA Directorate Office).
4. Provide storage of and ready access to work documents/records.
5. Identify and maintain a list of equipment that needs to be replaced.
6. Maintain property accounts.
7. Provide cost estimates for services and functions provided.
8. Perform and maintain configuration management (CM) of facility baseline documentation for all facility-related assets.
9. Propose revisions to standard operating procedures and documentation to ensure they accurately reflect processes and identify those that could be rescinded.
10. Maintain laboratory equipment and systems.
11. Maintain pressure systems, including pressure testing of hardware, and ensure up to date certification of active pressure systems.
12. Inspect Lifting Devices and Equipment (LDEM), ensure appropriate certifications prior to use, and execute non-critical rigging and lifts.
13. Plan and schedule all M&O activities to minimize impacts to product-related TO activities.
14. Administer service contracts for equipment.
15. Ensure all Inspection, Testing and Measurement Equipment (IMTE) is within calibration during data measurement.
16. Perform periodic functional tests and operational readiness of equipment and facility systems.
17. Operate database and/or website that tracks maintenance items and property.

EA5 Safety Occupational Health and Environmental Management

In compliance with the above identified SOW(s) the contractor shall perform common health, safety & environmental (HSE) related requirements for the EA5 laboratories and facilities in accordance with JPR 1700.1 and EA-WI-024. Standard health, safety and environmental tasks that span the division's facilities, laboratories and systems are included but not limited to the list below.

1. Conduct periodic safety and compliance inspections and meetings. Track and close findings
2. Provide, service, maintain, and repair all PPE associated with M&O of facilities and systems
3. Conduct facility safety reviews
4. Conduct emergency drills for OSHA and test operations
5. Perform testing of all emergency and facility safety systems
6. Maintain an inventory of hazardous chemicals
7. Perform, maintain environmental compliance

EA5 Property Administration

The Contractor shall be responsible for identifying and tracking all EA5 government property assigned to their area. Each administrator shall maintain property accountability records and conduct property inventories in compliance with established JSC policies and procedures

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
EA-WI-027	Configuration Management for Government Furnished Equipment	Rev B, Sept. 2010
JPR 1700.1	JSC Safety and Health Handbook	Rev. J, Jun. 2011
JPR 5322.1	Contamination Control Requirements Manual	Rev G, Feb. 2012
JPR 8550.1	JSC Environmental Compliance Procedural Requirements	Nov. 2004
JPR 8553.1	JSC Environmental Management System Manual	Mar. 2011

JWI 1282.11	Calibration and Control of Measuring and Test Equipment	Feb. 2010, Chg. 1 Nov. 2011
EA-WI-024	General Operating Procedures Manual for EA Testing Facilities	Rev B, April 2014
JWI 4200.1	Manement of Controlled Equipment	Rev A, July 2013
NPR 4200.2	Equipment Management Manual for Property Custodian	Rev B Change 1, Sept 2003

c. Required DRDs

5.3.1 EA5 General Facility M&O Requirements, Safety and Environmental and Property		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
TD-11	Test Report	1 per test, irregular frequency

d. Products

5.3.1 EA5 General Facility M&O Requirements, Safety and Environmental and Property		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Test Report	1 per test	2 weeks after test completion

e. Product Verification

5.3.1 EA5 General Facility M&O Requirements, Safety and Environmental and Property	
. Test Report	
- The above stated product shall be verified through review at scheduled periodic status meetings with NASA EA5 personnel	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA32T TO# 219	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: Technical Manager and Property Manager Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$321,445	\$321,445

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: Signature: _____ Date: _____	Name: Rochelle N. Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rmoverst, cn=ROCHELLE OVERSTREET Date: 2015.09.15 09:20:16 -05'00' Signature: _____ Date: 9/15/2015 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA32T-TO219 BASE

Originator: JARED WOODFILL (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 ER JETS Division Technical Manager and Property Manager Services

2. Date of Request: 09/02/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 ER Division Technical and Property Manager Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall As per ER-TM219 Original

5.1.1 ER Division Technical Manager Services

Project Code:

Per ER-TM219 Original

5.1.2 ER Division Property Manager Services

Project Code:

As per Er-TM219 original

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER-TM219	ER Master Plan and Schedule	Original

c. **Required DRDs**

5.1.1 ER Division Technical Manager Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

5.1.2 ER Division Property Manager Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
None		NA

d. **Products**

5.1.1 ER Division Technical Manager Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Meeting with ER Division JETS Management	1	Bi-weekly

5.1.2 ER Division Property Manager Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Status Meeting with ER Division JETS Management	1	Quarterly

e. **Product Verification**

5.1.1 ER Division Technical Manager Services	
i. Status Meeting with ER Division JETS Management	
- Approval by ER Division JETS Management	

5.1.2 ER Division Property Manager Services

i. Status Meeting with ER Division JETS Management
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- Approval by ER Division JETS Management

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA33T TO# 220	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Docking Hatch (TO 171) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$372,165	\$372,165

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=movers
t, cn=ROCHELLE OVERSTREET
Date: 2015.09.28 11:44:25 -0500

9/28/15

Date: _____

JSC Engineering, Technology and Science Contract

NNJ16HA33T-TO220 BP1

Originator: DAVID HALL (EA529) (281) 483-9781 **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 Docking Hatch (TO 171) (LOE)

2. Date of Request: 09/16/2015

3. Statement of Work Task Description

a. 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.

b. 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

c. 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.

d.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Docking Hatch Support

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide Level of Effort products and services in support of the Docking Hatch. Contractor shall provide support per the attached LOE spreadsheet.

A limited amount of materials and travel may be provided up to the limit allowed in this TO.

5.1.1 Provide design, analysis, procurement, assembly and testing support for the Docking Hatch Project Code:

Provide design, analysis (stress/pressure/vibration/dynamic), procurements, manufacturing, logistics, assembly, test planning, and testing associated with the Docking Hatch Leak/Pressure/Vacuum/Vibration Test Fixture and the Docking Hatch engineering development unit.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
None	None	None

c. **Required DRDs**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the Docking Hatch		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	As Needed

d. **Products**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the Docking Hatch		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As Needed

e. **Product Verification**

5.1.1 Provide design, analysis, procurement, assembly and testing support for the Docking Hatch	
i. LOE	
- As approved by the Docking Hatch Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ16HA34T TO# 221	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 CPAS Engineering Services(TO137)(LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$309,294	\$309,294

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: 9/30/15
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=moverst,
cn=ROCHELLE OVERSTREET
Date: 2015.09.30 13:17:51 -05

JSC Engineering, Technology and Science Contract

NNJ16HA34T-TO221 BASE

Originator: ROBERT VILLARREAL (EA551) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 CPAS Engineering Services (TO137) (LOE)

2. Date of Request: 09/16/2015

3. Statement of Work Task Description

a. 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 JETST Technical Library and specified on each task order.

b. 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.

c. 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.

d. 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.

e. 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.

f.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Consultation and Engineering Services

- a. **Requirement -** In compliance with the above identified SOW(s) the contractor shall provide independent consultant services to the CPAS design team in review of the parachute and deployment system. The contractor shall provide design recommendations for the parachute and deployment system.

5.1.1 Engineering Services

Project Code: 00067

The contractor shall provide support in the following areas:

- Engineering drawings
- Stress analysis
- Stress analysis reports
- Parachute system test procedures
- Parachute analysis
- Schedule design reviews
- Teleconferences

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 64221	Implementation Plan for the Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS)	Latest Revision
JSC 66003	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Technical Guidance Document	Latest Revision
JSC 66004	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Management Integrated Product Team (IPT) Record (MIPTR)	Latest Revision

c. **Required DRDs**

5.1.1 Engineering Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Per JSC 64221

d. **Products**

5.1.1 Engineering Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

e. **Product Verification**

5.1.1 Engineering Services	
i. LOE	
- As approved by the CPAS Project Manager	

5.2 Engineering Technical Services and Drafting

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide CPAS design, drafting and analysis services.

5.2.1 Engineering Technical Services and Drafting

Project Code: 00067

The contractor shall provide CPAS design, drafting and analysis services.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JSC 64221	Implementation Plan for the Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS)	Latest Revision
JSC 66003	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Technical Guidance Document	Latest Revision
JSC 66004	Multi-Purpose Crew Vehicle (MPCV) Capsule Parachute Assembly System (CPAS) Management Integrated Product Team (IPT) Record (MIPTR)	Latest Revision

c. **Required DRDs**

5.2.1 Engineering Technical Services and Drafting		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Per JSC 64221

d. **Products**

5.2.1 Engineering Technical Services and Drafting		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
LOE	LOE	As needed

e. **Product Verification**

5.2.1 Engineering Technical Services and Drafting	
. LOE	
- As approved by the CPAS Project Manager	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 3
Task Order Number: NNJ16HA35T TO# 222	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Emily Barth Tel No.: 281-792-7979 E-mail: emily.a.barth@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Orion Testing Laboratory Services(TO144)

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$229,191	\$229,191

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=mover st, cn=ROCHELLE OVERSTREET Signature: ROCHELLE OVERSTREET Date: 2015.09.28 10:03:41 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA35T-TO222 Base

Originator: JARED WOODFILL (ER7) (281) 483-6331 **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 Orion Testing Laboratory Services(TO144)

2. Date of Request: 09/14/2015

3. Statement of Work Task Description

a. **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.

b. **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.

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 MPCV Testing Laboratory Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide software engineering services for the Orion Multi-Purpose Crew Vehicle (MPCV). The contractor shall evaluate requirements, architecture, processes, designs, and configuration management. Additionally, the contractor will foster a collaborative environment with the Orion prime contractor to create an open forum that allows for the exchange of information that will allow the NASA Orion team to assess the prime contractor's software development activities for the entire software life cycle.

The contractor shall perform the following:

- a1. Equipment selection and procurement
- a2. Test coordination.
- a3. Scheduling and planning.

The contractor will use ER7 or Lockheed Martin products necessary to perform product management, evaluations, test and verification, and develop software prototypes and accomplish training. The contractor will use ER7 or Lockheed laboratory space, and development systems required to accomplish Orion Test Lab Support tasks. Services to be provided are detailed in the body of TO-222 and its Master Plan and Schedule ER7-TM222.

5.1.1 MPCV Software Engineering Services for the Multi-Purpose Crew Vehicle (MPCV)

Project Code:

The contractor shall provide software engineering services for the Orion Multi-Purpose Crew Vehicle (MPCV).

- b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
CxP-72099	Crew Exploration Vehicle Software Management Plan	Basic, Sept. 18, 2007
ER7-TM222	ER7-TM222 Master Plan and Schedule	Original

- c. **Required DRDs**

5.1.1 MPCV Software Engineering Services for the Multi-Purpose Crew Vehicle (MPCV)		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

- d. **Products**

5.1.1 MPCV Software Engineering Services for the Multi-Purpose Crew Vehicle (MPCV)		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Product, associated DRDs, quantities, and delivery dates are specified in TO-222 and ER7-TM222, Master Plan and Schedule	Per TO-222 and ER7-TM222	Per TO-222 and ER7-TM222

- e. **Product Verification**

5.1.1 MPCV Software Engineering Services for the Multi-Purpose Crew Vehicle (MPCV)	
. Product, associated DRDs, quantities, and delivery dates are specified in TO-222 and ER7-TM222, Master Plan and Schedule	
- Product, associated DRDs, quantities, and delivery dates are specified in TO-222 and ER7-TM222, Master Plan and Schedule	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 5
Task Order Number: NNJ13HA01C TO# 223	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ashley Harral Tel No.: 281-792-7921 E-mail: ashley.e.harral@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 SuperNature Development Technical Services

Task Order Contract Type: Cost Plus Award Fee – Completion Form

Period of Performance: See Item 4

Description/Purpose: In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the products and/or services identified in Item 5. Detailed task descriptions are included in the following pages.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours	(b)	(4)	
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL	\$0	\$99,934	\$99,934

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor <input type="checkbox"/> is, <input checked="" type="checkbox"/> is not required. Sign below if required and return to the Contracting Officer. Name: _____ Signature: _____ Date: _____	Name: Rochelle Overstreet Digitally signed by ROCHELLE OVERSTREET DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=rnovers, t, cn=ROCHELLE OVERSTREET Date: 2015.10.20 09:45:29 -0500 Signature: _____ Date: 10/20/15 Contracting Officer
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JSC Engineering, Technology and Science Contract

NNJ16HA36T-TO223 BP1

Originator: JARED WOODFILL (ER7) **TMR:** JARED WOODFILL (ER) (281) 483-6331

1. Title of Effort: FY16 SuperNature Development Technical Services

2. Date of Request: 09/15/2015

3. Statement of Work Task Description

a. 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.

b. 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.

c. 2.3 Analysis and Assessment

d. 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.

e. 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.

f. **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.

g.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 12/31/2015.

5. Product Requirements

5.1 FY16 SuperNature Development Technical Services

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall technical services as described in ER4-TM223 and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD). All technology development will be done as described in ER4-TM223.

5.1.1 SuperNature Development Technical Services

Project Code: NA

Requirement - In compliance with the above identified SOW(s) the contractor shall provide technical services as described in ER4-TM223 and under the technical authority of the Robotic Systems Technology Branch of the Software, Robotics, and Simulation Division (SR&SD). All technology development will be done as described in ER4-TM223.

b. **Applicable Documents**

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
ER4-TM223	Master Plan and Schedule SuperNature Development Technical Services	Original

c. **Required DRDs**

5.1.1 SuperNature Development Technical Services		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	Monthly

d. **Products**

5.1.1 SuperNature Development Technical Services		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Implementation of ER4-TM223 Section I.	1	09/30/2016
RV-02 - Regular Status Report/Summary Review	1	Monthly

e. **Product Verification**

5.1.1 SuperNature Development Technical Services	
i. Implementation of ER4-TM223 Section I.	
- ER4 Branch review and acceptance of products identified in ER4-TM223	
ii. RV-02 - Regular Status Report/Summary Review	
- ER4 Branch review and acceptance of products identified in ER4-TM223	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TX 77058	ORDER FOR SUPPLIES OR SERVICES	Page 1 of 4
Task Order Number: NNJ16HA37T TO# 224	Revision Number: Base	Appropriation Data: Funded at Contract
SOW WBS: See Item 3	Fiscal Year(s): 2016	Technical Monitor/Org/Ext: Jeff Dutton/EA2/x32841
Issuing Office: NASA, Johnson Space Center 2101 NASA Parkway Houston, TX 77058-3696 Org/Buyer: BH2/Ryan Hancock Tel No.: 281-792-8314 E-mail: joseph.r.hancock@nasa.gov	Contractor: Jacobs Technology 2224 Bay Area Blvd Houston, TX 77058	Except for the Terms and Conditions of this order listed on the following pages, this delivery order is subject to the instructions contained on this form and is issued subject to the terms and conditions of contract number: NNJ13HA01C .

Title: FY16 Alpha Magnetic Spectrometer (TO139) (LOE)

Task Order Contract Type: Cost Plus Award Fee (LOE)

Period of Performance: See Item 4

Description/Purpose: Task descriptions are included in the following pages. In accordance with SOW(s) elements listed in Item 3, the contractor is directed to provide the level of effort described in the table below and is authorized to incur costs up to the amounts authorized in the table below to support the task requirements identified herein. The contractor's proposal is hereby incorporated by reference.

Task Order Estimated Cost and Fee			
	Previous Value	This Action	Current Value
Direct Labor Hours		(b) (4)	(4)
Direct Labor Cost			
Subcontract Cost			
Material Cost			
Travel Cost			
NLR Misc Cost			
Burden on NLR			
Total Non-Labor Cost			
Total Cost			
Fee			
SOW 1.0			
TOTAL		\$802,028	\$802,028

The contract value is hereby modified by the value of the change above. The contract estimated cost and fee (clause B.4) will be updated by a formal contract modification (to follow) that documents the change.

—Continued on following pages—

Written acceptance of this order by the contractor ☐ is, ☒ is not required. Sign below if required and return to the Contracting Officer.

Name:

Signature: _____ Date: _____

Name: **Rochelle N. Overstreet**

**ROCHELLE
OVERSTREET**

Signature: _____ Date: **9/30/15**
Contracting Officer

Digitally signed by ROCHELLE
OVERSTREET
DN: c=US, o=U.S. Government,
ou=NASA, ou=People,
0.9.2342.19200300.100.1.1=rmove
rst, cn=ROCHELLE OVERSTREET
Date: 2015.09.30 10:44:04

JSC Engineering, Technology and Science Contract

NNJ16HA37T-TO224 BASE

Originator: ROBERT VILLARREAL (EA551) **TMR:** ROBERT VILLARREAL (EA5) (281) 483-0143

1. Title of Effort: FY16 Alpha Magnetic Spectrometer (TO139) (LOE)

2. Date of Request: 09/21/2015

3. Statement of Work Task Description

a. 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  Safety 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.

b. 2.3 Analysis and Assessment

c.

4. Period of Performance

The period of performance does not commence until the CO has granted authorization to proceed.

This task order period of performance starts 10/01/2015 and ends 09/30/2016.

5. Product Requirements

5.1 Products and services to support on-going mission support for Alpha Magnetic Spectrometer.

- a. **Requirement** - In compliance with the above identified SOW(s) the contractor shall provide LOE products and services as directed by the NASA AMS Project Manager in support of ongoing on orbit operations of the Alpha Magnetic Spectrometer. Contractor shall provide support per the attached LOE spreadsheet.

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.

Project Code:

All necessary ISS data products shall be collected and delivered to AMS Collaboration in Geneva, Switzerland.

All necessary analysis reports shall be developed and delivered to ISS program and AMS Collaboration as required.

A limited amount of materials may be purchased up to the limit allowed in this TO, as approved by the NASA PM. The materials may include, but are not limited to, renewal of a Unigraphics software license.

Travel may be required to support the activities on this TO. The contractor should expect trips to Geneva, Switzerland, and Taipei, Taiwan. Other trips may be required and must be approved by the NASA PM.

b. Applicable Documents

<u>Document Number</u>	<u>Document Name</u>	<u>Rev.</u>
JPR 8500.4	JSC Drawing Manual	Rev. K, PCN-1 Jan. 2010

c. Required DRDs

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.		
<u>DRD #</u>	<u>DRD Title</u>	<u>Quantity/Frequency</u>
RV-02	Regular Status Report/Summary Review	1 per week

d. Products

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.		
<u>Product(s)</u>	<u>Quantity</u>	<u>Delivery Date</u>
Weekly Operational Reports provided to AMS Collaboration	1 per week	1 per week
Trip Reports	As required	1 week after return from travel

e. Product Verification

5.1.1 Provide day-to-day operational support of AMS. Provide thermal, structural, electrical and materials engineering analysis needed to support on going on orbit operations of AMS.	
i. Weekly Operational Reports provided to AMS Collaboration	
- As approved by AMS PM	
ii. Trip Reports	
- As approved by AMS PM	

