

**RVGSS SAMPLE TASK ORDER # 2****TASK ORDER TITLE: Rendezvous, Proximity Operations, and Docking Simulation Services****PERIOD OF PERFORMANCE: July 1, 2014 – June 30, 2015****TASK OVERVIEW:**

The objective of this task is to provide simulation development, integration, verification, validation, analysis, documentation, maintenance, and troubleshooting support for space-based vehicle rendezvous, proximity operations, and docking simulation efforts managed by the Engineering Directorate. The resulting non-real-time (NRT) and real-time (RT) robotics simulation applications have traditionally been used in support of procedures development, engineering analysis, and crew/flight controller training. In accordance with Statement of Work 3.2, Rendezvous, Proximity Operations, and Docking Simulation Services, the contractor shall provide the technical requirements listed below.

**TECHNICAL REQUIREMENTS:**

1. The Engineering Directorate is currently supporting numerous ongoing spacecraft programs as well as investigating advanced exploration projects, including the International Space Station (ISS), Visiting Vehicles (VV), and NASA Exploration Systems Simulation (NExSyS). Fundamental to the spacecraft simulations needed for these programs and projects is the ability to successfully model high fidelity orbital dynamics and the associated natural space environment.
  - 1.1. *JEOD Development and Maintenance* – The contractor shall develop and maintain models, simulations, and documentation associated with the JSC Engineering and Orbital Dynamics (JEOD) software package. The work shall include support to new capabilities and releases. Processes used for development and documentation shall be consistent with NASA Procedural Requirements (NPR) 7150.2 Class C software certification. The contractor shall also provide systems engineering support in terms of requirements maintenance, Application Programming Interface (API) design and review, and system architecture development.
2. The Engineering Directorate has traditionally used detailed modeling approaches to simulate vehicle Guidance, Navigation, and Control (GN&C) systems for the purposes of analyzing and training rendezvous, proximity operations, and docking of spacecraft. This includes but is not limited to integrated flight control algorithms or embedded/encapsulated flight software, hardware sensor models, propulsion driven effector models, and others. Complex mechanism and contact dynamics modeling of systems such as the NASA Docking System (NDS) is often required to simulate docking operations.

- 2.1. *iSES Spacecraft Prototype* – The contractor shall develop generic capabilities of sufficient engineering fidelity in order to simulate the automated rendezvous, proximity operations, and docking of one spacecraft to another in the form of a new integrated Spacecraft Engineering Simulation (iSES) prototype. The iSES should be capable of supporting advanced exploration initiatives such as NASA's Asteroid Redirect Mission. Knowledge of Lagrange Points (L1, L2, L3), Earth-Moon halo orbits, and Distant Retrograde Orbits (DROs), as well as orbital maintenance and low-lunar to L2 orbital trajectory planning, are keys to this requirement. The contractor shall plan the work to support an integrated demonstration of the iSES and shall participate in conducting the demonstration.
3. The Engineering Directorate has a need to maintain 21<sup>st</sup> Century Training Systems (TS21) VV and ISS math models and simulations for crew and flight controller training. The Engineering Directorate will continue this type of support post Operational Readiness Review (ORR) throughout the life of the ISS.
  - 3.1. *TS21 GN&C Sustaining Engineering* – The contractor shall provide maintenance and troubleshooting support for VV and ISS GN&C models including sensors, effectors, and interfaces associated with flight software.
  - 3.2. *TS21 GN&C Interface Maintenance* – The contractor shall provide maintenance and troubleshooting support for VV and ISS GN&C model capabilities that interface to external Modeling and Simulation (M&S) subsystems such as TS21 On-Board Computing System (OBCS) software and core dynamics and environment.
  - 3.3. *TS21 SEIT Support* – The contractor shall provide Systems Engineering, Integration and Test (SEIT) consultation support to TS21 facility maintenance individuals, focusing on vehicle GN&C performance issues.

#### **DELIVERABLES & SCHEDULES:**

1. Subtask 1 deliverables:
  - A. Initial JEOD software release and NPR 7150.2 compliant documentation deployed to JEOD customer Wiki (January 1, 2015). Releases should be compatible with Trick 13.x.
  - B. Final JEOD software release and NPR 7150.2 compliant documentation deployed to JEOD customer Wiki (June 30, 2015). Releases should be compatible with Trick 13.x.
2. Subtask 2 deliverables:
  - A. Initial prototype demonstration of iSES (January 1, 2015). This demonstration should be targeted for a desktop simulation environment as well as the Systems Engineering Simulator (SES) Video wall. iSES prototype should be developed using Trick 13.x.
  - B. Final prototype demonstration of iSES (June 30, 2015). This demonstration should be targeted for a desktop simulation environment as well as the Systems

Engineering Simulator (SES) Video wall. iSES prototype should be developed using Trick 13.x.

- C. iSES verification and validation test cases along with documentation (June 30, 2015).

3. Subtask 3 deliverables:

- A. Initial VV and ISS GN&C maintenance release (January 1, 2015).
- B. Updated VV and ISS maintenance release (June 30, 2015).

**DEPENDENCIES:**

NASA shall provide access to required development resources including workstations, laptops, network infrastructure, software licenses, avionics system engineering units, vehicle and environment simulations, and supporting tools resources at JSC.