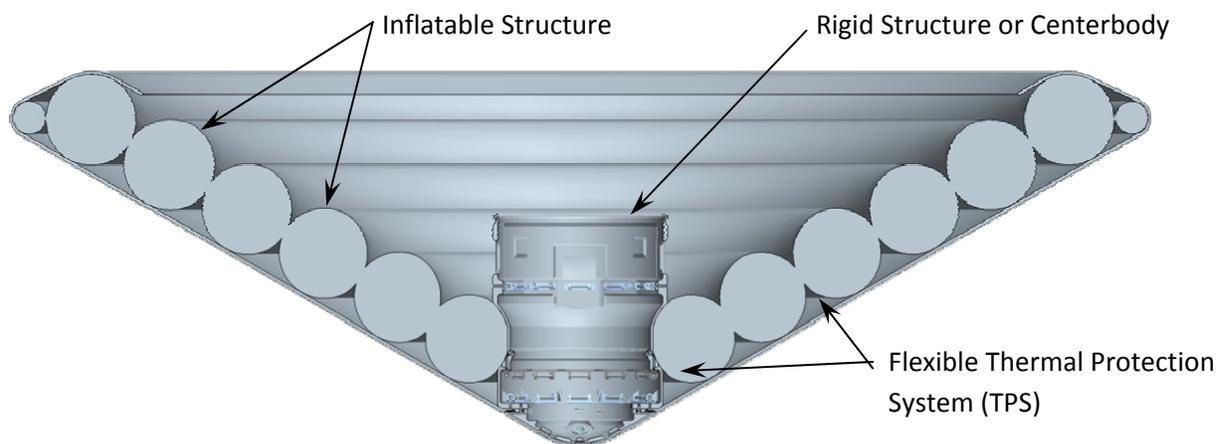

EXHIBIT A – STATEMENT OF WORK

Inflatable Aerodynamic Decelerators**1.0 Introduction and Background**

Inflatable and deployable aerodynamic decelerators are a cross-cutting technology being developed to achieve improved atmospheric entry capabilities, which can enable delivery of large mass payloads in a variety of NASA applications. Successful development of the Inflatable Aerodynamic Decelerators (IAD) technology can lead to an improved entry, descent, and landing (EDL) timeline, improved mission flexibility, as well as increased landed mass, accuracy, and ability to land at higher altitude. Future high-mass robotic and human exploration missions that could benefit from the use of IAD technology include: Mars robotic, Mars human, Venus, Low Earth Orbit/International Space Station, Near Earth Object return-robotic, and terrestrial robotic missions.

On August 17, 2009, the IRVE-II project (with a 2.96m (116.5in) inflatable aeroshell) was launched on a sounding rocket out of Wallops Flight Facility, with a goal of demonstrating the concept of inflatable reentry vehicles. During the IRVE-II flight, the aeroshell inflated as designed and maintained stability through hypersonic reentry, and the supersonic, transonic and subsonic flight regimes.

To advance this technology, demonstration of larger scale IAD inflatables, ranging between 3 to 15 meters in diameter with scalability beyond 15 meters in diameter, will begin with ground testing and progress to space flight demonstrations over a range of flight conditions to assess the performance of thermal protective systems (TPS) under higher heat flux levels and the response to vehicle flight controls. The IADs will be designed to meet specific requirements for aerocapture, EDL, which may therefore include hypersonic, supersonic, transonic and subsonic regimes, depending upon the specific application. Development activities may also include integration with various flight vehicle configurations, stowage arrangements, deployment methods, inflation systems, and instrumentation. The following is an illustration of an IAD system.



2.0 Scope and Objectives

This contract is for the development of IADs technology for space vehicle aerocapture and EDL for atmospheric entry applications in hypersonic, supersonic, transonic and subsonic regimes. The scope of the task orders (TOs) may be related to a range of applications including, but not limited to, test coupons, ground articles, engineering development units, or space flight units. A complete IAD system includes, but is not limited to, the inflatable structure, TPS, and restraint system for stowage. Materials to be used for the IAD systems may include refractory cloths, threads, and yarns; ceramic insulating battings; polyimide films; and fiber-reinforced polyimide films. Interfaces for the IADs may include attachment to the vehicle centerbody, inflation system, and instrumentation.

3.0 Design & Manufacturing of TPS Layups

As required by individual TOs, the Contractor shall design and manufacture flexible TPS including, but not limited to, the following:

- Develop conceptual and detailed designs, and construction methods, of TPS based on government specified materials and layups set forth in the TO. The construction design specified in the TO may include, but is not limited to, manufacturing and integration details and pertinent drawings. Drawing details required will also be specified in the TO and may include, but are not limited to, construction stitching, weave type, close-out, and integration
- Fabricate and deliver TPS components. TPS components will be specified in each TO and may include, but are not limited to, test coupons, ground article assemblies, or flight unit assemblies
- Integrate instrumentation into the TPS fabrication construction of a TO specified layup. Instrumentation integrated into TPS will be specified in each TO and may include, but are not limited to, thermal flux, surface temperature, strain, shape, and surface pressure instrumentation
- Provide mass estimates and actual mass measurements which may include, but are not limited to, estimates of TPS assembly masses, interim mass estimates of components, and final as-built mass of the assembly
- Investigate the advancement of TPS construction techniques including, but not limited to, mass reduction, improved packing efficiency, increased thermal resistance, increased fault tolerance, or increased system reliability
- Develop methods to improve fabrication techniques that reduce integration complexities or improve system reliability
- Develop methods to improve integration of required sensors compatible with the TPS
- Develop methods to improve mechanical interface with the rigid structure and mechanical interface with the inflatable structure to meet system requirements
- Conduct evaluations of advanced materials for improved system development

4.0 Design & Manufacturing of Inflatable Structures

As required by individual TOs, the Contractor shall design and manufacture inflatable structures including, but not limited to, the following:

- Develop conceptual and detailed designs, and construction methods, of inflatable structures. The contractor shall provide a design as specified in the TO that may include, but is not limited to, materials selection, Computer-aided Design (CAD) models, structural analysis models, and pertinent drawings

- Fabricate and deliver inflatable structure components. Inflatable structure components will be specified in the TO and may include, but are not be limited to, fabrication and delivery of test coupons, ground article assemblies, and flight unit assemblies
- Integrate TO specified instrumentation into the inflatable structure. Instrumentation may include, but are not limited to, the measurement of temperature, strain, shape, and internal pressure
- Provide mass estimates and actual measurements which may include, but are not limited to, estimates of the structural assembly mass, interim masses of components, and final as-built mass of the assembly
- Investigate the advancement of the structural design to reduce mass, improve packing efficiency, increase structural stiffness, increase fault tolerance, and increase system reliability
- Develop methods to improve fabrication techniques that reduce integration complexities or improve system reliability
- Develop methods to improve integration of required sensors compatible with the inflatable structure
- Develop methods to improve mechanical interface with the rigid structure and mechanical interface with the TPS
- Develop conceptual and detailed design of Inflation Systems. The contractor shall provide a design as specified in the TO that may include, but is not limited to, materials selection, CAD models, structural analysis models, and pertinent drawings
- Fabricate and deliver Inflation System assemblies. Inflation System assemblies may be for use in ground test articles or flight units

5.0 Systems Integration

As required by individual TOs, the Contractor shall perform the system integration of IAD components including, but not limited to, the following:

- Perform system integration of the sub-elements of the IAD to form a complete aeroshell assembly or components thereof, as specified in the TO. The contractor shall provide pertinent documentation associated with the integration including, but not limited to, CAD models and pertinent drawings
- Develop conceptual and detailed design, and fabrication of ground support equipment as specified in the TO. This may include, but is not limited to, materials selection, CAD models, and pertinent drawings
- Provide written verification and validation of requirements as specified in the TO. This may include, but is not limited to, proof of inspection, verification, and calibration

6.0 Performance Analysis

As required by individual TOs, the Contractor shall conduct performance analysis of IAD components including, but not limited to, the following:

- Conducting analysis including, but not limited to, establishing IAD inflation pressures, material stresses, and structural response to specified load environments
- Conducting system analysis of a complete aeroshell assembly or components thereof and associated deliverables as specified in the TO. This may include, but is not limited to, CAD models, structural analysis models, material properties models, and pertinent drawings

7.0 Packaging and Flight Restraint

As required by individual TOs, the Contractor shall design and manufacture packaging and flight restraint of IAD components including, but not limited to, the following:

- Develop conceptual and detailed design of flight restraint as specified in the TO. This may include, but is not limited to, materials selection, CAD models, and pertinent drawings
- Fabricate and deliver flight restraint assemblies, which may be used during ground or flight testing
- Provide mass estimates and actual mass measurements, which may include, but are not limited to, estimates of the flight restraint assembly mass, interim masses of components, and final as-built mass of the assembly
- Develop methods to improve fabrication techniques and reduce integration complexities
- Develop methods to improve mechanical interfaces with the packaged IAD and rigid structure
- Develop flight restraint designs to improve mass of restraint and deployment system, increase fault tolerance, or increase system reliability
- Develop packaging approaches for stowing IADs for flight testing or ground testing requiring a deployment

8.0 Testing

As required by individual TOs, the Contractor shall perform testing of IAD components including, but not limited to, the following:

- Conduct testing for sub-component, component or system level development tests as specified in the TO. This may include, but is not limited to, materials, construction techniques, interfaces, stowage, deployment, instrumentation functionality, or leakage
- Develop written test plans and procedures
- Perform a technical analysis of test results and prepare corresponding test documentation and reports
- Provide on-site technical support for system level tests that are conducted at NASA or other facilities