Statement of Work - ISS Dewar

1.0 General Background

The National Aeronautics and Space Administration (NASA) will be procuring a Dewar (Fig 1) for use in a cryogenic experiment on the International Space Station. The instrumented Dewar will be integrated with a receiver tank, and used in a demonstration of the storage and transfer of liquid methane in zero g. Constraints on the experiment timeline will require the tank to be maintained with zero boiloff for six months or more.

2.0 Vendor Qualifications

Vendor must have a Quality Management Program which has been certified to be compliant with ISO 9001:2008 or equivalent.

Vendor shall be capable of design, fabrication and certification in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII Division 1 or Division 2, if at all possible, or alternatively with AIAA S-080.

Aluminum welding capabilities shall be in accordance with ASME Boiler and Pressure Vessel Code

Vendor shall establish and implement a system to review and take action, as necessary, on Government-Industry Data Exchange Program (GIDEP) Alerts.

Vendor shall maintain a calibration system based on standards traceable to NIST. (A system compliant with ANSI/NCSL Z540 is preferred).

3.0 Technical requirements

3.1 Mass

The dry mass of the Dewar shall be less than 50 kg.

3.2 Envelope and interfaces

The outer envelope of the Dewar shall be less than 65 cm diameter and 60 cm high.

The top and bottom heads of both the tank and vacuum shell shall be removable. Any MLI blanket on the tank shall be fabricated to accommodate this feature.

The top head of the vacuum shell shall have two access ports of at least 5 cm clear diameter.

The top head of the tank shall have two access ports of at least 5 cm clear diameter, and one of at least 10 cm clear diameter.

The bottom head of the vacuum shell and the tank shall each have three access ports of at least 5 cm clear diameter.

The space between the two bottom heads shall allow a free volume for internal manifold components of at least 45 cm diameter and 15 cm height.

The contractor shall develop an external structural interface for the Dewar in cooperation with the customer.

3.3 Volume

The tank volume shall be at least 50 liters, with a strong desire for more volume within the limits of dry mass.

3.4 Thermal Requirements

The Dewar shall allow both active and passive operation, in an environment that may vary between -40°C to +50°C. In a 20°C operating environment, the active mode shall use no more than 50W for a flight-capable cryocooler to maintain the tank at a constant temperature of 80K with no venting. In the same 20°C environment, the passive mode with no venting shall allow no more than 2.0W of heat load on the tank at 80K, with zero electric power. The vendor shall provide non-flight electronics to drive the active mode for all ground test activities. The customer will assume responsibility for acquiring a set of flight electronics to drive the active mode.

For certain servicing operations where power will not be available for active mode operation, the tank shall have a cooling loop for liquid nitrogen flow which will allow at least 1.0 gram/sec flow rate at a gas quality between 0-100%.

3.5 Operating Lifetime

The dewar shall be capable of running in active mode for a duration of two years of ground test and flight operations.

3.6 Pressure, Temperature and Loads

The internal MAWP or MEOP of the tank shall be at least 0.21 MPa over a temperature range of -215°C to +50°C, and of the vacuum shell at least 0.10 MPa over a temperature range of -40°C to +50°C. Both shall be capable of one atmosphere external pressure for leak check operations at 20°C. The tank and vacuum shell shall both be provided with appropriate pressure relief devices.

The Dewar shall be designed for typical ground shipping loads. As a minimum, the Dewar shall be designed for a 10 g acceleration in any direction, simultaneous with pressure loading and with a full load of methane. The Dewar shall be designed for a minimum natural frequency of greater than 50 Hz.

3.7 Leak

The Dewar shall be leak tight to better than $1x10^{-8}$ standard cc/second of GHe, as measured by a calibrated helium mass spectrometer.

3.8 Handling

The vendor shall provide a cart or work stand designed and tested for the full wet weight of the Dewar, and which enables the Dewar to be inverted. The Dewar shall be provided with lift points designed and rated for the dry weight of the Dewar.

3.9 Shipping

The vendor shall provide a shipping container for the Dewar, consistent with the shipping loads of Sec 3.6.

4.0 Programmatics

4.1 Customer access

The vendor shall allow reasonable access for the customer's Quality Assurance or Engineering personnel to witness any phase of the production of the Dewar, at the contractor's facilities or at any subcontractor.

4.2 Customer reviews

At a location of its choosing, the contractor shall conduct technical reviews with the customer, as listed in Sec 5.0 1). At least two weeks advance notice shall be given for each of the reviews.

4.3 Delivery schedule

The Dewar should be delivered within 14 months of contract initiation (Fig 2), including 3 months of schedule allowance for customer/contractor interaction on analysis and review.

4.4 Structural analysis task sharing

The vendor shall bear all responsibility for the design and fabrication of the Dewar for pressure and temperature environments. The customer will share responsibility for structural analysis related to the space flight environment.

4.5 Testing

The vendor shall be responsible for verifying by test that the Dewar complies with each of the technical requirements of Section 3, except for the acceleration and frequency requirements, which will be verified by the customer.

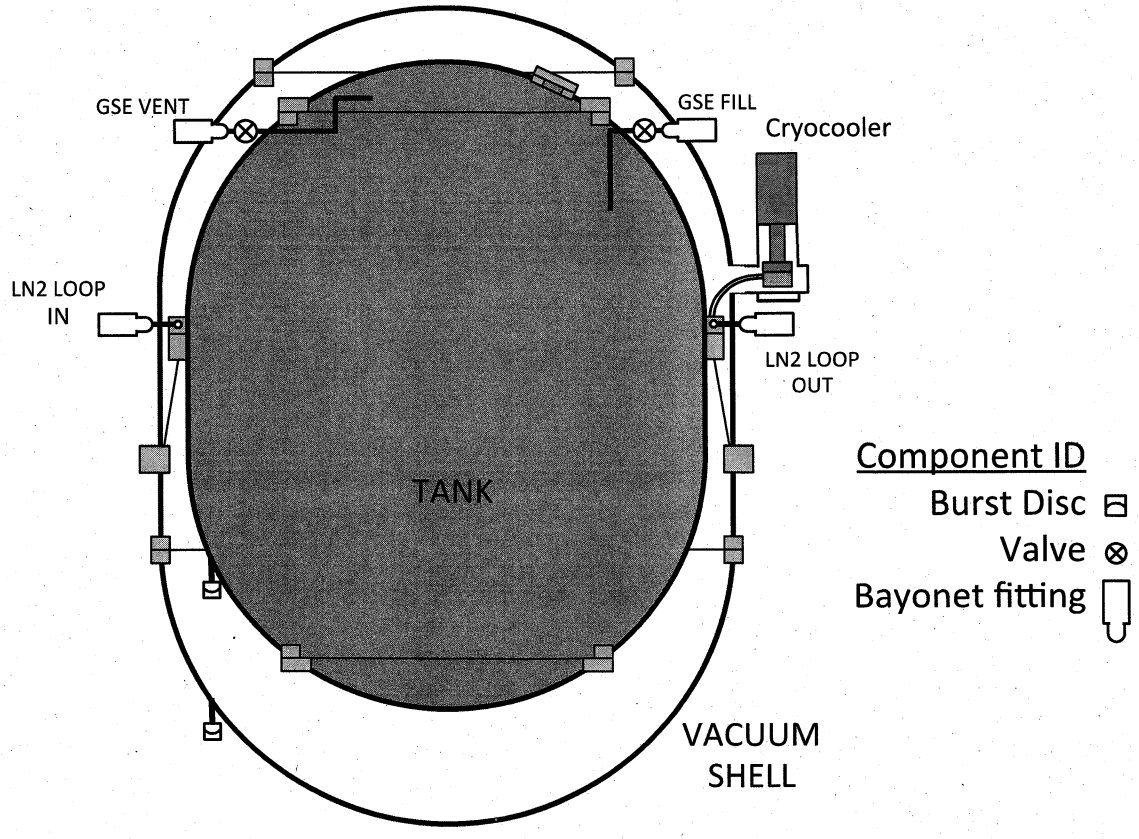
Vibration qualification will be performed by the customer at NASA. The vendor is welcome to witness the qualification testing.

Liquid nitrogen may be used in place of liquid methane for all of the testing at the vendor's location.

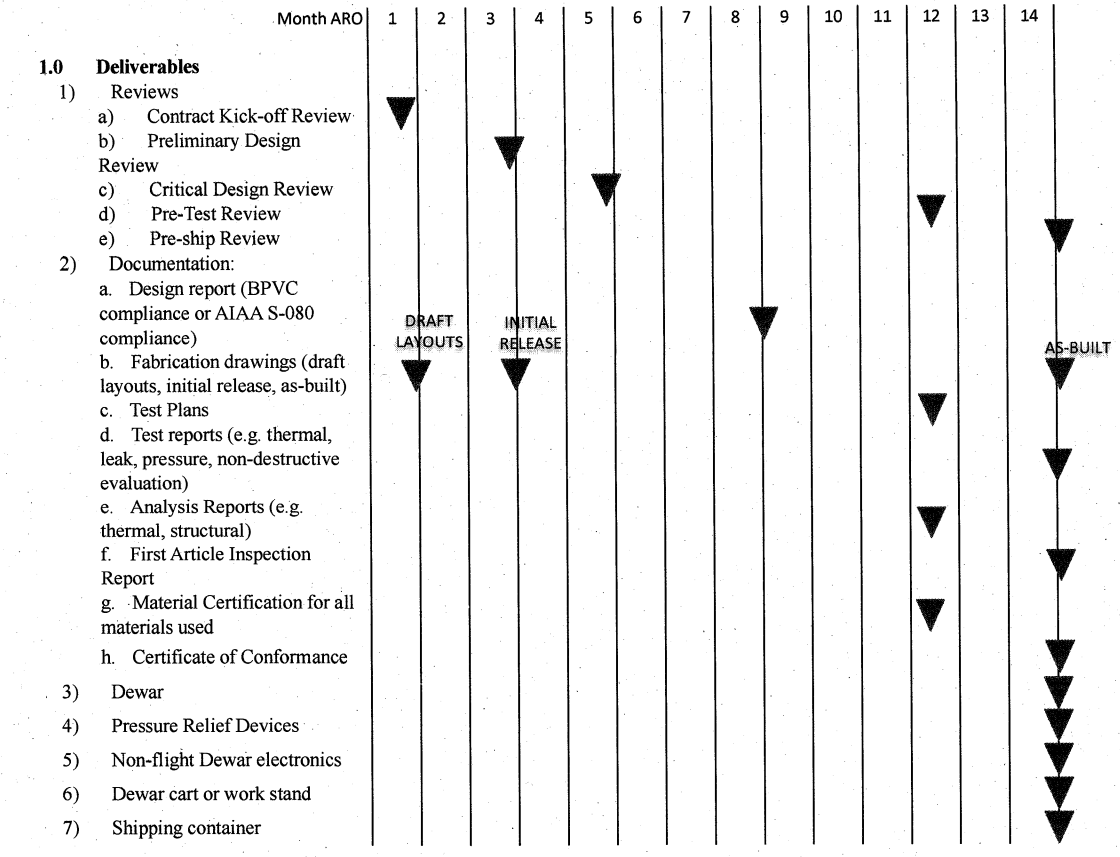
5.0 Deliverables

1) Contract Kick-off Review, Preliminary Design Review, Critical Design Review, Pre-Test Review, Pre-ship Review
2) Documentation:
    a. Design report (BPVC compliance or AIAA S-080 compliance)
    b. Fabrication drawings (draft layouts, initial release, as-built)
    c. Test Plans
    d. Test reports (e.g. thermal, leak, pressure, non-destructive evaluation)
    e. Analysis Reports (e.g. thermal, structural)
    f. First Article Inspection Report
    g. Material Certification for all materials used
    h. Certificate of Conformance

3) Dewar
4) Pressure Relief Devices
5) Non-flight Dewar electronics
6) Dewar cart or work stand
7) Shipping container



- Fig 1. Features of the Dewar include removable heads on the tank and vacuum shell, access ports, an internal manifold volume, a cryocooler for zero boiloff, and a liquid nitrogen cooling loop.



- Fig 2. Nominal delivery schedule