University-affiliated Spaceport Technology Development Contract NAS1003006

100812

TASK ORDER

TO Ref.	Task Order No.	Contract Year	Task Order Revision	Reference Plan Revision	Laboratory/Area	Type:
SPI	00425	7	RFP	A		Mission Support

Title: **CLV ML Fluid Systems**

Director Area	R&D / Scope Change	Manager Group	Period of Performance
Systems & Project Engineering	R&D: No Scope Change: Yes	Project Engineering	From: 02/20/2007 To: 06/30/2010

Note: Target Costs change only if scope changes	CY1 to CY5 (K$)	CY6 (K$)	Contract Year 7 (CY7) Cost Targets FROM:	DELTA:	TO:	CY8 (K$)	OUTYEARS (K$)	TOTAL (K$)
TOTAL ADJUST TARGET LABOR COSTS								
ESTIMATED OTHER DIRECT COSTS								
SUBTOTAL TOTAL ESTIMATED COSTS								
AWARD FEE (on labor only)								
INCENTIVE FEE (on labor only)								
TOTAL COST AND FEE	1,361.37	4,673.03	$4,658,604	$0	$4,658,604	3,390.43	0.00	14,083.44

FS	PROGRAM	FUND CODE	$ FROM	$ DELTA	$ TO	INITIALS
1	CONSTL	321379.09.01.05.01.11	$1,045,975.00	$0.00	$1,045,975.00	
2	CONSTL	292360.09.20.02.10	$8,772,392.00	$0.00	$8,772,392.00	
3	CONSTL	292360.09.20.02.24.01	$645,000.00	$0.00	$645,000.00	
TOTAL CUMULATIVE FUND LIMIT (NOT TO EXCEED)			$10,463,367.00	$0.00	$10,463,367.00	

DATE IN 04-02-09
DATE OUT 04-02-09

NASA TASK ORDER MANAGER/ ORG / PHONE — SIGNATURE Robert Mott / NE-F2 / (321)867-0836 — DATE 27MAR09	CUSTOMER TECH REP(OPTIONAL)/ ORG / PHONE — SIGNATURE Larry Schultz / LX-01 / (321)867-8803 — DATE 3/31/09
CERTIFICATION OF FUNDING/ ORG / PHONE — SIGNATURE — DATE	CONTRACT TECHNICAL MANAGER/ ORG / PHONE — SIGNATURE Nancy Hoffman / NE-I2 / (321)867-4014 — DATE 3/31/2009
CONTRACT OFFICER/ ORG / PHONE — SIGNATURE Andrew Dennis / OP-ES / (321)867-4174 — DATE 4/1/09	ACCEPTANCE ACKNOWLEDGEMENT BY CONTRACTOR/ ORG / PHONE — SIGNATURE Martin Cummins / USTDC / (321)867-5408 — DATE 4/2/2009

A. PROJECT DESCRIPTION & SCOPE

RFP A: This Request for Proposal (RFP) requests the contractor to provide support for 1) Fluid Systems Ground Support Equipment (GSE) Installation Design, and 2) the design of a remotely controlled hypergolic servicing system for the Constellation Program (CxP) Mobile Launcher Element (MLE).

Under the guidance of the NASA Lead Design Engineer (LDE), the contractor shall provide technical expertise and engineering support for the design of Fluid Systems on an ML for the Crew Launch Vehicle (CLV)/Crew Exploration Vehicle (CEV).

Basic: The purpose of this Revision is to define project scope continued from CY6/FY08, as outlined in TO 6SPI00425, Revision D. Unless specifically addressed below, the scope of work defined in 6SPI00425, Revision D remains unchanged.

CY6/FY08 Activity

Engineering support activities continued throughout CY6/FY08 and evolved as the subsystem and element projects matured. The USTDC team supported the 30% design reviews and the ML Preliminary Design Review (PDR) efforts as requested by the NASA LDEs. Labor target values have been adjusted to reflect actual effort.

CY7/FY09 - CY8/FY10 Activity

Requirement development activities will continue into CY7/FY09 and evolve as the subsystem and element projects mature. Subsystems will proceed to 60, 90 and 100% design and the Mobile Launcher (ML) Critical Design Review (CDR) in CY8/FY10. Under the direction of the NASA Lead Design Engineer (LDE), the contractor shall support the completion of the design for Fluid Systems up through 100% design / CDR completion, and shall support the development of all required documentation as per *KDP-P-2713, Technical Review Process*.

This Task Order (TO) defines work to be provided by the contractor in support of development of Fluid Systems for the next generation of Launch Systems. The contractor shall provide technical expertise and engineering support for the definition and development of design concepts for Fluid Systems on a ML for the Crew Launch Vehicle (CLV)/Crew Exploration Vehicle (CEV). Under the direction of the NASA LDE, the contractor shall support the completion of the design for Fluid Systems up through CDR and shall provide all required documentation as per KDP-P-2713. The contractor shall support the design reviews and meetings as required by the NASA design lead.
The Fluid Systems shall consist of Cryogenic Propellants, Hypergolic Propellants (both mono and bipropellant), Pneumatics (high and low pressure), Hydraulic Systems, Environmental Control Systems (ECS) and Cold Helium systems for a ML at the Kennedy Space Center.

Required products shall include General Arrangement Drawings, system descriptions, design analyses, System Requirements Document (SRD), Space and Weight drawings, block diagrams, system specifications, Materials and Processes (M & P, if required), end-to-end (including Pad) System Mechanical Schematics (SMS), System Electromechanical Control Diagrams (EMCD), cable interconnect diagram, equipment list(s), Advanced Order Parts Lists (AOPL), application software development measurements, Logistics Support Plan.

The preliminary requirements are defined by *CxP 70000 Constellation Architecture Requirements Document (CARD), CxP 70023 Design Specification for Natural Environments, CxP 70028 Ground Systems*

to CEV Interface Requirements Document (IRD), CxP 70052 Ground Systems to CLV IRD, CxP 72034 SRD and CxP 72121 Ground Support Equipment (GSE) Requirements Document. All designs shall be in compliance with *KSC-DE-512-SM Facility, System and Equipment General Design Requirements, ANSI/ASME-B31. 3 Process Piping and ASME Boiler and Pressure Vessel Code*, except as noted below.

B. TASKS

1.0 The contractor shall provide technical and engineering support for the development of Cryogenic Propellant Systems through 100% Design.
These systems are:

1.1 - Liquid Hydrogen (LH2) Propellant System in accordance with *KSC-STD-Z-0009, Standard for Design of Cryogenic GSE and ANSI/AIAA-G-095 Guide to Safety of Hydrogen and Hydrogen Systems*. LH2 is used as the primary fuel for the CLV Upper Stage.

1.2 - Liquid Oxygen (LO2) Propellant System in accordance with *KSC-STD-Z-0009* and *ASTM-MANL-36 Manual for Safe Use of Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operations, Storage and Transportation (superseding NSS-1740. 15).* LO2 is used as the primary oxidizer for the CLV Upper Stage.

2.0 The contractor shall provide technical and engineering support for the development of Hypergolic Propellant Systems through 100% Design.
These systems are:

2.1 - Nitrogen Tetroxide (N2O4) Propellant System in accordance with *KSC-STD-Z-0006, Standard for Design of Hypergolic GSE*. Nitrogen Tetroxide is used as the oxidizer for the Solid Rocket Booster (SRB) Roll Control Reaction Control System (RCS) on the CLV Interstage and the Service Module (SM) of the CEV.

2.2 - Monomethylhydrazine (MMH) Propellant System in accordance with *KSC-STD-Z-0006*. Monomethylhydrazine is used as the fuel for the SRB Roll Control RCS on the CLV Interstage and the SM of the CEV.

2.3 - Hydrazine (N2H4) Propellant System in accordance with *KSC-STD-Z-0006*. Hydrazine is used as a monopropellant for the CLV Upper Stage RCS and the CLV First Stage SRB Hydraulic Power Unit (HPU).

3.0 The contractor shall provide technical and engineering support for the development of Pneumatic Pressure Systems (high and low pressure) through 100% Design.
These systems are:

3.1 - Gaseous Nitrogen (GN2) System in accordance with *KSC-STD-Z-0005, Standard for Design of Pneumatic GSE*. Gaseous Nitrogen is used for servicing the SM Environmental Control & Life Support System (ECLSS), inert purges during propellant loading, explosion proofing electrical enclosures, environmental purges and many other general service uses.

3.2 - Gaseous Helium (GHe) System in accordance with *KSC-STD-Z-0005*. Gaseous Helium is used for pre-pressurization of the LH2 and LO2 tanks servicing the SM, Upper Stage RCS and SRB Roll Control RCS GHe propellant pressurization tanks, inert purges during propellant loading and many other general service uses such as system leak checks.

3.3 - Breathing Air System in accordance with *KSC-STD-Z-0005* and *KSC-STD-Z-0008C, Standard for Design of Ground Life Support Systems and Equipment*, as applicable. Breathing Air System is used for the

Crew Module (CM) pressure leak check prior to flight and other possible uses.

4.0 The contractor shall provide technical and engineering support for the development of Hydraulic Systems through 100% Design.

5.0 The contractor shall provide technical and engineering support for the development of Environmental Control Systems through 100% Design.

6.0 The contractor shall provide technical and engineering support for the development of Cold Helium Subsystem through 100% Design.

7.0 The contractor shall provide support for the development of Liquid Nitrogen (LN2) performance testing at the LETF for the Cold GHe effort. In addition, functional testing of a helium coriolis flowmeter shall be included as part of LN2 performance testing.

8.0 The contractor shall provide support for the development of a LH2 calorimeter test to obtain data in order to develop a LH2 boiling curve for the ML LH2 Heat Exchanger (HEX) design.

9.0 The contractor shall provide support in obtaining Request for Information (RFI) responses from experienced cryogenic HEX designers/manufacturers on cost and schedule for the following: a) design and manufacture of a prototype sub-scale HEX test article, b) design and manufacture of a full-scale HEX test article.

10.0 The contractor shall provide support for development of the design and manufacture, and/or for the manufacture only of a sub-scale or full-scale HEX test article (decision will be based on cost/ schedule response obtained from Task 9).

11.0 The contractor shall provide project and systems engineering support for Fluid Systems development.

12.0 The contractor shall provide engineering support for the design of fluid subsystems for the ML GSE installation contract. The subsystems shall include Hypergols, Hydraulics, Pneumatics, ECS, Ground Coolant, Ammonia, Cryogenics and Cold GHe. [RFP A]

13.0 The contractor shall support the ML GSE installation design reviews, interface meetings with the installation contractor, and provide the recommended ML subsystem equipment locations for all NE-F2 fluid subsystems. [RFP A]

14.0 The contractor shall provide support for engineered subsystems (Cryogenics and ECS). This shall include the coordination of pipe routings with the installation contractor, development of pipe spool drawings for incorporation into the installation contractor construction drawings, and final design calculations (including pipe stress). [RFP A]

15.0 The contractor shall provide technical expertise and engineering support for the design of a remotely controlled hypergolic servicing system. [RFP A]

C. MILESTONES/DELIVERABLES

1. - Support for CDR Package submittal.
Start Date : 10/01/2008End Date : 06/30/2010

2. - Support for LN2 Performance testing and reporting.
Start Date : 10/01/2008**End Date** : 11/25/2008

3. - Support for LH2 Calorimeter testing and reporting.
Start Date : 10/01/2008**End Date** : 03/05/2009

4. - Support in obtaining RFI responses for cost/schedule of design/manufacture of a Hex (sub-scale or full-scale options).
Start Date : 10/01/2008**End Date** : 12/26/2008

5. - Support for the completion of the sub-scale/full-scale prototype HEX.
Start Date : 10/20/2008**End Date** : 05/19/2010

6. - **Support for 30% Design Review for ML GSE Installation. [RFP A]**
Start Date : 05/01/2009**End Date** : 08/28/2009

7. - **Support for 60% Design Review for ML GSE Installation. [RFP A]**
Start Date : 05/01/2009**End Date** : 11/06/2009

8. - **Support for 90% Design Review for ML GSE Installation. [RFP A]**
Start Date : 05/01/2009**End Date** : 03/19/2010

9. - **Support for 100% Design Release for ML GSE Installation. [RFP A]**
Start Date : 05/01/2009**End Date** : 06/11/2010

D. STANDARDS OF PERFORMANCE (METRICS)

1. - Task Order metrics will be collected in accordance with the USTDC Internal Surveillance Plan.