Marshall Space Flight Center
Engineering, Science & Technical Services

Task Order Plan (TOP)

Contract Number: *NNM05AB50C*
TO Title: *Integrated Systems Health Management and Sensors*
TO Number: *32-040307* **Revision:** *03*

Period of Performance: *10/02/2010* to *09/30/2011*

MSFC Initiator: *Angela Shields*

(b)(4) [redacted]

Emergency: *No*

WBS # **425180.01.08**

Revision 03:
This Task Order (TO) defines and estimates work for the period October 2, 2010 through September 30, 2011 for Contract Year 6 of the NNM05AB50C ESTS contract. Additionally, the Schedule and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

Revision 02:
The purpose of this revision is to increase the scope and reflect the current objectives of this task at the request of the customer. The added scope is due to the need to define technology development in the area of cryogenic fuel management, propulsion systems and structure & thermal applications. The total cost estimate increased by (b)(4) [redacted] The Task Order Description & Objectives in the Task Order Plan were modified to reflect current task requirements. The Risk Assessment was updated to reflect the current revision number and the Performance Plan was updated to reflect the current task objectives.

Subcontract estimate is increased by (b)(4) [redacted]
Labor estimate is increased by (b)(4) [redacted]

Revision 01:
The purpose of this revision is to modify the task objectives to explicitly define the task description and reflect the current objectives at the request of the customer. There is no increase to the cost estimate. The Task Order Description & Objectives, Milestones & Deliverables, and Participating Subcontractors in the Task Order Plan were modified to reflect current task requirements. The Performance Plan was updated to reflect the current task objectives, and the Risk Assessment was updated to reflect the current revision number.

Revision 00;
This Task Order (TO) defines and estimates work for the period October 3, 2009 through October 14, 2010 for Contract Year 5 of the NNM05AB50C ESTS contract. This task reflects a continuation of support previously provided under TO 32-040306-01.

1.0 Task Order Description & Objectives [updated at Rev.02]

Integrated Structural Health Monitoring (ISHM) Instrumentation Development, Test and Evaluation (DTE):
Provide technical support for the definition of test configurations, assembly of test equipment, execution of the test, and analysis of the test data for evaluation of the effectiveness of candidate systems to monitor the structural health of composite structures that are representative of those to be used on Ares V. Develop algorithms that assist in the interpretation of structural health monitoring (SHM) sensor signals. Be able to properly discern the state of health of a structure by the diagnosis of the signal received from an SHM sensor. Develop algorithms for the Pitch Echo and Pitch Catch type sensors.
Perform laboratory electronics testing and evaluation by accurately acquiring the test sensor's electronic data signal. Analyze data using standard data reduction software.
Assembly of laboratory electrical equipment and the operation of monitoring tools for all functional tests will be required. Mechanical assembly of test article and sensor will be required. The ability to use data acquisition system for a variety of platforms is required. Perform hydrazine sensing; provide composite health monitoring support, and Development Motor-2 (DM-2) health monitoring support. Provide Hydrazine Sensing support for the Diamond MEMS pressure sensor via fabrication, characterization of material compatibilities, completed sensor chip, and integrated sensor system in liquid hydrazine and air. Design and fabricate housing and packaging for sensor system. Provide hydrazine sensing support for the leak detection sensor via fabrication, design and characterization of metals, polymers and other materials.
Develop Abort (Motor Pressure) and Caution & Warning (C&W) Messages (Motor Pressure/Forward Dome Temperature) Algorithms to demonstrate these algorithms in real-time during DM-2 Full Scale Static Test Motor Firing at (b)(4) and work with (b)(4) to Interface (b)(4) Data Acquisition System to obtain the required data in real-time without compromising test objectives and hardware.
Define ISHM technology development for cryogenic fuel management, propulsion systems and structure & thermal applications.

2.0 Technical Approach (Including required input, guidelines & assumptions)

Office automation software will be utilized as appropriate to create the required documentation for reviews, engineering meetings and compilation of engineering data as required. This software will include but is not limited to MathCad, Microsoft Office products such as Word, Excel, Power Point, Simulink, and Microsoft Project. The Micron Optics si920 optical sensing interrogator will be utilized in the Joint Army/MSFC Weapons Science Lab to measure the high frequency response data in the test series.

3.0 Discussion of Skills Required

A mix of junior and senior engineers with vehicle, subsystem, operations, test, and design experience, with specific skills in sensor development is required. Personnel should be capable of utilizing Microsoft Office software. The ability to create and manipulate Excel spreadsheets and PowerPoint presentations is required.

4.0 Special Tools Required

None.

5.0 Participating Subcontractors [updated at Rev.01]

(b)(4)

6.0 Milestones & Deliverables [updated at Rev.01]

(1) Test Procedures Report as needed through testing series.
(2) Abort and Caution and Warning sensors/algorithms/testing in support of the project schedule.
(3) Pitch Echo and Pitch Catch algorithms according to the project schedule.
(4) Weekly Notes.

(5) Monthly Activity Report (MAR).
(6) Other presentations and documents, as required.

7.0 Special Considerations (Recruiting, Special Equipment / Material, Safety, etc.) [updated at Rev.03]

Three trips are estimated to support this task. The travel estimate is included as part of the subcontract estimate.

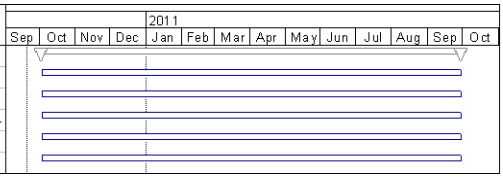
8.0 Work Shelf

The following activities could be accomplished as part of the Task Order performance by personnel that are temporarily available due to program or funding delays on other Tasks. Specific assignments will be coordinated with the Task Initiator to ensure appropriate skills and experience.

TO/Subelement	Description	Due Date	Skill

9.0 Schedule [updated at Rev.03]

Task Order #	SubE	Task Work Element
32-040307	**00**	**Integrated Structural Health Monitoring (ISHM) Instru Dev, Test & Eval (DTE)**
32-040307	00	Monthly Activity Report
32-040307	00	ISHM Test Procedures Report - as needed through testing series
32-040307	00	Abort and Caution and Warning sensors/algorithms/testing in support of the project schedu
32-040307	00	Pitch Echo and Pitch Catch algorithms according to project schedule
32-040307	00	Other presentations and documents, as required



ESTS Contract Task Order Request Performance Plan

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Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	65%	X 65% = **Justification**
(1) Assist in the definition of test configurations, assembly of test equipment, execution of the testing, and analysis of the test data for evaluation of the effectiveness of candidate systems to monitor the structural health of composite structures that are representative of those to be used on Ares V. (2) Determine the state of health of a structure by the diagnosis of the signal received from an SHM sensor. (3) Develop algorithms that assist in the interpretation of structural health monitoring (SHM) sensor signals. (4) Develop algorithms for the Pitch Echo and Pitch Catch type sensors. (5) Perform laboratory electronics testing and evaluation of the test sensor. (6) Analyze data using standard data reduction software. (7) Assemble laboratory electrical equipment and monitoring tools for all functional tests. (8) Assemble test article and sensor. (9) Perform hydrazine sensing; provide composite health monitoring support, and Development Motor-2 (DM-2) health monitoring support. (10) Provide Hydrazine Sensing support for the Diamond MEMS pressure sensor via fabrication, characterization of material compatibilities, completed sensor chip, and integrated sensor system in liquid hydrazine and air. Design and fabricate housing and packaging for Diamonds MEMS		

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sensor system. Provide Hydrazine sensing support for the Hydrazine Leak detection sensor. (11) Develop Abort (Motor Pressure) and Caution & Warning (C&W) Messages (Motor Pressure/Forward Dome Temperature) Algorithms to demonstrate these algorithms in real-time during DM-2 Full Scale Static Test Motor Firing at ATK/Utah, and work with ATK to Interface ATK's Data Acquisition System to obtain the required data in real-time without compromising test objectives and hardware. Define ISHM technology development for cryogenic fuel management, propulsion systems and structure & thermal applications.		
Schedule Objectives (Milestones)	**Weighting Schedule %** 10% *(min 10%)*	**Schedule Score** X 10% = **Justification**
1) ISHM Test Procedures Report - as needed through testing series. 2)Abort and Caution and Warning sensors/algorithms/testing in support of the project schedule. 3)Pitch Echo and Pitch Catch algorithms according to the project schedule. 4) Monthly Activity Report (MAR). 5)Other presentations and documents, as required.		
Cost (actual vs. negotiated)	**Weighting Cost%** 25% *(min.25%)*	**Cost Score** X 25% = **Justification**
	Weighting Total % 100.00%	**Total Score**

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Technical, Schedule, and Cost Grading Scale

Score	Description
9.0-10.0	Exceeded TO Performance Plan objectives resulting in major benefit(s)
8.0-8.9	Exceeded TO Performance Plan objectives resulting in modest benefit(s)
7.0-7.9	Met TO Performance Plan objectives
3.0-6.9	Did not meet all TO Performance Plan objectives resulting in minimal impact or requiring additional agency funds
0.0-2.9	Did not meet TO Performance Plan objectives resulting in substantial impact and/or requiring additional agency funds

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Comments:

Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS
ESTS Group

Risk Assessment

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(b)(4)

Task Order Risk Assessment to Cost, Technical, and Schedule

List identified risk associated with Task Order performance as related to task cost, technical, and schedule. Classify the risk(s) according to probability of occurrence and impact as defined below and enter the risk into risk matrix.

Risk	Risk Type	Probability (1-4)	Impact (1-4)	Risk Description
Risk C1	Cost	**1**	**4**	Nominal support efforts are associated with the estimate for this task. If unforeseen analyses or schedule demands require increased workload, additional funds may be needed to meet the increased requirements.
Risk C2	Cost			
Risk T1	Technical			No technical risk has been identified with this task.
Risk T2	Technical			
Risk S1	Schedule			No schedule risk has been identified with this task.
Risk S2	Schedule			

*Note: See page 2 for risk mitigation plan for those risks which are Primary Risk Drivers.

Task Order Risk Matrix

	1 Minimal Impact	2 Minor Impact	3 Medium Impact	4 Major Impact
4 Inevitable Occurrence (>95% Probability)	Y	Y	R	R
3 High Probability of Occurrence (>60% but <95% Probability)	G	Y	Y	R
2 Medium Probability of Occurrence (>25% but <60% Probability)	G	Y	Y	Y
1 Low Probability of Occurrence (<25% Probability)	G	G	Y	Y

Legend

- R — **Primary Risk Driver:** Requires Risk Mitigation Plan
- Y — **Caution:** Requires status updates and general plan for risk reduction as determined necessary by Team Lead and Initiator
- G — **Watch:** No Action required

Impact Level	Cost Impact Definition	Technical Impact Definition	Schedule Impact Definition
(1) Minimal Impact	No significant cost impact	No significant technical impact	No significant schedule impact
(2) Minor Impact	Potential to recover cost	Potential to gain required technology without impact	Minor delay in deliverables but no impact to customer
(3) Medium Impact	>0 but <10% subtask cost overrun	Some technical impact but potential to recover	Delay in subtask deliverables but work arounds available and acceptable to customer
(4) Major Impact	>10% subtask cost overrun	Unable to meet technical requirements to perform subtask	Delay in subtask deliverables with impact to customer

Risk Mitigation Plan

Complete the following chart for those risks identified on page 1 as “Primary Risk Drivers”. The following chart will serve as the Risk Mitigation Plan.

Risk No.: Risk Description:		
Mitigation Step No.	Planned Completion Date	Mitigation Step Description