Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS ESTS Group

Task Order Plan (TOP)

Contract Number: *NNM05AB50C*
TO Title: *Combustion Devices Technology Development*
TO Number: *33-030201* **Revision:** *22*

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

MSFC Initiator: *David Sparks*

(b)(4)

Emergency: *No.*

Revision 22: The purpose of this revision is to increase estimated hours on subelement -02 and reduce estimated hours on subelement -04. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities. (b)(4) (b)(4) The total estimate for this Revision 22 is reduced by (b)(4) from the prior revision.

Subelement Revision Summary			
Subelement	**WBS**	**Change(s)**	**Reason(s)**
-00, Combustion Devices Internal Engineering Support	321878.04.10.01.01	1. No changes.	**Total Change In Cost** (b)(4
-01, Combustion Devices Injector Technology Engineering Support	206518.01.20	1. No changes.	**Total Change In Cost** (b)(4
-02, Combustion Devices Technology Development	253225.04.04.10.05.08	1. Added (b)(4) 2. Removed (b)(4) (b)(4)	1. Increased support to match increased scope for additional insight activity. 2. Planned support changed from (b)(4) **Total Change In Cost** (b)(4)
-03, Test Bed Engineering and Technical Support	665858.01.08.06	1. No changes.	**Total Change In Cost** (b)(4)
-04, Ascent Main Engine Engineering and Technical Support	253225.04.03.02.04 644423.06.34.03.01.08	1. Remove (b)(4) (b)(4)	1. Reduced support to match reduced scope. Remaining hours are planned for future work. **Total Change In Cost** (b)(4)
-05, LOX/Methane Engine Engineering and Technical Support	253225.04.03.02.04	1. No changes.	**Total Change In Cost** (b)(4)
-11, Pintle Development Project Support	253225.04.04.20.04.08 644423.06.34.03.01.08	1. No changes.	**Total Change In Cost** (b)(4) **Task Total Change in Cost =** (b)(4)

Revision 21: The purpose of this revision is to extend this task into Contract Year 6 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period October 2, 2010 through September 30, 2011. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. Subelements –XA, -XB, and –EA are closed by this revision the scope for these elements is remapped to -03, -04, and -05, respectively. Total cost of the Task Order Estimate (b)(4)

1.0 Task Order Description & Objectives

1.1 Subelement 00: Combustion Devices Internal Engineering Project

Under this subelement, the ESTS Group will provide general engineering support in support of ER32 projects. Support activities include the design, fabrication, and testing of hardware as required, as well as development of test documents, hardware management, and data reduction. Support of post-test hardware inspections and associated test activities is also required. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals. Acquisition of materials and technologies in support of these projects is also included.

1.2 Subelement 01: Combustion Devices Injector Technology Engineering Support

Under this subelement, the ESTS Group will provide general engineering support in development of Combustion Devices Technology. Support activities include the design, fabrication, and testing of hardware as required, as well as development of test documents, hardware management, and data reduction. Support of post-test hardware inspections and associated test activities is also required. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

1.3 Subelement 02: Combustion Devices Technology Development

Under this subelement, the ESTS Group will provide engineering and technical support to next generation rocket engine programs, including Common Extensible Cryogenic Engine (CECE), and in-house research and development activities. Activities will include support of program definition and requirements development; the design, fabrication, and testing of hardware; development of program documentation; hardware management; component testing activities; development and testing of unique or specialized devices and diagnostics and pre- and post-test data reduction and analysis. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

1.4 Subelement 03: Test Bed Engineering and Technical Support

Under this subelement, the ESTS Group will provide engineering and technical support to Test Bed activities. Activities will include support of program definition and requirements development; the design, fabrication, and testing of hardware; development of program documentation; hardware management; component testing activities; development and testing of unique or specialized devices and diagnostics and pre- and post- test data reduction and analysis. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

1.5 Subelement 04: Ascent Main Engine Engineering and Technical Support

Under this subelement, the ESTS Group will provide engineering and technical support to Ascent Main Engine activities. Activities will include support of program definition and requirements development; the design, fabrication, and testing of hardware; development of program documentation; hardware management; component testing activities; development and testing of unique or specialized devices and diagnostics and pre- and post- test data

reduction and analysis. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

1.6 Subelement 05: Propulsion Engineering and Technical Support

Under this subelement, the ESTS Group will provide engineering and technical support to Propulsion Engineering activities. Activities will include support of program definition and requirements development; the design, fabrication, and testing of hardware; development of program documentation; hardware management; component testing activities; development and testing of unique or specialized devices and diagnostics and pre- and post- test data reduction and analysis. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

1.7 Subelement 11: Pintle Development Project Support

Under this subelement, the ESTS Group will provide engineering and technical support for the Pintle Injector Development activities. Activities will include support of program definition and requirements development; the design, fabrication, and testing of hardware; development of program documentation; hardware management; component testing activities; development and testing of unique or specialized devices and diagnostics and pre- and post- test data reduction and analysis. The ESTS Group will provide technical integration and leadership as required and interact with other MSFC organizations to achieve project/program goals.

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

2.1 All Subelements:

1. Coordinate/oversee the design, analysis, and fabrication of combustion device components.
2. Acquire hardware and technologies required for project.
3. Generate procedures for test hardware checkout and verification.
4. Perform qualitative and quantitative analysis, as required, to support design of combustion devices and test operations.
5. Support test operations from requirements and procedure generation through post-test data reduction and analysis, to generation of final test report and technical papers.

3.0 Discussion of Skills Required

3.1 All Subelements

This subelement requires Junior Engineer(s) and/or Senior Engineer(s) with general knowledge of fluid mechanics and test operations of gas and liquid propellant rocket engines. Detailed knowledge of combustion chemistry, fluid mechanics, and methods of design analysis is required.

4.0 Special Tools Required

All computer hardware and software will be provided by NASA MSFC.

5.0 Participating Subcontractors

None.

6.0 Milestones & Deliverables

1. Each subelement will provide inputs to Monthly Activity Report that is compiled and delivered at the task order level.
2. Deliverables are to be submitted at designated milestones as negotiated between the Task Initiator, Task Lead, and technical personnel performing the efforts on a case-by-case basis.

7.0 Special Considerations (Recruiting, Special Equipment / Material, Safety, etc.)

7.1 Subelement 00: Combustion Devices Internal Engineering Project

None.

7.2 Subelement 01: Combustion Devices Injector Technology Engineering Support

None.

7.3 Subelement 02: Combustion Devices Technology Development

None.

7.4 Subelement 03: Test Bed Engineering and Technical Support

None.

7.5 Subelement 04: Ascent Main Engine Engineering and Technical Support

None.

7.6 Subelement 05: Propulsion Engineering and Technical Support

None.

7.7 Subelement 11: Pintle Development Project Support

None.

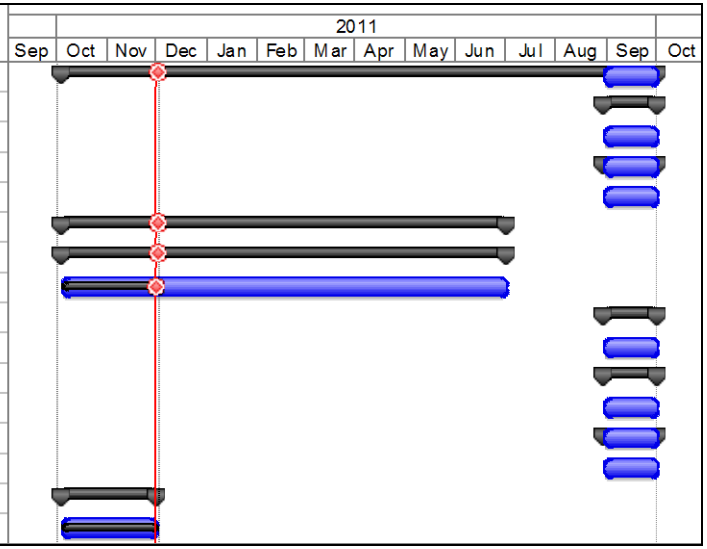
8.0 Work Shelf

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

Subtask #	SubElement	Task Work Element
33-030201	**00**	**Combustion Devices Technology Design and Development**
33-030201	**00**	**Combustion Devices Internal Engineering Support**
33-030201	00	Engineering and Technical Support Combustion Devices Programs
33-030201	**01**	**Combustion Devices Injector Technology Engineering Support**
33-030201	01	Technology Development and Insight
33-030201	**02**	**Combustion Devices Technology Development**
33-030201	**02**	**Dual Stage Injector Engine Engineering Insight Support**
33-030201	02	Engineering Insight, Technical and Test Support
33-030201	**03**	**Test Bed Engineering and Technical Support**
33-030201	03	Test Support
33-030201	**04**	**Ascent Main Engine (AME) Engineering and Technical Support**
33-030201	04	Technology Investigations and Assessments
33-030201	**05**	**Propulsion Engineering and Technical Support**
33-030201	05	Engineering and Technical Support
33-030201	**11**	**Pintle Development Project Support**
33-030201	11	Technical and Test Support



ESTS Contract Task Order Request Performance Plan

Task Order Title: Combustion Devices Design and Development Branch

Task Order Number: 33-030201 Revision: 22

Category	Weighting Technical %	End of Period Technical Score
	60%	X 60% =
Technical Objectives		**Justification**
1. All products / services delivered meet negotiated scope and objectives. 2. All products / services delivered demonstrate quality in both content and presentation. 3. All tools and methodologies utilized are sufficient for intended use. 4. All resources assigned exemplify appropriate technical knowledge. 5. Results, issues, actions items, etc., are appropriately communicated and documented. 6. Personnel demonstrate continuous improvement.		
	Weighting Schedule %	**Schedule Score**
	15%	X 15% =
Schedule Objectives (Milestones)	*(min 10%)*	**Justification**
1. Schedule milestones are met. 2. Work progression is appropriate for resources assigned. 3. Responses to action items are timely. 4. Exemplify ability/willingness to adjust to changing priorities.		
	Weighting Cost%	**Cost Score**
	25%	X 25% =
Cost (actual vs. negotiated)	*(min.25%)*	**Justification**
	Weighting Total %	**Total Score**
	100.00%	

ESTS Contract Task Order Request Performance Plan

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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

ESTS Contract Task Order Request Performance Plan

Task Order Number: Combustion Devices Design and Development Branch

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Comments:

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Risk Assessment

Contract Number: *NNM05AB50C*
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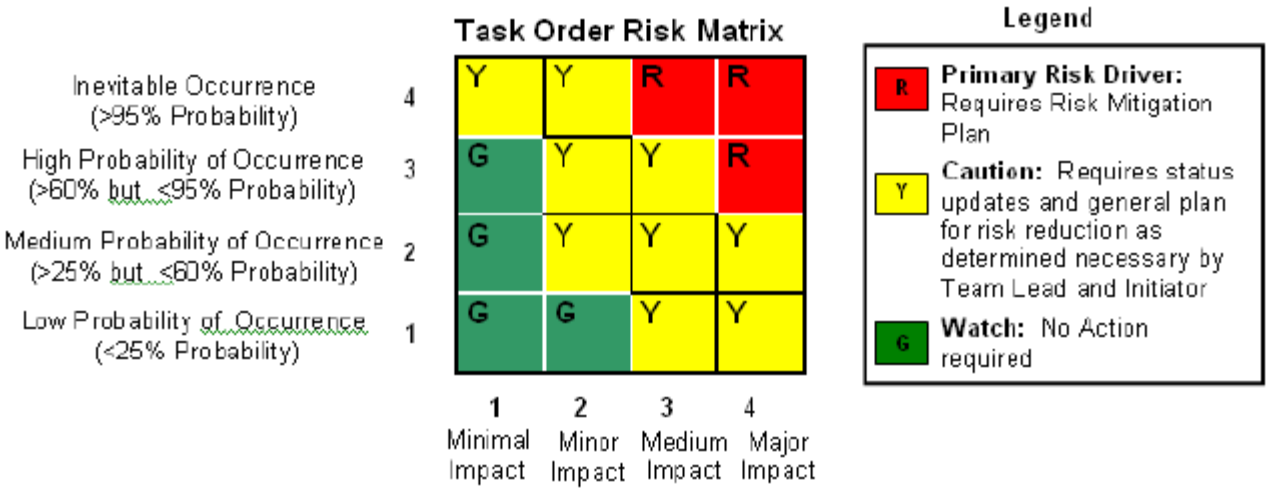
Task Order Risk Assessment to Cost, Technical, and Schedule

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	3	1	NASA Contractors slip delivery delaying project activities.
Risk C2	Cost	1	2	Additional travel required beyond the plan to support project activities.
Risk C3	Cost			
Risk T1	Technical	3	1	Additional support required beyond the plan to resolve technical issues related to testing, i.e. combustion instabilities.
Risk T2	Technical	1	1	Hardware issues resulting in lost testing, i.e. leaking calorimeter chambers.
Risk S1	Schedule	2	1	Resolution technical issues related to testing delays completion of deliverables, i.e. investigations of combustion instabilities.
Risk S2	Schedule	3	1	NASA Contractors slip delivery delaying project activities.

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



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