Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS ESTS Group

Task Order Plan (TOP)

Contract Number: *NNM05AB50C*
TO Title: *Constellation Structural Strength Analysis Support*
TO Number: *33-040116* **Revision:** *08*

Period of Performance: *11/01/2010* to *9/30/2011*

MSFC Initiator: *Gregory Duke*

(b)(4)

Emergency: *No*

Revision 8: The purpose of this revision is to implement a customer-requested re-activation of the Crew Exploration Vehicle (CEV) Stress Support previously provided by this task order under subelement EA. This revision will restore this task order and extend it into Contract Year 6 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period November 1, 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.

Subelement EA, CEV Stress Support (WBS 644423.06.32.03.10.08)
Estimated (b)(4) and 1 trip to support meetings for a total cost estimate of (b)(4)

Revision 7: The purpose of this revision is to account for additional stress analyses requested under subelement XA to support the Final Design Review of the Lunar Surface Access Module (LSAM) Fuel Turbopump. In addition, this revision implements a customer request to consolidate future LSAM stress and dynamics task work under one task. Consolidation will be accomplished by closing subelement XA and performing future LSAM stress analysis task work under Task Order 33-040109-XA. The Schedule, Performance Plan and Risk Assessment have been revised to reflect these changes. Changes by subelement are as follows:

Subelement EA, CEV Stress Support (WBS 644423.06.32.03.10.08)
No changes in this revision. Estimated (b)(4) and 1 trip to support meetings for a total cost estimate of (b)(4)

Subelement XA, LSAM Stress (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04)
Increased the labor estimate for this subelement by (b)(4) resulting in a increase of (b)(4) from Revision 6. Estimated (b)(4) for a total cost estimate of (b)(4). This subelement is closed by revision 7.

The total cost estimate for Revision 7 of this Task Order is (b)(4) an increase from Revision 6 of (b)(4)

Revision 6: The purpose of this revision is to extend this task into Contract Year 5 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period October 3, 2009 through October 14, 2010. Additionally, the Schedule, Performance Plan and Risk Assessment have

been revised to reflect changes in task activities for the new period of performance. Changes by subelement are as follows:

Subelement EA, CEV Stress Support (WBS 644423.06.32.03.10.08)
Estimated (b)(4) and 1 trip to support meetings for a total cost estimate of (b)(4)

Subelement XA, LSAM Stress (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04)
Estimated (b)(4) for a total cost estimate of (b)(4)

The total estimate for this Task Order is (b)(4)

Revision 5: The purpose of this revision is to adjust labor hours to reflect actual utilization. Labor hours that are not anticipated to be utilized in Contract Year 4 (CY4) are removed from the estimate. Travel estimate is updated to reflect actual utilization. The net change in the Task Order cost estimate for this revision is an increase of (b)(4) from the previous revision. Changes by subelement are as follows:

Subelement EA, CEV Stress Support (WBS 644423.06.32.03.10.08)
Delete (b)(4) that are not expected to be utilized. Add (b)(4) travel to cover travel expenses that were than originally estimated. The net change in cost estimate for this subelement is a decrease of (b)(4)

Subelement XA, LSAM Stress (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04)
Add (b)(4) to cover recently-added subtask personnel. The net change in cost estimate for this subelement is an increase of (b)(4)

Revision 4: The purpose of this revision is to extend the period of performance for subelement XA, Lunar Surface Access Module (LSAM) Structural Analysis and Insight (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04). Ongoing design development support will continue, culminating in the completion of analyses adequate to validate the structural integrity of applicable LSAM components in support of the LSAM Critical Design Review (CDR) now planned for late-Summer 2009. Specific tasks to be completed include:

- CDR analysis of the LSAM Fuel Turbopump (FTP) Stage 1 and 2 Impellers with refined Computational Fluid Dynamics pressure data.
- CDR analysis of the two-dimensional stack-up model of the LSAM FTP rotating components.
- Static stress analysis of the LSAM FTP Blisk, Turbine Nozzle Ring, and Exit Guide Vanes with updated CDR geometry and loads.
- Documentation of the CDR analyses.

The labor estimate for subelement XA is increased by (b)(4) resulting in an estimated cost increase of (b)(4) Subelement EA, Crew Exploration Vehicle Service Module Insight Support, is unchanged by this revision.

Revision 3: The purpose of this revision is to extend the period of performance for subelement XA, Lunar Surface Access Module (LSAM) Structural Analysis and Insight (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04). Ongoing design development support will continue, culminating in the completion of analyses adequate to validate the structural integrity of applicable LSAM components in support of the LSAM Critical Design Review planned for mid-March 2009. The labor estimate for subelement XA is increased by (b)(4) resulting in an estimated cost increase of (b)(4) Subelement EA, Crew Exploration Vehicle Service Module Insight Support, is unchanged by this revision.

Revision 2: The purpose of this revision is to re-open subelement EA, Crew Exploration Vehicle Service Module Insight Support (WBS 644423.06.32.03.10.08). Estimated (b)(4) and one trip for a total cost estimate of (b)(4) for subelement EA. Subelement XA, Lunar Surface Access Module Structural Analysis and Insight, is unchanged by this revision.

Revision 1: The purpose of this revision is to extend this task into Contract Year 4 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period September 27, 2008 through October 2, 2009. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. Subelements CA and EA are closed under revision 1. Changes by subelement are as follows:

Subelement CA (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04)
This subelement is closed by revsion 1. Work performed on this subelement will be continued under Task Order 33-040116-XA, Lunar Surface Access Module Structural Analysis and Insight.

Subelement EA (WBS 644423.06.32.03.10.08)
This subelement is closed by revision 1.

Subelement XA (WBS 136905.02.99.05.08.03, 136905.02.99.05.08.04)
This new subelement continues work previously performed under Task Order 33-040116-CA, Lunar Surface Access Module Structural Analysis and Insight. Estimated (b)(4) for a total cost estimate of (b)(4)

This Task Order combines work previously performed under Task Orders 33-040108, LSAM Structural Analysis and Insight, and 33-040111, CEV Service Module Insight Support.

Subelement CA, Lunar Surface Access Module Structural Analysis and Insight:

WBS 136905.02.99.05.08.03
WBS 136905.02.99.05.08.04

Subelement EA, Crew Exploration Vehicle Service Module Insight Support:

WBS 644423.06.32.03.10.08

1.0 Task Order Description & Objectives

Subelement XA, Lunar Surface Access Module Structural Analysis and Insight
This subelement was closed by Revision 7.

Subelement EA, Crew Exploration Vehicle Service Module Insight Support
This subelement will provide structural insight analysis for the propulsion elements of the Crew Exploration Vehicle (CEV) Service Module. Insight will be accomplished by performing reviews and assessments of conceptual designs for components of the CEV Service Module propulsion elements.

2.0 Technical Approach

Subelement XA, Lunar Surface Access Module Structural Analysis and Insight
This subelement was closed by Revision 7.

Subelement EA, Crew Exploration Vehicle Service Module Insight Support
The objectives of this subelement are to perform both direct and indirect structural analysis in support of the CEV Service Module Project Office. Direct support would include supporting meetings, identifying the need for independent analyses, and providing independent assessments/analyses. The indirect support would include such activities as supporting meetings in lieu of the NASA task initiator.

The ESTS Group will support the CEV Service Module Propulsion System design development effort by providing review and analysis of component conceptual designs. Anticipated areas of work will include:

a) Review and assess CEV Service Module structural requirements.
b) Assess component loading, and adequacy of conceptual designs.

c) Provide structural input to component trade studies.
d) Assess vendor-provided structural specifications.
e) Review and evaluate adequacy of component and system level test plans and procedures.
f) Assess and recommend revisions to test plans and procedures as necessary.
g) Participate in regularly scheduled structural design telecons and meetings.
h) Participate in scheduled program milestone reviews and technical interchange meetings.

3.0 Discussion of Skills Required

Subelement XA, Lunar Surface Access Module Structural Analysis and Insight
This subelement was closed by Revision 7.

Subelement EA, Crew Exploration Vehicle Service Module Insight Support
A senior engineer with experience in the structural analysis of rocket propulsion systems will be staffed for this task order. Personnel assigned to work this task must be knowledgeable in Finite Element Analysis (FEA), PATRAN, and NASTRAN or ANSYS. The personnel should be familiar with structural analysis techniques and background, including structural/proof testing experience.

4.0 Special Tools Required

NASTRAN/PATRAN/ANSYS

5.0 Participating Subcontractors

None

6.0 Milestones & Deliverables

a) Monthly Activity Reports
b) Presentations as required
c) Development of Strength/Fracture Requirements
d) Analysis/Methodology Reports as required
e) Biweekly notes

A Monthly Activity Report (MAR) will be provided to the MSFC Initiator with a detailed description of completed work. Technical documentation and reports will be delivered to the MSFC Initiator; finite element model definitions and results files will also be delivered and archived on approved MSFC computer systems or on CD/DVD-ROM.

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

Subelement EA, Crew Exploration Vehicle Service Module Insight Support
One trip will be needed to support meetings. The travel estimate is (b)(4)

Finite element analyses shall be performed using PATRAN/NASTRAN or ANSYS on MSFC-provided workstations.

Reports will appropriately reference the source of methodology and analysis data necessary to meet requirements of the ESTS Group's AS9100-compliant Performance Management System.

8.0 Work Shelf

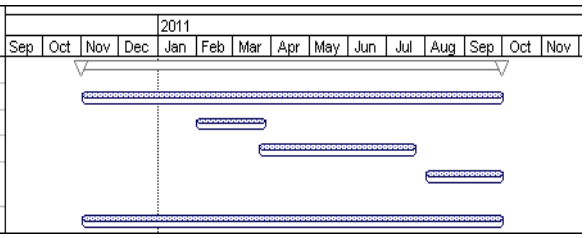
The following activities could be accomplished as part of the Task Order performance by personnel that are temporarily available due to program or funding delays on other Tasks. Specific

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
33-040116	**EA**	**Crew Exploration Vehicle Service Module Insight Support**
33-040116	EA	Review CEV Service Module Propulsion System Design - Ongoing.
33-040116	EA	Support CEV Propellant Tank Shell Trade Study.
33-040116	EA	CEV Crew Module Propellant Tank PDR
33-040116	EA	Support CEV Service Module Propellant Tank Assembly Configuration Trade Study.
33-040116	EA	Support Meetings, Reviews, and Telecons.



ESTS Contract Task Order Request Performance Plan

Task Order Title: Constellation Structural Strength Analysis Support

Task Order Number: 33-040116 Revision: 08

Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	65%	__ X 65% =
Subelement EA: Provide structural assessments/analyses and oversight for the CEV Service Module Project.		**Justification**

	Weighting Schedule %	Schedule Score
Schedule Objectives (Milestones)	10% *(min 10%)*	__ X 10% =
Subelement EA: a) Monthly Activity Reports b) Presentation inputs c) Analysis/Methodology Reports d) Biweekly notes		**Justification**

	Weighting Cost%	Cost Score
Cost (actual vs. negotiated)	25% *(min.25%)*	__ X 25% =
		Justification

Weighting Total %	Total Score
100.00%	

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

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Comments:

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Risk Assessment

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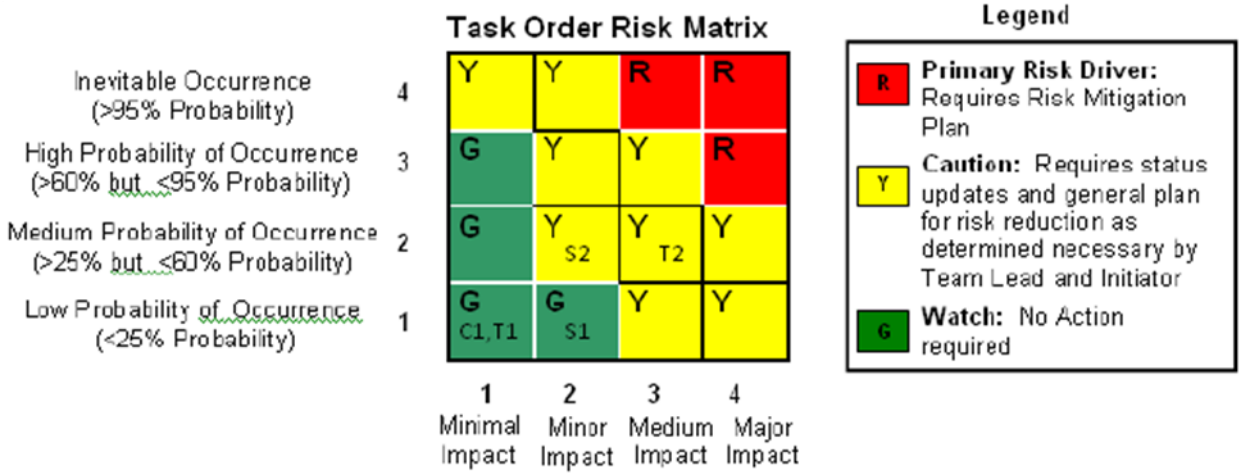
(b)(4)

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	1	Staffing commensurate with funding. Negative programmatic cost risk impacts are avoided through reviews. Only positive programmatic cost impacts are expected.
Risk C2	Cost			
Risk T1	Technical	1	1	Technical knowledge of personnel assigned appropriate for work assigned.
Risk T2	Technical	2	3	Program requirements or design are changed.
Risk S1	Schedule	1	2	If required input data is not available on schedule, it may cause delays in associated deliverables.
Risk S2	Schedule	2	2	Task/program schedule changes.

*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