Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS ESTS Group

Task Order Plan (TOP)

Contract Number: *NNM05AB50C*
TO Title: *ER21 - Liquid Engines and Shuttle Integration Support*
TO Number: *33-020101* **Revision:** *13*

Period of Performance: *10/02/2010* to *03/31/2011*

MSFC Initiator: *Mark Rogers*

(b)(4)

Emergency: *No*

Revision History

Revision 13: 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 March 31, 2011. Because of the new subelement numbering convention, Subelement -01 is being renumbered to –SA. Subelement -04 is not being continued. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

Subelement Summary

Subelement	WBS	Resource Summary
-SA, Space Shuttle Main Engine	522094.08.01.01.03.01	1. Journeyman engineering support. 2. One trip to contractor site. 3. Expenses for task related professional development and training. 4. Safety equipment. **Total cost for this subelement is** (b)(4)

Revision 12: This revision was necessitated because of the Constellation Program Re-plan for Fiscal Year 2010. Effective July 2, 2010, the Constellation subelements (CE, CF, CG, and CI) will be administratively closed and work on these subelements will be transferred to 33-000001-CA. The estimate for subelement 01 Space Shuttle Main Engine was also increased by (b)(4) to increase analysis and tool development support. Additionally, all unused non-labor resources on subelements 01 and 04 have been converted to labor. The schedule has been revised to reflect the closure of the Constellation subelements and the addition of scope for the Space Shuttle Main Engine. The Performance Plan and Risk Assessment have not been revised since there are no expected changes resulting from this revision. The impact of this revision is a reduction in estimate of (b)(4)

Revision 11: This revision was necessitated because project funding for Fiscal Year 2010 negotiations had not been completed in time to impact Revision 10 of this Task Order. This revision aligns scope, schedule and resources with latest expectations for the contract year. The Performance Plan and Risk Assessment have not been revised since there are no expected changes resulting from this revision. This revision affects the following APO elements: Upper Stage Engine (Subelement CE, CF, CG, CI, and CJ). A summary of changes to the resource loadings by subelement is shown below.

Subelement Summary

Subelement	Resource Summary Revision 10	Resource Summary Revision 11
-01, Space Shuttle Main Engine (522094.08.01.01.03.01)	5. (b)(4) 6. One trip to contractor site. 7. Expenses for task related professional development and training. 8. Safety equipment.	1. (b)(4) and 2. No change. 3. No change. 4. No change.
		Total cost for this subelement = (b)(4) **Total change from previous revision**
-04 Shuttle Integration (197009.10.01.01.12)	1. (b)(4) 2. One trip to contractor site. 3. One trip to Kennedy Space Center. 4. Expenses for task related professional development and training. 5. Safety equipment.	1. (b)(4) 2. No change. 3. No change. 4. No change. 5. No change.
		Total cost of this subelement is (b)(4) **Total change from previous revision =**
-CE J-2X Systems Engineering & Integration (136905.08.04.01.08.02)	1. (b)(4) 2. Six trips to contractors sites. 3. Two trips to Stennis Space Flight Center. 4. Recruiting and relocation expenses. 5. Expenses for task related professional development and training. 6. Safety equipment.	1. No change. 2. No change. 3. No change. 4. Removed. 5. No change. 6. No change.
		Total cost of this subelement is (b)(4) **Total change from previous revision =**
-CF J-2X Engine Systems Test (136905.08.04.01.08.04)	1. (b)(4) 2. Two trips to contractors sites. 3. Eight trips to Stennis Space Flight Center. 4. Expenses for task related professional development and training. 5. Safety equipment.	(b)(4) 2. Five trips to contractors sites. 3. Six trips to Stennis Space Center. 4. No change. 5. No change.
		Total cost of this subelement is (b)(4) **Total change from previous revision**
-CG J-2X Engine Systems Hardware (136905.08.04.01.08.05)	1. (b)(4) 2. Six trips to contractors sites. 3. Four trips to Stennis Space Flight Center. 4. Expenses for task related professional development and training. 5. Safety equipment.	1. (b)(4) 2. No change. 3. No change. 4. No change. 5. No change. 6. Added recruiting and relocation expenses.
		Total cost of this subelement is (b)(4) **Total change from previous revision**
-CI J-2X Engine Systems Controls & Health Management (136905.08.04.01.08.07)	1. (b)(4) 2. Sixteen telecommuting trips. 3. Expenses for task related work in other locations. 4. Safety equipment	1. No change. 2. No change. 3. No change. 4. No change.
		Total cost of this subelement is (b)(4) **Total change from previous revision = $0.**

Subelement Summary

Subelement	Resource Summary Revision 10	Resource Summary Revision 11
-CJ Ares I Vehicle Integration Aborts Modeling Support (136905.08.04.01.08.XX)	1. (b)(4) 2. Safety equipment.	1. Removed. 2. Removed.

Total cost of this subelement is (b)(4)
Total change from previous revision (b)(4)
Total cost of the task order is (b)(4)
Total change from previous revision = (b)(4)

Revision 10: 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 03, 2009 through October 1, 2010. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. This revision affects the following APO elements: Upper Stage Engine (Subelement CE, CF, CG, CI, and CJ).

Revision 09: The primary purpose of this revision is to add labor to support the Space Shuttle launch schedule and reallocate existing labor resources to better align with the latest expectations for the contract year. Non-labor resources were also reduced to better align with the latest expectations for the contract year. The Schedule, Performance Plan and Risk Assessment have not been revised since there are no expected changes in task activities for this period of performance.

Revision 08: This revision aligns scope, schedule and resources with latest expectations for the contract year. This revision affects the following APO elements: Upper Stage engine (Subelement CE, CF, CG, and CI).

Revision 07: 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.

Revision 06: This revision aligns scope, schedule and resources with latest expectations for the contract year. Subelement -01,-04,-CE,-CF, and -CI were over budgeted due to changes in staffing and delays in the addition of new employees. Subelement –CG was under budgeted based on greater than expected travel demands and work loads in this area of support.

Revision 05: The purpose of this revision is to extend this task into Contract Year 3 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period 29 September 2007 through 26 September 2008. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

Revision 04: The primary purpose of this revision was to adjust task order estimates to better reflect actual requirements. Subelement -04, -CE, -CF were over budgeted due to changes in staffing and delays in the addition of new employees. Subelements -01, -CA and –CC were under budgeted based on greater then expected work loads in these areas of support.

Revision 03: The primary purpose of this revision was to adjust task order estimates to better reflect actual requirements. Subelement – 03 is replaced with Subelement – CH which is funded and Subelement – CI is created to support Crew Launch Vehicle J-2X Engine Controls Systems.

Revision 02: The purpose of this revision is to extend this task into 2007 of Contract Year 2 for the NNM05AB50C ESTS contract. This revision defines and estimates work for the period 30 September 2006 through 28 September 2007.The Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. Additionally, this revision will realign or close subelements with new subelements open which reflect the Crew Launch Vehicle Work Breakdown Structure.

Revision 01: The primary purpose of this revision was to adjust task order estimates to better reflect actual requirements. Resources) are reduced on Subelement -01, Space Shuttle Main Engine, to reflect less than anticipated resources required to support testing and return to flight activities. Resources are reduced on Subelement -02, Integrated Powerhead Demonstrator, due to less than expected support required for testing. Resources are reduced on Subelement -04, Shuttle Integration,

to reflect less then anticipated resources required to support launch activities and integration issues. Resources are increased for the addition of three team members; one each, to support Subelement -03, Exploration Initiative, Subelement, -06, Crew Launch Vehicle Upper Stage Main Propulsion System, and Subelement -07, J-2X Engine. Recruiting, travel, and relocation are added to Subelements -03 and -08. Additional resources are required to support ramp up of efforts within the existing scope of this Task Order. The additional support under Subelements -03 and -06 will begin in September 2006. Additional support under Subelement -07 begins in July 2006. This revision is effective July 1, 2006.

Revision 00: This Task Order (TO) replaces TO 23-020101 due to the NASA/MSFC reorganization and the subsequent realignment of the NNM05AB50C ESTS contract. This TO defines and estimates work for the period 1 April 2006 through 29 September 2006. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

1.0 Task Order Description & Objectives

1.1 Subelement SA: Space Shuttle Main Engine

Under this subelement the ESTS Group will provide engineering support to the Space Shuttle Main Engine (SSME) Project for ER21, Liquid Engine Systems Branch. Activities will include:

- Maintain a detailed knowledge of engine system operation including control system logic, software specifications, hot fire specifications, component sensitivities, etc.
- Support for the development and maintenance of appropriate databases for characterizing/analyzing nominal and out-of-family conditions for engine systems.
- Maintaining a working knowledge of current SSME engine system issues and anomalies through attendance of and participation in project office meetings where engine system issues are being presented or in contact with project office personnel.
- Participation in the assessment of SSME or integrated systems issues and provide engineering analysis to determine requirements and system effects for proposed actions, updates, or changes.
- Specialized support for enhancing performance analysis capabilities including training MSFC personnel in liquid engine systems modeling, expert review of models produced, and supporting liquid engine system design reviews and anomaly investigations.
- Computer programming and software engineering support for ongoing and proposed efforts to upgrade the Rocket Engine Transient Simulation (ROCETS) mathematical modeling code.
- Test and flight data analysis support including real-time engine test support in the engine systems data room as required and real-time launch operation support at Huntsville Operations Support Center (HOSC), reduction, analysis, and presentation of SSME Engine Systems data and anomaly identification and resolution.
- Engineering support to maintain effective engine systems capability at the HOSC including maintaining the appropriate software on the HOSC computers, development and maintenance of WinPlot scripts and support for the implementation of new data analysis and database tools.

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

Specific technical approaches for each support activity will be as identified and coordinated on a case-by-case between the MSFC Task Initiator and ESTS Task Lead. Shown below are generic technical approaches for categories of ESTS products:

2.1 Systems Engineering

- Attend technical interchange, project planning, design review and other appropriate meetings to maintain a current knowledge base of design, requirements, issues, action items, and resolution activities. Identify issues and pursue resolutions.

- Support reviews of existing requirements documentation to determine level of applicability to future vehicle concepts and documentation modifications required.
- Support modification of existing and/or development of new requirements documentation.
- Provide independent technical reviews of vehicle and/or engine systems documentation produced/provided internal to MSFC or provided by others.
- Support requirements tracking, flow-down, verification and validation.
- Support action item status and resolution tracking.

2.2 Test and Data Review/Analysis

- Support component and/or system level test planning, post test data reviews and evaluation of anomalous test events as required. This includes performing post test data reviews, specialized analysis/evaluation of unique or out of family test conditions and test request presentations.
- Support test and flight hardware acquisition, tracking, and integration.
- Provide integration insight, evaluation and review for test article and facility interfacing.
- Provide real time and post test/flight data evaluation using WinPlot or other MSFC provided graphical software.
- Develop and maintain WinPlot scripts as needed. Participate in the development and implementation of new data analysis and database tools.
- Maintain start, shutdown, mainstage and Launch Commit Criteria (LCC) sigma and parameters database for applicable engine support. This should include both ground and flight databases.

2.3 Thermofluid Analysis

- Attend technical interchange, project planning, design review and other appropriate meetings to maintain a current knowledge base of design, requirements, issues, action items, and resolution activities. Identify issues, pursue resolutions, and provide supporting analyses.
- Identify customer objective and requirements for analyses.
- Identify analysis methodology, develop tools as needed, and perform analysis using the identified methodology and inputs.
- Document and deliver analysis, results, and recommendations.
- Provide expert programming, analysis, and training support on a case-by-case basis. Check and verify modeling results and suggest alternate approaches.
- Perform detailed thermo-fluid analysis for vehicle and/or engine systems using the following MSFC provided software or other applicable/equivalent tools: ROCETS, Generalized Fluid System Simulation Program (GFSSP).

2.4 Data Reduction, Analysis and Presentation

- Attend technical interchange, project planning, design review and other appropriate meetings to maintain a current knowledge base of design, requirements, issues, action items, and resolution activities. Identify issues, pursue resolutions, and provide supporting analyses.
- Support/Provide data reduction, analysis, and presentation of data.
- Identify anomalies and support/provide resolution.
- Follow-up with the resolution of and recommendations for any outstanding issues and present the findings to obtain closure.
- Develop and maintain WinPlot scripts as needed. Participate in the development and implementation of new data analysis and database tools.
- Provide real time and post test/flight data evaluation using WinPlot or other MSFC provided graphical software.

2.5 Critical Math Model Support

- Review math model requirements, documentation and code.
- Assess and document requirements against documentation and code.

- Review math model configuration control and provide recommendations / maintenance.
- Conduct/review analyses and provide recommendations/updates.

2.6 Database Development and Maintenance

- Develop and maintain appropriate databases in support of requirement development, risk management, test activities and data management as required.
- Participate in the development and implementation of new database tools.

3.0 Discussion of Skills Required

3.1 Subelement SA: Space Shuttle Main Engine

This subelement requires (b)(4) with knowledge of liquid rocket engine systems, fluid systems, and propellant systems design/analysis.

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 SA: Space Shuttle Main Engine

1. One trip to a contractor site is estimated at (b)(4)
2. Other Direct Costs are estimated at (b)(4)
    a. Recruiting costs to fill vacant or pending positions are estimated at (b)(4)
    b. Relocation expenses for new recruits are estimated at (b)(4)
    c. Other costs for training are estimated at $1,402.
3. Material costs for safety equipment are estimated (b)(4)

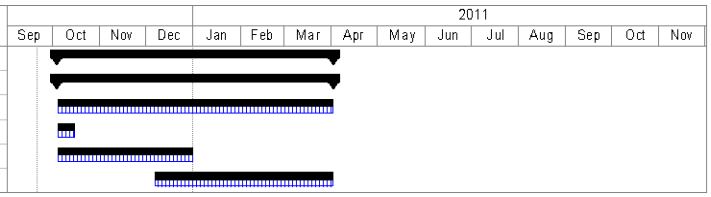
8.0 Work Shelf

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

ID	Task Number	S/E	Task Name
1	**33-020101**	**-**	**ER21 - Liquid Engine Systems & Shuttle Integration Support**
2	**33-020101**	**SA**	**Space Shuttle Main Engine**
3	33-020101	SA	Data Analysis Training
4	33-020101	SA	Review / Analyze Date for Virtual Test A2-9006v
5	33-020101	SA	Support STS-133 Launch and Post Flight Data Review
6	33-020101	SA	Support STS-134 Launch and Post Flight Data Review



ESTS Contract Task Order Request Performance Plan

Task Order Title: ER21 - Liquid Engines and Shuttle Integration Support

Task Order Number: 33-020101 Revision: 13

Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	65%	X 65% =
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.		**Justification**
	Weighting Schedule %	**Schedule Score**
Schedule Objectives (Milestones)	10% *(min 10%)*	X 10% =
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.		**Justification**
	Weighting Cost%	**Cost Score**
Cost (actual vs. negotiated)	25% *(min.25%)*	X 25% =
		Justification
	Weighting Total %	**Total Score**
	100.00%	

ESTS Contract Task Order Request Performance Plan

Task Order Title: ER21 - Liquid Engines and Shuttle Integration Support

Task Order Number: 33-020101 Revision: 13

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: ER21 - Liquid Engines and Shuttle Integration Support

Task Order Number: 33-020101 Revision: 13

Comments:

Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS ESTS Group

Risk Assessment

Contract Number: *NNM05AB50C*
TO Title: *ER21 - Liquid Engines and Shuttle Integration Support*
TO Number: *33-020101* **Revision:** *13*

Period of Performance: *10/02/2010 to 03/31/2011*

MSFC Initiator: *Mark Rogers*

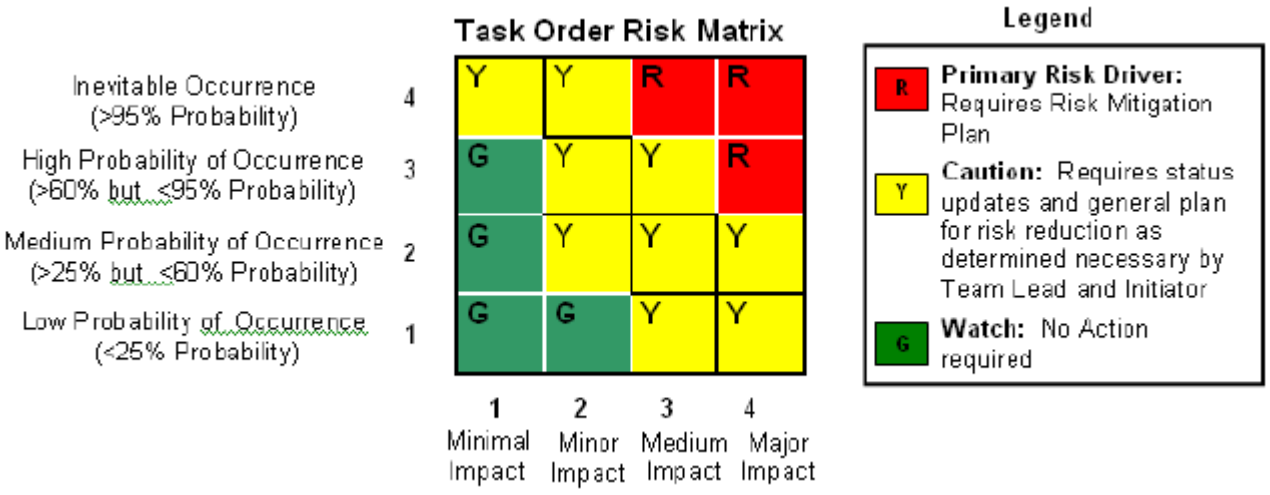
(b)(4)

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			
Risk S1	Schedule	1	1	Task schedule is driven almost exclusively by programmatic schedules. Negative programmatic schedule risk impacts are avoided through status reviews. Only positive programmatic schedule impacts are expected.
Risk S2	Schedule			

*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