

Task Order Plan (TOP)

Contract Number: NNM05AB50C
TO Title: Shuttle Solid Rocket Booster Thrust Vector Control Systems
TO Number: 33-030501 **Revision:** 03

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

MSFC Initiator: John Laszar

(b)(4)

Emergency: No

Revision 03: The purpose of this revision is to extend this task into Contract Year 6 of the NNM05AB50C ESTS contract. This revision defines work for the period October 2, 2010 through September 30, 2011. The estimated costs are limited to the period from October 2, 2010 through March 31, 2011. Additionally, the Schedule has been revised to reflect changes in the task activities for the new period of performance. Subelement suffixes have been revised from 33-030501-01, -02, -03, -04 to 33-030501-SA, -SB, -SC, SD, respectively, to reflect the Shuttle Program Support.

Sub-	WBS	ODC, Material, Travel, and Subcontracts	Labor Only Delta	Cost Delta Subelement	Total Cost Subelement	Rationale
-SA	522632.08.01.01	New contract year revision	New contract year revision	New contract year revision	(b)(4)	Similar level of effort expected for start of CY'06 as with end of CY'05.
SB	520871.08.01.01	New contract year revision	New contract year revision	New contract year revision		Similar level of effort expected for start of CY'06 as with end of CY'05.
SC	522632.08.01.01	New contract year revision	New contract year revision	New contract year revision		Similar level of effort expected for CY'06 as with CY'05.
SD	520871.08.01.01	New contract year revision	New contract year revision	New contract year revision		Similar level of effort expected for CY'06 as with CY'05.

Revision 02: This revision aligns scope and resources estimates with expectations for the remainder of the contract year based on requested changes. In particular, the labor estimates for subelements -01 and -03 were increased to reflect a requested scope increase to support laboratory activities, engineering support, and technician support for the Automated Dynamic Acceptance Procedure Test Stands (ADAPTS). To accommodate anticipated trips to support ADAPTS at the pump vendor, the travel estimate for subelement -01 has been increased. The table below details the revisions.

(b)(4)



Revision 01: This revision aligns scope and resources estimates with expectations for the remainder of the contract year based on requested changes. In particular, the labor estimate for subelement -03 was increased to reflect a requested scope increase to support laboratory activities. Also, the travel estimate for subelement -01 was increased to provide added support of ADAPTS integration at the pump vendor. The Performance Plan and Risk Assessment have not been revised. The table below details the revisions.

(b)(4)



Revision 00: This is a new Task Order (TO) for Contract Year 5 of the NNM05AB50C ESTS contract, and it replaces subelement -04 of TO 33-030302 and subelements -01, -02, -03, and -04 of TO 33-030308 from Contract Year 4 of the same contract. This TO 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.

1.0 Task Order Description & Objectives

This task order provides support for the planning, design, development, analysis, review, testing and inspection of various systems including:

- Shuttle Solid Rocket Booster (SRB) Thrust Vector Control (TVC) System Labor and Material
- Shuttle Solid Rocket Booster (SRB) Automated Dynamic Acceptance Procedure Test Stand (ADAPTS) Labor and Material

Specifically, this task provides engineering and technical support to the Solid Rocket Booster (SRB) program. Responsibilities include, but are not limited to supporting anomaly resolution and problem investigation efforts, supporting corrective action activities including developing test plans, test procedures, technical reports, design modifications, fabrication of hardware; development of program documentation; and hardware management.

The following will be developed: specifications, test plans, test procedures, and technical reports for evaluation of the TVC system and associated ground test systems, fluid system components, detailed design changes and documentation preparation. Support will be provided for component level evaluations, analysis of design specifications and drawings, and recommend changes to enable proper functioning of the hardware. Support will be provided for component test activities to evaluate performance of valves, actuators, lines, miscellaneous fluid components, and fluid systems.

This TO will also provide technician support including: input to test equipment design and fabrication, installation of test article, maintenance/modification of test equipment, test operations, data acquisition, maintenance, operation of overhead cranes, operation of fork lift, and coordination of facility modification, compliance, and maintenance.

1.1 Subelement –SA SRB ADAPTS 1 & 2 Labor

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 522094. This Subelement provides support for fabrication, assembly, testing, procedure preparation, installation of the ADAPTS at (b)(4) and at building 4205 at MSFC and training for the two ADAPTS units.

1.2 Subelement -01 SRB ADAPTS 1 & 2 Labor

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 522094. This Subelement provides support for fabrication, assembly, testing, procedure preparation, installation of the ADAPTS at (b)(4) and at building 4205 at MSFC and training for the two ADAPTS units. Closed with Revision -03. Efforts transferred to Subelement -SA.

1.3 Subelement -SB SRB ADAPTS 1 & 2 Materials

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 520871.08.01.01.02. This Subelement provides materials to support the fabrication, assembly, testing, and installation of the ADAPTS at (b)(4) and at building 4205 at MSFC.

1.4 Subelement -02 SRB ADAPTS 1 & 2 Materials

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 520871.08.01.01.02. This Subelement provides materials to support the fabrication, assembly, testing, and installation of the ADAPTS at (b)(4) and at building 4205 at MSFC. Closed with Revision -03. Efforts transferred to Subelement -SB.

1.5 Subelement -SC SRB TVC Labor

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 522632.08.01.01. This Subelement provides labor to support for the SRB TVC system.

1.6 Subelement -03 SRB TVC Labor

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 522632.08.01.01. This Subelement provides labor to support for the SRB TVC system. Closed with Revision -03. Efforts transferred to Subelement -SC.

1.7 Subelement -SD SRB TVC Materials

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 520871.08.01.01.02. This Subelement provides materials and subcontract support the SRB TVC system.

1.8 Subelement -04 SRB TVC Materials

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 520871.08.01.01.02. This Subelement provides materials and subcontract support the SRB TVC system. Closed with Revision -03. Efforts transferred to Subelement -SD.

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

Technical support for subelements -SA through -SD will involve the following. (These subelements were -01 through -04, respectively, closed per Revision 03).

- 2.1 Support for troubleshooting and resolving anomalies associated with the SRB TVC system.
- 2.2 Support for the development of specifications, test plans, test procedures, and technical reports for evaluation of the TVC system and associated ground test systems, fluid system components, detailed design changes and documentation preparation.
- 2.3 Support for component level evaluations, analysis of design specifications and drawings, and recommend changes to enable proper functioning of the hardware.
- 2.4 Support for component test activities to evaluate performance of valves, actuators, lines, miscellaneous fluid components, and fluid systems.
- 2.5 Support for the review of ADAPTS and the SRB TVC System design requirements and objectives.
- 2.6 Support for dynamic modeling, fluid flow, thermal and stress analysis.
- 2.7 Support for the evaluation of component requirements and specifications.
- 2.8 Support for the preparation and development of test plans, procedures and reports.
- 2.9 Attending technical interchange, project planning, design review and other appropriate meeting to maintain a current knowledge base of design, requirements, issues, action items, and resolution activities.
- 2.10 Provide independent technical reviews of documentation produced/provided by others.
- 2.11 Support component level test planning.
- 2.12 Support flight and test data reviews.
- 2.13 Documentation and delivery of test and data review results with recommendations.
- 2.14 Support for component level disassembly, inspection, and reassembly procedures.
- 2.15 Insight and oversight during system and component level reviews.

- 2.16** Insight and oversight during test equipment design, fabrication and installation.
- 2.17** Support of maintenance and modification of test equipment, test operations, data acquisition.
- 2.18** Operation of overhead cranes and forklifts.
- 2.19** Support and coordination of facility modification, compliance and maintenance.

3.0 Discussion of Skills Required

In general, Senior and Junior engineers with experience in fluid systems design, development, and test are required. More specifically, the following skills are required.

TVC test engineers with strong SRB TVC actuator and components knowledge is required. Test knowledge shall include hydraulics system test design and instrumentation. These engineers shall have experience in initiating work orders, authoring Test Procedures and Work Instructions, conducting TVC component tests, and authoring Test Reports. These test engineers shall have flight test experience that would be directly applicable to future test flight programs. Additionally, these engineers shall have historical knowledge and experience in SRB TVC components and their associated stress, fatigue, and fracture analysis. These engineers shall also have extensive experience with interpreting vibration environments and vehicle dynamics. These engineers shall also have historical knowledge and experience with the Shuttle TVC non-linear math model operation.

The TVC engineers shall also have a strong component and system level design experience. These engineers shall have background and knowledge of the specifications for and the design of hydraulic systems test stands, pump stations, and hydraulic facility installation. In addition, these engineers shall possess hydraulic directional control and proportional control valve design experience. These engineers shall also have background and knowledge of ADAPTS operation and maintenance.

In general, Senior and Junior technicians with electrical and/or mechanical experience in fluid systems design, development, and test are required. More specifically, the following skills are required.

A mechanical technician with extensive knowledge and experience with fabrication of test equipment and systems for hydraulic systems, gaseous systems including inert and propellant, and structural fabrication for development and qualification testing of flight hardware. This technician shall also have extensive knowledge and experience with preventative, scheduled maintenance of hydraulic and gaseous systems.

An electrical technician with extensive knowledge and experience with fabrication of test equipment and systems for hydraulic systems, gaseous systems including inert and propellant is required. This technician shall have knowledge and experience with Labview and the SRB Portable Command Signal Controller (PCSC). This technician shall have background and knowledge of the specifications for and the troubleshooting performed on the SRB electrohydraulic TVC data acquisition system which employs unique software for control and data acquisition of the SRB TVC actuator. This technician shall also have knowledge and experience with inertial load and rated load testing of the SRB TVC actuator.

4.0 Special Tools Required

- 4.1** Solid and dynamic modeling software packages will be provided by MSFC.
- 4.2** Tools required for the operation and maintenance of ADAPTS, the SRB TVC System, associated ground equipment and facilities will be provided by MSFC.

5.0 Participating Subcontractors

(These subelements were -01 through -04, respectively, closed per revision 03).

5.1 Subelement -SA

None.

5.2 Subelement -SB

None.

5.3 Subelement -SC

None.

5.4 Subelement -SD

None

6.0 Milestones & Deliverables

Work is primarily driven by milestones that are set by the respective project customers, and are not within the control of the Task. Deliverables will include presentations, reports, and letters documenting findings, issues, meetings, trips, etc., as scheduled on a case by case basis. Reports documenting significant tasks will be provided as they are completed. Progress of efforts and significant issues will be formally documented in Monthly Activity Reports provided in the Jacobs Enterprise Management System. See Task schedule.

Deliverables will include:

- Input to CAD component and systems drawings.
- Input to preliminary thermal/stress analysis.
- Draft and final results of kinematics analysis.
- Draft and final results of fluid/gas flow analysis.
- Draft and final results of component sizing and selection research, trade studies and technical interchange.
- Draft and Final system schematics.
- Draft and Final Test plans/procedures.
- Draft and Final Test Reports.
- Draft and final results of specification reviews.
- Draft and Final Component specifications.
- Input to Monthly Activity Reports.
- Draft and final trip reports.

Milestones for technical assessments and evaluations as specified above will be coordinated between NASA and technical personnel to perform the efforts, and negotiated with Task Lead and Task Initiator on a case-by-case basis.

6.1 Subelement -SA

(This subelement was-01, closed per Revision 03)

- ADAPTS Operator's Manual Revisions, planned completion 03/02/2011
- ADAPTS Maintenance Manual Revisions, planned completion 03/02/2011
- ADAPTS Certification Review Revisions, planned completion 03/02/2011
- ADAPTS Software Update Trips, planned completion 03/02/2011
- ADAPTS System Readiness Review Support Revisions, planned completion 03/02/2011

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

This task order supports work previously covered under subelements -01, -02, -03, -04 of Task Order 33-030501.

- 7.1 Subelement -SA SRB ADAPTS 1 & 2 Labor**
Travel = (b)(4) for four installation and training support trips.
- 7.2 Subelement -01 SRB ADAPTS 1 & 2 Labor**
Closed with revision 03. All efforts transferred to subelement SA.
- 7.3 Subelement -SB SRB ADAPTS 1 & 2 Materials**
Materials = (b)(4) for parts and equipment needed for the installation and facility integration of ADAPTS 1 & 2.
- 7.4 Subelement -02 SRB ADAPTS 1 & 2 Materials**
Closed with revision 03. All efforts transferred to subelement SB.
- 7.5 Subelement -SC SRB TVC Labor**
Travel = (b)(4) for two SRB TVC System technical interchange trips.
- 7.6 Subelement -03 SRB TVC Labor**
Closed with revision 03. All efforts transferred to subelement SC.
- 7.7 Subelement -SD SRB TVC Materials**
Materials = This subelement is a placeholder for potential future parts and equipment needed to support build-up and maintenance of support equipment for the SRB TVC system. This subelement is not included in the estimate at this time.
- 7.8 Subelement -04 SRB TVC Materials**
Closed with revision 03. All efforts transferred to subelement SD.

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
All	Monthly Activity Reports	End of Each Month	All

9.0 Schedule

Task Order Number	S/E	Task Name	2011																
			Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
33-030501		Shuttle Solid Rocket Booster Thrust Vector Control Systems	▶																
33-030501	-SA	ADAPTS Operator's Manual Revisions	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SA	ADAPTS Certification Revisions	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SA	ADAPTS Software Revisions	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SA	ADAPTS System Readiness Support	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SB	Sustained Material Procurement Support	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SC	Sustained Engineering Support	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																
33-030501	-SD	Sustained Material Procurement Support	▶																
33-030501		Product Development	▶																
33-030501		Product Drop	▶																
33-030501		Customer Need Date	▶																

ESTS Contract Task Order Request Performance Plan

Task Order Title: Shuttle Solid Rocket Booster Thrust Vector Control Systems

Task Order Number: 33-030501 Revision: 03

Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	65%	X 65% = Justification
<ol style="list-style-type: none"> 1. Prepare Thrust Vector Control System component functional specifications 2. Provide fluid/gas flow analysis as needed for test development or specification development. 3. Prepare Thrust Vector Control System component test plans and procedures for development testing. 4. Communicate results, issues, action items, etc., to both NASA and Jacobs management. 5. Document development and use of analysis tools and methodologies as appropriate for future reference. 		
Schedule Objectives (Milestones)	Weighting Schedule % <u>10%</u> <i>(min 10%)</i>	Schedule Score X 10% = Justification

ESTS Contract Task Order Request Performance Plan

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<ol style="list-style-type: none"> 1. Unless otherwise noted, milestones and deliverables are defined on a case-by-case basis as coordinated between the Task Initiator and Task Lead and are met. 2. Work progression is appropriate for action assigned. 3. Resource loading commensurate with task schedule. 4. Specifications preparation and performance completed on time to support other areas. 5. Test Plans and Procedure completed as negotiated with Task Initiator 6. Exemplify ability/willingness to adjust changing priorities. 7. Response to action items are timely. 		
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	Weighting Cost% <u>25%</u> <i>(min.25%)</i>	Cost Score X <u>25%</u> = Justification
<u>Cost (actual vs. negotiated)</u>		

ESTS Contract Task Order Request Performance Plan

Task Order Title: Shuttle Solid Rocket Booster Thrust Vector Control Systems

Task Order Number: 33-030501 Revision: 03

Weighting	Total Score
Total %	
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

Task Order Number: Shuttle Solid Rocket Booster Thrust Vector Control Systems

Task Order Number: 33-030501 Revision: 03

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- Comments:**
1. Provide technical support mechanical design and development of detailed CAD components and systems drawings.
 2. Provide preliminary thermal/stress analysis and kinematics analysis for piping systems.
 3. Provide component selection engineering.
 4. Demonstrate initiative in taking independent actions when required.
 5. Communicate ideas for improvement of current efforts.
 6. Demonstrate ability to discover "gaps" in work products, training, and capabilities. Develop and communicate plans to close gaps.
 7. Work is accurate for intended use.
 8. Level of detail is appropriate for intended use.
 9. Tools and methodologies applied are appropriate for intended use.
 10. Work is of appropriate quality.
 11. Resources assigned exemplify appropriate technical knowledge.
 12. Progress and results are appropriately documented.
 13. Results, issues, actions items, etc., are appropriately communicated and exemplify appropriate knowledge.
 14. Demonstrate continuous improvement.
 15. Level of technical oversight required is appropriate for resources and work assigned.
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Risk Assessment

Contract Number: NNM05AB50C

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TO Number: 33-030501 Revision: 03

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

MSFC Initiator: John Laszar

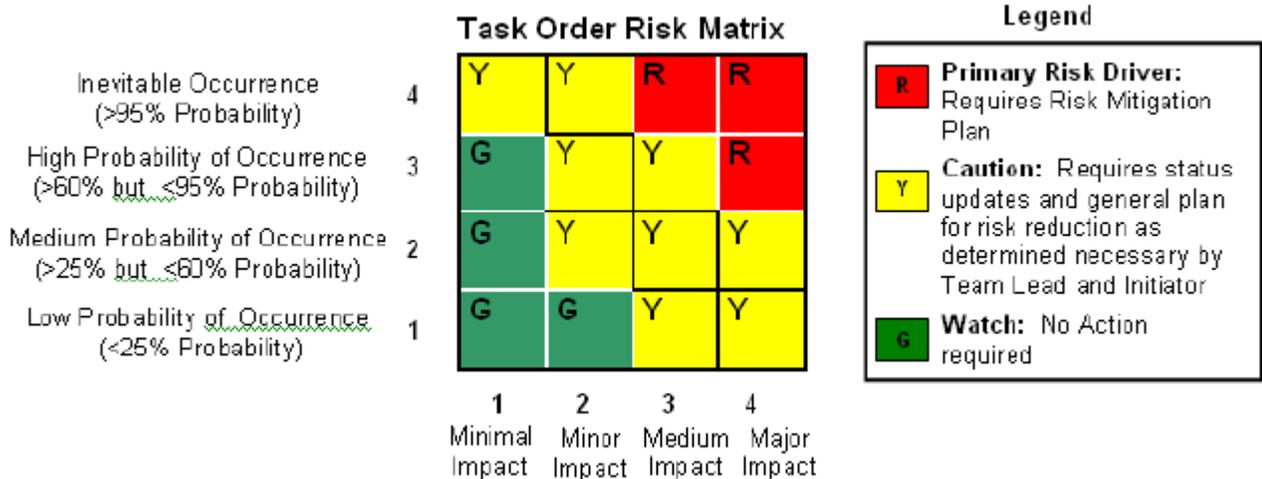
(b)(4)

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			No cost risks have been identified.
Risk T1	Technical	3	1	Lack of expertise in some technical areas resulting in required training of staff.
Risk S1	Schedule	2	1	Delays hiring personnel to fill position openings.

*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