

Task Order Plan (TOP)

Contract Number: NNM05AB50C
TO Title: Propulsion Research & Technology Applications Branch
TO Number: 33-020401 **Revision:** 11

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

MSFC Initiator: Boise Pearson

(b)(4)



Emergency: No

Revision 11: This revision defines and estimates work for the period October 2, 2010 through September 30, 2011. Subelement -11 is re-opened with this Revision 11 with the advent of ER24 securing additional funding to support this project. Subelement -16 is added to support an Advanced In-Space Propulsion task. Subelement -AA is added for Integrated Thermal/Fluid MLI Ascent Model Support. The total estimate for Revision 11 is (b)(4) which is (b)(4) higher than the previous revision 10.

(b)(4)



Revision 10: 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. Subelement -11 is Closed with this Revision 10 since no further funding is expected to support it. Additionally, the Schedule, Performance Plan, Work Breakdown Structure, and Risk Assessment have been revised to reflect changes in task activities for the new period of performance." The total estimate for Revision 10 is (b)(4)

Sub-	WBS	ODC, Material, Travel, and Subcontracts	Labor Only Delta	Cost Delta Subelement	Total Cost Subelement	Rationale
-03	095240.04.02.21.08	New contract year revision	New contract year revision	New contract year revision	(b)(4)	Similar level of effort expected for CY'06 as with CY'05.
-04	698671.01.08.06.35	New contract year revision	New contract year revision	New contract year revision		Similar level of effort expected for CY'06 as with CY'05.
-11	698671.01.08.06.34	CLOSE	CLOSE	CLOSE		No further funding is expected.
-12	463169.04.12.01.01	New contract year revision	New contract year revision	New contract year revision		Similar level of effort expected for CY'06 as with CY'05.
-15	698671.01.08.06.35	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 09: The revision aligns scope, schedule, and resources with current expectations for the remainder of the contract year. This revision defines and estimates work for the period October 3, 2009 through October 14, 2010. (b)(4)

(b)(4) Scope within Subelement -04 has increased due to additional non-nuclear facilities integration activity. Variance of (b)(4) on Subelement -11 since Revision 08 was due to increased labor hours versus ODC. Also, regarding Subelement -11, FY'11 costs of (b)(4) from Revision 08 have been removed in Revision 09. Scope within Subelement -12 has increased due additional procurements required to support Alkali Metal Handling test-bed buildup. Scope within Subelement -15 has decreased slightly due to forecast for less expensive purchased items. The total estimate for Revision 09 has increased to (b)(4)

(b)(4)

Revision 08: 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. Scope within Subelement -03 has increased due to additional ODCs required for material required for accomplishing development and buildup for experiments to anchor predictive analysis and for the fabrication of the Multi-purpose Hydrogen Test Best (MHTB) work platform. Scope within Subelement -11 has decreased slightly due an initial funding hold on the task required to support early CY'05 activity. Subelements 12 and -15 have been slightly adjusted to account for forward trending of work activity. The total estimate for Revision 08 is (b)(4)

(b)(4)



Revision 07: 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. The total estimate for Revision 07 is (b)(4)

Revision 06: This Task Order (TO) defines and estimates work for the period 27 September 2008 through 2 October 2009. The purpose of this revision is to update the estimated costs for Subelements -03, -04, -11, -12, and -15 based on an overall decreased variance of work and ODCs. Subelements -13, -14, -CA, and -CB are closed with this revision. Subelement -13 is complete supporting the fabrication for the Seal Test Rig. Subelement -14 was never funded for the Space Shuttle Main Engine Accelerated Learning lab and no further funding or tasks associated with this subelement are expected. Subelement -CA's funding has been removed by the Project Office and further support to the subelement is not expected. Subelement -CB supporting Solids Fabrication for Upper Stage was never funded and no further task support is anticipated. This Revision 06 decreases the overall task order by (b)(4) from the previous Revision 05. The total estimate for Revision 06 is (b)(4)

(b)(4)



(b)(4)



Revision 05: This Task Order (TO) defines and estimates work for the period 27 September 2008 through 2 October 2009. The purpose of this revision is to update the estimated costs for Subelements -03 and -15, for which increases of (b)(4) respectively, are applied to fund hardware acquisitions. This Revision 05 increases the overall task order by (b)(4) from the previous Revision 04 for hardware acquisitions. The total estimate for Revision 05 is (b)(4).

(b)(4)



(b)(4)



Revision 04: This Task Order (TO) defines and estimates work for the period 27 September 2008 through 2 October 2009. The purpose of this revision is to update the scope and estimated costs for all subelements. Estimate is applied to new Subelement -CB to support solids fabrication tasks. A slight increase in subcontracts is added to cover latent (b)(4) invoices from FY'08 only estimated in CY04. UAH subcontract is removed from Subelement -15 and balance of estimate is moved up to Subelement -03 to match the current scope of both subelements. This Revision 04 reduces the overall task order by (b)(4) from the previous Revision 03 mostly through the reduction of scope in Subelement -11. The total estimate for Revision 4 is (b)(4)

(b)(4)



Revision 03: 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. Subelement -15 is added to delineate Cryogenic Fluid Management Internal Research and Development funded tasks separate from Subelement -03. This revision affects the elements and their corresponding Work Breakdown Structure (WBS) codes are listed below:

Non-Constellation funded subelements:

Subelement -02, Nuclear Systems Design and Analysis. WBS: 136905.01.01.08.

Subelement -03, Cryogenic Fluid Management Program Activity Support. WBS: 253225.04.01.02.04.03.08.

Subelement -04, Non-Nuclear Facilities/Test. WBS: 698671.01.08.06.35.

Subelement -11, High-Voltage Pulsed Power Systems. WBS: 698671.01.08.06.34.

Subelement -12, Alkali Metal Handling. WBS: 136905.02.99.02.08.10.

Subelement -13, Seal Test Rig. WBS: 206518.01.01.08

Subelement -14, Space Shuttle Main Engine Accelerated Learning. WBS: 522094.08.01.01.03.01.

Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity. WBS: 698671.01.08.06.35

Constellation funded subelements:

Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded. WBS: 136905.08.05.11.01.01.08

The total task order estimate for this Revision 03 estimate is: (b)(4)

Revision 02: The purpose of this revision is to more accurately reflect the effort required during this period of performance. Labor estimate on Subelements -03, -04, -11, -12, -13, and -14, and -CA were reduced per the table below with noted rationale. ODC, travel and/or material estimates were reduced on Subelements -02, -03, -04, -12, -13, -14, and -CA per the same table. 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. No additional budget is required. This Revision 02 reduced the overall TO estimate by (b)(4)

(b)(4)



(b)(4)

Revision 01: This Task Order (TO) includes the estimate for Subelement –CA. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. Subelement CA was missing the estimate from before and this revision simply adds the estimate to the TO since the narrative existed prior and unchanged. This Revision 01 will reduce the overall TO estimate by (b)(4)

Revision 00: This Task Order (TO) replaces most of the work previously performed on TO 33-010101 due to a NASA organizational restructuring of the Branch from ER11 to ER24. This TO defines and estimates work for the period 29 September 2007 through 26 September 2008. Funding is provided by NASA Purchase Requests: 4200205838, 4200207722, 4200216857, 4200200957, and 4200216697. Subelement -03 is transferred from TO 33-020302 to 33-020401 due to the transfer of the NASA Team Lead and key NASA personnel supporting this work from ER23 to ER24. Subelement -13 is added for Seal Test Rig. Also, Subelement -14 is added for Space Shuttle Main Engine (SSME) Accelerated Learning (SAL) lab support. Subelements -01 and -07 are Closed due to several months of inactivity; future work not expected. 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 -02, Nuclear Systems Design and Analysis

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 136905.01.01.08. Provide support for nuclear propulsion systems design and analysis including non-nuclear prototypical systems. Provide mechanical engineering, electrical engineering, controls system design and other engineering discipline support, specifically, but not limited to, thermal resistance heater design and test support. Close with Revision 06.

1.2 Subelement –03, Cryogenic Fluid Management Program Activity Support

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 095240.04.02.21.08. Provide technical expertise and support for the design, analysis, fabrication, testing, integration, and operation related to the conception, assessment and demonstration of technologies/concepts which assist cryogenic fluid management activities. This includes investigation and resolution of engineering issues for long term/in-space cryogenic propellant storage and utilization covering technology areas such as, but not limited to, insulation, pressure control, liquid acquisition/propellant management devices, propellant transfer, mass gauging and system/subsystem integration. To support this activity requires knowledge in heat transfer, thermodynamics and fluid mechanics, with the capability to develop analytical and numerical techniques and tools to assess and quantify problems and perform sensitivity trades. Support program planning and capture progress by producing reports and presentations as required by the program which document the results of activities covering but not li-

mitted to development, fabrication, assembly, test, analysis, results evaluation and assessment. In addition, provide procurement and technical support in fabrication, assembly and operation of facilities and experiments, typically coordinated on a case-by-case basis.

1.3 Subelement -04, Non-Nuclear Facilities/Test

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 698671.01.08.06.35. Provide technical support to assist in the construction of an advanced Non-Nuclear, nuclear systems test facility in the Propulsion Research Laboratory, Bldg 4205. Tasks will include, but not be limited to, welding, electrical support and general mechanical technical support for this project and other projects supporting ER24 as coordinated on a case-by-case basis.

1.4 Subelement -11, High-Voltage Pulsed Power Systems

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 698671.01.08.06.34. Provide technical support for assembly, test, and operation of high-voltage pulsed-power activities in Bldg. 4205, including the Plasmoid Thruster, Exploding Wire Gun, and Micro-Meteoroid Gun. This work will consist of circuit fabrication, control system assembly and test, vacuum system assembly and operation, and machining and welding of parts (flanges, mounts, piping, tubing and miscellaneous assemblies) as needed. Close with Revision 10. Re-opened with Revision 11.

1.5 Subelement -12, Alkali Metal Handling

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 463169.04.12.01.01. Provide technical and operations support for EFF-TF Team experiments/research in buildings 4205 and 4655. Support experiments involving NaK handling. Support assembly and operation of vacuum systems, including chamber, plumbing, rough and high-vac pumps, instrumentation, and some fabrication and modification of specialized components. Fabricate and assemble mechanical support structures and test articles. Assemble and integrate data acquisition and control systems. Perform electrical wiring of test articles and power supplies to house power.

1.6 Subelement -13, Seal Test Rig

This subelement supports efforts under NASA MSFC Work Breakdown Structure code To Be Determined (TBD). Provide technical support to assist in the construction of a Seal Test Rig in the Propulsion Research Laboratory, Bldg 4205. Tasks will include, but not be limited to, welding, electrical support and general mechanical technical support for this project and other projects supporting ER24 as coordinated on a case-by-case basis. Close with Revision 6.

1.7 Subelement -14, Space Shuttle Main Engine Accelerated Learning

This subelement supports efforts under NASA MSFC Work Breakdown Structure code To Be Determined (TBD). Provide technical support to assist in the construction of a SSME Accelerated Learning (SAL) lab in the Propulsion Research Laboratory, Bldg 4205. Tasks will include, but not be limited to, welding, electrical support and general mechanical technical support for this project and other projects supporting ER24 as coordinated on a case-by-case basis. Close with Revision 06.

1.8 Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 698671.01.08.06.35. Provide technical support and assistance to internal research and development related to cryogenic fluid management activities. Provide general support in analysis and the setup and execution of experiments being undertaken by ER24 to support CFM tech-

nologies. Task will include but not be limited to analysis, procurement, welding, machining, electrical work, fabrication & assembly, and general mechanical technical support to activities supporting ER24 as coordinated on a case-by-case basis.

1.9 Subelement -16, Advanced In-Space Propulsion

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 566548.01.03. To support Advanced In-Space Propulsion (AISP) activity by providing technical support to assist in the assembly, test and operations of facilities, hardware components and equipment for evaluation of nuclear thermal and electric propulsion concepts at the PRDL, bldg 4205. This work will include but not be limited to welding, electrical/data support, and general mechanical technical support of this project coordinated on a case-by-case basis.

1.10 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 136905.02.09.08.01. Provide technical expertise and support for the design, analysis, fabrication, testing, integration, and operation related to the conception, assessment and demonstration of technologies/concepts which assist cryogenic fluid management activities. This includes investigation and resolution of engineering issues for long term/in-space cryogenic propellant storage and utilization covering technology areas such as, but not limited to, insulation, pressure control, liquid acquisition/propellant management devices, propellant transfer, mass gauging and system/subsystem integration. To support this activity requires knowledge in heat transfer, thermodynamics and fluid mechanics, with the capability to develop analytical and numerical techniques and tools to assess and quantify problems and perform sensitivity trades. Support program planning and capture progress by producing reports and presentations as required by the program.

1.11 Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 136905.08.05.11.01.01.08. Provide technical support to assist in the construction of an advanced test facilities in the Propulsion Research Laboratory, Bldg 4205 including fabrication support to the Performance, Design, Analysis, and Demonstrator (PADD) Mockup. Tasks will include, but not be limited to, welding, electrical support and general mechanical technical support for this project and other projects supporting ER24 as coordinated on a case-by-case basis. Close with Revision 06.

1.12 Subelement -CB, Solids Fabrication/Upper Stage Funded

This subelement supports efforts under NASA MSFC Work Breakdown Structure code 136905.08.01.17.01. Provide technical support to support First Stage cold-flow testing efforts in Bldg 4205. Tasks will include, but not be limited to, welding, electrical support and general mechanical technical support for this project as coordinated on a case-by-case basis. Close with Revision 06.

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

2.1 Subelement -02, Nuclear Systems Design and Analysis

- 2.1.1 Identify/coordinate/support mechanical and electrical hardware design, analysis, fabrication, and testing requirements.
- 2.1.2 Support design and analysis.
- 2.1.3 Support design reviews, including review of design drawings and/or sketches, to as-

sure requirements are met.

- 2.1.4 Support procurement, fabrication, and assembly of hardware and special test equipment.
- 2.1.5 Support development of test plans and procedures.
- 2.1.6 Support test readiness reviews to assure planned testing meets requirements.
- 2.1.7 Support test conduct.
- 2.1.8 Support post test data analysis.
- 2.1.9 Support development of reports.
- 2.1.10 Work with MSFC personnel to insure safety.
- 2.1.11 Provide monthly activity reports.

Close with Revision 06.

2.2 Subelement –03, Cryogenic Fluid Management Program Activity Support

- 2.2.1 Conduct literature searches, research, and formulate PMD concepts for new applications.
- 2.2.2 Formulate numerical methods and develop tools needed to support PMD design, development and analysis activities.
- 2.2.3 Provide engineering support to develop, maintain, and transfer detailed knowledge of designs through attendance of and participation in technical interchange meetings and joint planning meetings with the project office(s) and contractor(s). Prepare guidelines or reports to assist engineers in the evaluation of PMDs. Provide engineering support required for development of the technology concepts and the integration of components to meet the program, technical and cost objectives of the overall system. Coordinate among the appropriate MSFC engineering disciplines to conduct analyses necessary to effectively evaluate the system. Support the evaluation of the systems program risks and provide recommendations for risk mitigation.
- 2.2.4 Provide requirements definition, review, and flow down support. This includes support for developing the necessary requirements, defining each of the requirements in detail, and incorporating these requirements into the proper documentation. Provide support to the development of integration requirements, including the identification of issues where a pushback on requirements is needed. Incorporate lessons learned from previous projects to ensure requirements definition meets the intended objectives of the project and that thought is given towards the method for eventual verification of the requirements. Support the development of detailed verification plans as required.
- 2.2.5 Provide support for the evaluation of proposed design changes. Actively participate in design reviews and support the resolution of all identified actions /issues generated during the review. Provide a detailed assessment of each design change, including an assessment of the impact of the change on system performance, identifica-

tion of the technical risks associated with the design change, and identification of any safety concern regarding the design change. Provide recommendation on whether the design change should be incorporated.

- 2.2.6 Provide support for trade studies and issue resolution as required. Actively participate in the study activities as required to ensure the appropriate data is brought to bear on the issue. Develop and maintain working knowledge of current systems issues and work with project office and/or contractor personnel to resolve.
- 2.2.7 Support the development of system level and component level test plans. Provide evaluation of test plans to ensure all the intended system verification objectives can be accomplished. Provide independent test data analysis support. Support will be provided for the reduction, analysis, and presentation of systems test data. This includes determining if test and performance objectives are met, and identification and resolution of any anomalies. Follow up with the resolution of, and recommendations for, any outstanding issues and present the findings to obtain closure.
- 2.2.8 Support procurement, fabrication, and assembly of hardware and special test equipment.

2.3 Subelement -04, Non-Nuclear Facilities/Test

- 2.3.1 Technical and engineering support.
- 2.3.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.
- 2.3.3 Support design and analysis.
- 2.3.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.3.5 Support procurement, fabrication, and assembly of hardware.
- 2.3.6 Support development of test plans and procedures.
- 2.3.7 Support test readiness reviews.
- 2.3.8 Support test conduct.
- 2.3.9 Support post test analysis.
- 2.3.10 Support development of reports.
- 2.3.11 Work with MSFC personnel to insure safety.
- 2.3.12 Provide monthly activity reports.

2.4 Subelement -11, High-Voltage Pulsed Power Systems

- 2.4.1 Technical Support.

- 2.4.2 Identify/coordinate/support mechanical hardware fabrication and testing.
- 2.4.3 Support design and analysis.
- 2.4.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.4.5 Support procurement, fabrication, and assembly of hardware.
- 2.4.6 Support development of test plans and procedures.
- 2.4.7 Support test readiness reviews.
- 2.4.8 Support test conduct.
- 2.4.9 Support post test analysis.
- 2.4.10 Support development of reports.
- 2.4.11 Work with MSFC personnel to insure safety.
- 2.4.12 Provide monthly activity reports.

Close with Revision 10. Re-opened with Revision 11.

2.5 Subelement -12, Alkali Metal Handling

- 2.5.1 Technical Support.
- 2.5.2 Identify/coordinate/support mechanical hardware fabrication and testing.
- 2.5.3 Support design and analysis.
- 2.5.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.5.5 Support procurement, fabrication, and assembly of hardware.
- 2.5.6 Support development of test plans and procedures.
- 2.5.7 Support test readiness reviews.
- 2.5.8 Support test conduct.
- 2.5.9 Support post test analysis.
- 2.5.10 Support development of reports.
- 2.5.11 Work with MSFC personnel to insure safety.
- 2.5.12 Provide monthly activity reports.

2.6 Subelement -13, Seal Test Rig

- 2.6.1 Technical Support.
- 2.6.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.
- 2.6.3 Support design and analysis.
- 2.6.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.6.5 Support procurement, fabrication, and assembly of hardware.
- 2.6.6 Support development of test plans and procedures.
- 2.6.7 Support test readiness reviews.
- 2.6.8 Support test conduct.
- 2.6.9 Support post test analysis.
- 2.6.10 Support development of reports.
- 2.6.11 Work with MSFC personnel to insure safety.
- 2.6.12 Provide monthly activity reports.

Close with Revision 06.

2.7 Subelement -14, Space Shuttle Main Engine Accelerated Learning

- 2.7.1 Technical Support.
- 2.7.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.
- 2.7.3 Support design and analysis.
- 2.7.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.7.5 Support procurement, fabrication, and assembly of hardware.
- 2.7.6 Support development of test plans and procedures.
- 2.7.7 Support test readiness reviews.
- 2.7.8 Support test conduct.
- 2.7.9 Support post test analysis.
- 2.7.10 Support development of reports.

2.7.11 Work with MSFC personnel to insure safety.

2.7.12 Provide monthly activity reports.

Close with Revision 06.

2.8 Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity

2.8.1 Technical and engineering support.

2.8.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.

2.8.3 Support design and analysis.

2.8.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.

2.8.5 Support procurement, fabrication, and assembly of hardware.

2.8.6 Support development of test plans and procedures.

2.8.7 Support test readiness reviews.

2.8.8 Support test conduct.

2.8.9 Support post test analysis.

2.8.10 Support development of reports.

2.8.11 Work with MSFC personnel to insure safety.

2.8.12 Provide monthly activity reports.

2.9 Subelement -16, Advanced In-Space Propulsion

2.9.1 Technician support for fabrication and assembly tasks.

2.9.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.

2.9.3 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.

2.9.4 Support procurement, fabrication, and assembly of hardware.

2.9.5 Work with MSFC personnel to insure safety.

2.9.6 Provide monthly activity reports.

2.10 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

2.10.1 Provide monthly activity reports. Generalize the integrated thermal/fluid MLI ascent

model to include configuration features such as variable layer density, variable open area and variable layer area (curved geometry). Perform literature search on cryopumping and off-gassing of SOFI/MLI and develop a modeling approach to include this phenomenon in the integrated thermal/fluid MLI ascent model. Furnish working version for evaluation

- 2.10.2 Identify one or more validation cases and validate the integrated thermal/fluid MLI ascent model. Furnish summary of validation results.
- 2.10.3 Assist with integration of the integrated thermal/fluid MLI ascent model with an all-up vehicle model for EDS (or similar) with complete interaction with the plume and ambient environment, including aero-heating, from ground hold to on-orbit steady-state.
- 2.10.4 Prepare technical user documentation for the integrated thermal/fluid MLI ascent model. Furnish draft for review.
- 2.10.5 Deliver FORTRAN source code for integrated thermal/fluid MLI ascent model in subroutine form for integration with Thermal Desktop vehicle thermal models and in stand-alone form. Deliver documentation for the integrated thermal/fluid MLI ascent model including code validation results.

2.11 Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded

- 2.11.1 Technical Support.
- 2.11.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.
- 2.11.3 Support design and analysis.
- 2.11.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.11.5 Support procurement, fabrication, and assembly of hardware.
- 2.11.6 Support development of test plans and procedures.
- 2.11.7 Support test readiness reviews.
- 2.11.8 Support test conduct.
- 2.11.9 Support post test analysis.
- 2.11.10 Support development of reports.
- 2.11.11 Work with MSFC personnel to insure safety.
- 2.11.12 Provide monthly activity reports.

Close with Revision 06.

2.12 Subelement -CB, Solids Fabrication/Upper Stage Funded

- 2.12.1 Technical Support.
- 2.12.2 Identify/coordinate/support mechanical and electrical hardware fabrication and testing.
- 2.12.3 Support design and analysis.
- 2.12.4 Support design reviews, including review of design drawings and/or sketches, to assure requirements are met.
- 2.12.5 Support procurement, fabrication, and assembly of hardware.
- 2.12.6 Support development of test plans and procedures.
- 2.12.7 Support test readiness reviews.
- 2.12.8 Support test conduct.
- 2.12.9 Support post test analysis.
- 2.12.10 Support development of reports.
- 2.12.11 Work with MSFC personnel to insure safety.
- 2.12.12 Provide monthly activity reports.

Close with Revision 06.

3.0 Discussion of Skills Required

3.1 Subelement -02, Nuclear Systems Design and Analysis

Journeyman and senior Engineers with experience in design, fabrication, assembly, maintenance and repair of mechanical, electrical, and electronic systems. Close with Revision 06.

3.2 Subelement -03, Cryogenic Fluid Management Program Activity Support

Senior Engineer with experience in cryogenic fluid management and/or thermal analysis. Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems.

3.3 Subelement -04, Non-Nuclear Facilities/Test

Senior Engineer with experience in cryogenic fluid management and/or thermal analysis. Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems.

3.4 Subelement -11, High-Voltage Pulsed Power Systems

Personnel with experience in: general mechanical assembly and fabrication including turning, milling, and welding; vacuum system fabrication, assembly and operation including experience with vacuum practice and measurement techniques from rough vacuum to UHV; electrical / electronic circuit assembly and test for control systems; circuit assembly and test for high-voltage pulsed-power systems; experience with high-voltage insulation techniques. Close with Revision 10. Re-opened with Revision 11.

3.5 Subelement -12, Alkali Metal Handling

One technician should have extensive experience as a lead technician, with the ability to direct the work of a pool of technicians. Requires experience and skills in Alkali metal (NaK) handling, rough to UHV vacuum systems, general mechanical including hand tools and machining, welding, general electrical, high-voltage fabrication and insulating practices, and control and data acquisition systems.

Note: NaK is a sodium-potassium mixture that is liquid at room temperature and burns on contact with water. It requires special training and experience to handle properly. Both technicians must have NaK handling training and experience.

3.6 Subelement -13, Seal Test Rig

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems.

Close with Revision 06.

3.7 Subelement -14, Space Shuttle Main Engine Accelerated Learning

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems. Close with Revision 06.

3.8 Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity

Senior Engineer with experience in cryogenic fluid management and/or thermal analysis.

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems.

3.9 Subelement -16, Advanced In-Space Propulsion

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems.

3.10 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

Senior Engineer with experience developing computational fluid dynamics models.

3.11 Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems. Close with Revision 06.

3.12 Subelement -CB, Solids Fabrication/Upper Stage Funded

Technicians with experience in fabrication, assembly, maintenance and repair of mechanical and electrical systems. Close with Revision 06.

4.0 Special Tools Required

All tools and equipment for efforts conducted at MSFC will to be provided by NASA MSFC. All tools and equipment for efforts conducted at Subcontractor facilities will be provided by the respective Subcontractor. All computer hardware and computer software will be provided by NASA MSFC for Jacobs ESTS employees.

5.0 Participating Subcontractors

5.1 Subelement -03, Cryogenic Fluid Management Program Activity Support

(b)(4)

5.2 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

(b)(4)

6.0 Milestones & Deliverables

Milestones and deliverables for 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. Reference Schedule for additional information.

6.1 Subelement -02, Nuclear Systems Design and Analysis

Provide lab support for the fuel rod simulation test hardware used to anchor thermal modeling for milestones specific to both MSFC and GRC as provided by NASA. Close with Revision 06.

6.2 Subelement -03, Cryogenic Fluid Management Program Activity Support

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. The following is a notional listing of deliverables based on current FY'11 NASA milestones:

- 6.2.1 Development of an analytical model and FORTRAN 90-95 code for a multi-node analysis and prediction of the TankSIM model development.
- 6.2.2 Add the TVS two-phase heat exchanger to program.
- 6.2.3 Add Joule-Thompson device efficiency estimation.
- 6.2.4 Minimize use of standalone software in developed program.
- 6.2.5 Use Fortran 90 and Intel Visual Fortran compiler 2010-2011 versions for Programming.
- 6.2.6 Validate code with LH2 and LCH4 tests made by MSFC and GRC.
- 6.2.7 Interim report (April 2011).
- 6.2.8 Final report (September 2011).

6.3 Subelement -04, Non-Nuclear Facilities/Test

This hardware is essentially complete with the exception of final adjustments that may carry over into FY'09.

6.4 Subelement -11, High-Voltage Pulsed Power Systems

Primary milestone is to complete both High-Voltage Pulsed Power Systems and get them into operation as funds are allocated. This task is dependent on NASA's ability to acquire funding for the completion of the subject task. Close with Revision 10. Re-opened with Revision 11.

6.5 Subelement -12, Alkali Metal Handling

Provide procurement support for acquiring catalog test and instrumentation products to support Alkali Metal Handling test equipment and technician support for test apparatus buildup.

6.6 Subelement -13, Seal Test Rig

This hardware is essentially complete with the exception of final adjustments that may carry over into FY'09. Close with Revision 06.

6.7 Subelement -14, Space Shuttle Main Engine Accelerated Learning

Milestones and funding are awaiting decision from NASA based on FY'09 budget. Close with Revision 06.

6.8 Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity

Milestones are similar to those in Subelement -03 with the exception that this work is more specific to test hardware buildup, checkout, and operation. The final FY'09 Internal Research and Development funds will determine the specific objectives for this work activity.

6.9 Subelement -16, Advanced In-Space Propulsion

Provide and meet incremental milestones for fabrication and assembly as designs are complete and materials are made available.

6.10 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

6.10.1 Model Configuration Deliverable, April 2011.

6.10.2 Identify Validation Cases, July 2011.

6.10.3 Vehicle Model for EDS, August 2011.

6.10.4 Deliver Technical User Documentation, August 2011.

6.10.5 Deliver FORTRAN Source Code and Documentation for Ascent Model, September 2011.

6.11 Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded

Milestones follow design definitization from the US Project Office and are achieved when the volumetric simulators are placed onto the US PADD Mockup. Close with Revision 06.

6.12 Subelement -CB, Solids Fabrication/Upper Stage Funded

Milestones are similar to those in Subelement -CA with the exception that this work is more specific to solids fabrication. Close with Revision 06.

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

7.1 Subelement -02, Nuclear Systems Design and Analysis

Primary safety certifications required for this effort include Confined Space Entry, Lockout/Tag-out, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Close with Revision 06.

7.2 Subelement -03, Cryogenic Fluid Management Program Activity Support

Per subcontract. Certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment.

Materials = (b)(4) for procurement of CFM test equipment specific to task.

ODC = (b)(4) for procurement of CFM test equipment and PPE specific to task.

Subcontract = (b)(4) for an (b)(4)

7.3 Subelement -04, Non-Nuclear Facilities/Test

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out,

High Pressure Systems, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment.

Materials = (b)(4) for procurement of test materials specific to task.

ODC = (b)(4) for procurement of ODC and PPE specific to task.

7.4 Subelement -11, High-Voltage Pulsed Power Systems

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment.

Materials = (b)(4) for procurement of CFM test equipment specific to task.

ODC = (b)(4) for procurement of CFM test equipment and PPE specific to task.

Close with Revision 10. Re-opened with Revision 11.

7.5 Subelement -12, Alkali Metal Handling

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Also requires experience and training in alkali metal handling.

Materials = (b)(4) for procurement of NaK test equipment specific to task.

ODC = (b)(4) for procurement of NaK test equipment and PPE specific to task.

7.6 Subelement -13, Seal Test Rig

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Close with Revision 06.

7.7 Subelement -14, Space Shuttle Main Engine Accelerated Learning

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Close with Revision 06.

7.8 Subelement -15, Cryogenic Fluid Management Internal Research and Development Activity

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Planned (b)(4) subcontract for Subelement -15 was caught in history after it was determined that (b)(4) was not required for this specific task.

Materials = (b)(4) for procurement of CFM test equipment specific to task.

ODC = (b)(4) for procurement of CFM test equipment and PPE specific to task.

7.9 Subelement -16, Advanced In-Space Propulsion

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Additional welding certifications though NASA MWI's or other may become necessary.

Materials = (b)(4) for procurement of CFM test equipment specific to task.

ODC = (b)(4) for procurement of CFM test equipment and PPE specific to task.

7.10 Subelement -AA, Integrated Thermal/Fluid MLI Ascent Model Support

Subcontract = (b)(4) to (b)(4) for an (b)(4)

7.11 Subelement -CA, Non-Nuclear Facilities/Test Upper Stage Funded

Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems, and Radiation Safety. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Close with Revision 06.

7.12 Subelement -CB, Solids Fabrication/Upper Stage Funded

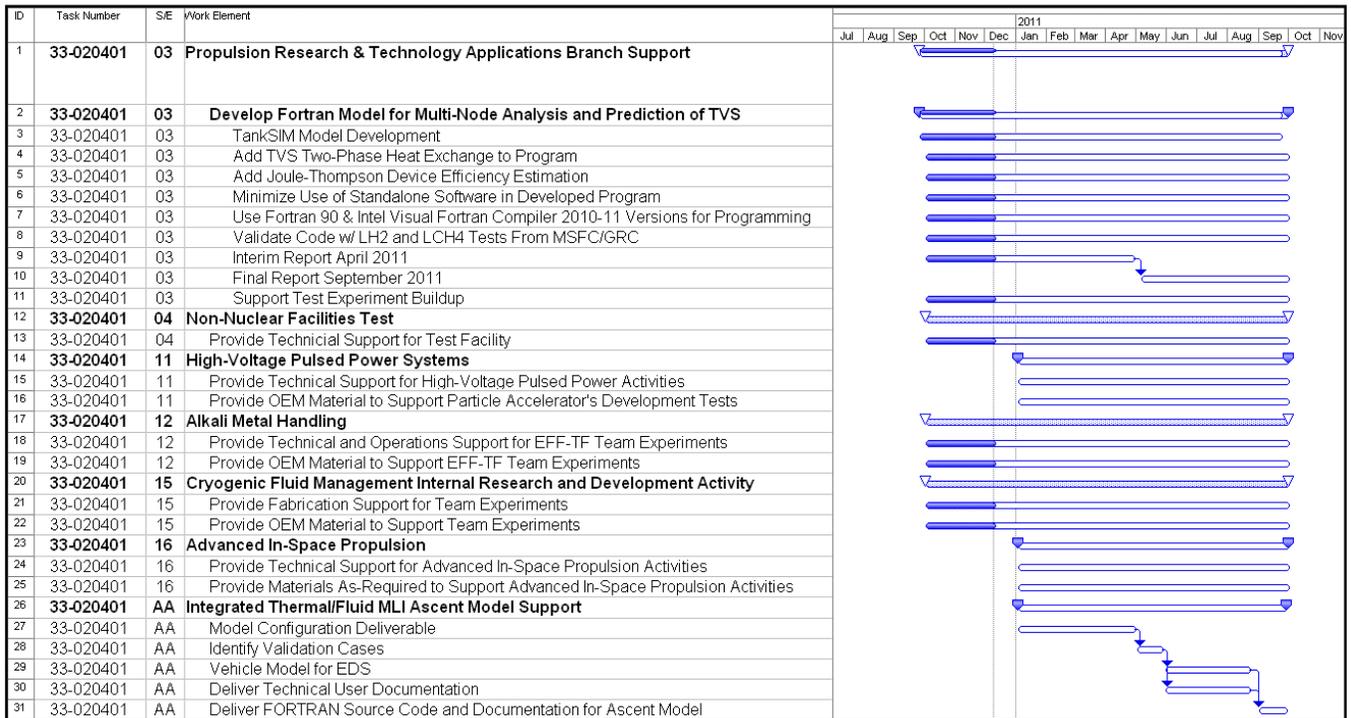
Technician support requires safety certifications for Confined Space Entry, Lockout/Tag-out, High Pressure Systems. Additional certifications are defined in the NASA MSFC Supervisor Safety Web Page Safety Assessment. Close with Revision 06.

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
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9.0 Schedule



ESTS Contract Task Order Request Performance Plan

Task Order Title: [Propulsion Research & Technology Applications](#)

Task Order Number: [33-020401](#) Revision: 11

Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	65%	X <u>65%</u> = Justification
<p>Non-nuclear simulation design, test & analysis support.</p> <p>Nuclear Thermal Propulsion design, test & analysis support.</p> <p>Advanced Propulsion Design, test & Analysis support.</p> <p>See Additional Comments Sheet.</p>		
Schedule Objectives (Milestones)	Weighting Schedule % <u>10%</u> (min 10%)	X <u>10%</u> = Justification
<p>On a case by case basis as coordinated between task initiator and task lead.</p> <p>See Additional Comments Sheet.</p>		
<u>Cost (actual vs. negotiated)</u>	Weighting Cost% <u>25%</u> (min.25%)	X <u>25%</u> = Justification
	Weighting Total % 100.00%	Total Score

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: [Propulsion Research & Technology Applications](#)

Task Order Number: [33-020401](#) Revision: 11

Comments: [Comments: Technical:](#)

[Work is accurate for intended use.](#)

[Level of detail is appropriate for intended use.](#)

[Tools and methodologies applied are appropriate for intended use.](#)

[Work is of appropriate quality.](#)

[Resources assigned exemplify appropriate technical knowledge.](#)

[Engineering and science disciplines are assigned as appropriate for their intended use.](#)

[Progress and results are appropriately documented.](#)

[Results, issues, actions items, etc., are appropriately communicated and exemplify appropriate knowledge.](#)

[Demonstrate continuous improvement.](#)

[Level of technical oversight required is appropriate for resources and work assigned.](#)

[Demonstrate initiative in taking independent actions when required.](#)

[Schedule:](#)

[See TO schedule. Schedule milestones are met.](#)

[Work progression is appropriate for resources assigned.](#)

[Response to action items are timely.](#)

[Pre-test preparations completed on time to support test schedule.](#)

[Post test results provided as establish on case by case basis with NASA Team Lead.](#)

[Exemplify ability/willingness to adjust to changing priorities.](#)

Risk Assessment

Contract Number: *NNM05AB50C*
TO Title: *Propulsion Research & Technology Applications*
TO Number: *33-020401* Revision: *11*

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

MSFC Initiator: *Boise Pearson*

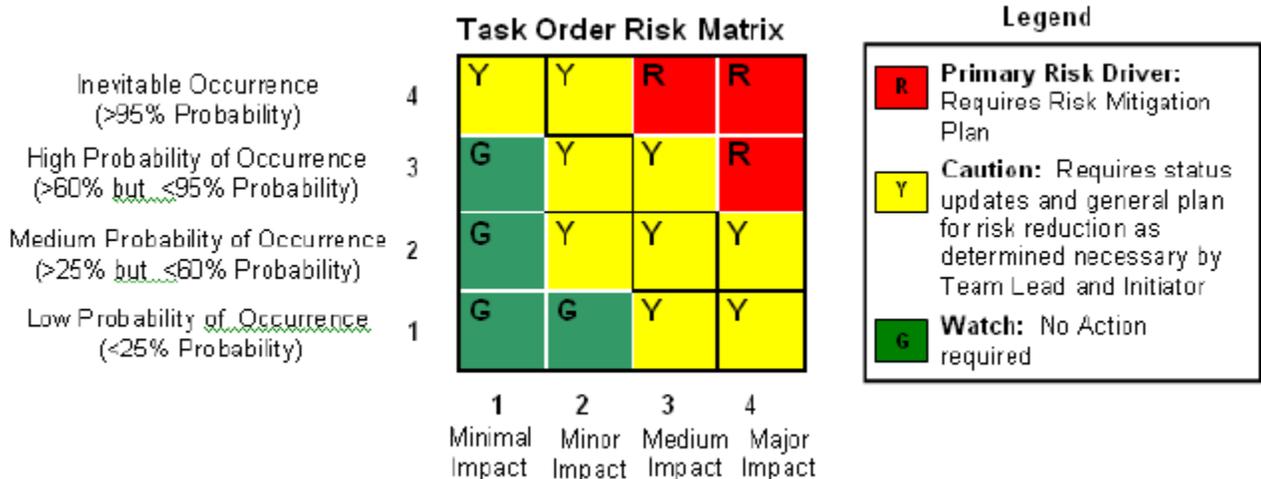
(b)(4)

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	No cost risks have been identified for this task order.
Risk T1	Technical	1	1	No technical risks have been identified for this task order.
Risk S1	Schedule	1	1	No schedule risks have been identified for this task order.

*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% sub-task 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.: C1 Risk Description: Minimal cost risks have been identified for this Task Order specific to additional labor required to meet milestones usually caused by unplanned overtime costs.		
Mitigation Step No.	Planned Completion Date	Mitigation Step Description
1	09/30/2011	Confirm availability with other supporting teams for available techs to support tasks as-required to meet schedule w/o incurring excessive overtime.
2	09/30/2011	Insure additional resources have proper SSWP certifications/training to support specific task.
3.	09/30/2011	Insure additional resources have a task charge code to begin support if required.

Risk No.: T1 Risk Description: Minimal technical risks have been identified for this Task Order specific to getting experiments baselined to begin acquiring data.		
Mitigation Step No.	Planned Completion Date	Mitigation Step Description
1	Before assembly begins.	Validate configuration of components fabricated and purchased to as-designed data package.
2	During physical configuration audit	Validate workmanship prior to checkout.
3.	Before functional configuration audit	Complete Test Readiness Review with all key personnel.

Risk No.: S1 Risk Description: Minimal schedule risks have been identified for this Task Order specific to getting some longer lead OEM items delivered.		
Mitigation Step No.	Planned Completion Date	Mitigation Step Description
1	Before completion of purchase request	Locate multiple sources for OEM OTS items when available.
2	Before forwarding purchase request package forward for approval	Insure proper EPMS procurement procedures are followed to avoid purchase order rejections.
3.	Post purchase request approval	Follow-up status with procurement to track progress after purchase request package has been approved.